

THE WORLD OF SCIENCE WITHOUT BORDERS

**PROCEEDINGS
OF THE 8th ALL-RUSSIAN SCIENTIFIC AND PRACTICAL
CONFERENCE (WITH INTERNATIONAL PARTICIPATION)
FOR YOUNG RESEARCHERS**

**February 12, 2021
Tambov**

МИР НАУКИ БЕЗ ГРАНИЦ

**МАТЕРИАЛЫ
8-й ВСЕРОССИЙСКОЙ НАУЧНО-ПРАКТИЧЕСКОЙ
КОНФЕРЕНЦИИ МОЛОДЫХ УЧЁНЫХ
(С МЕЖДУНАРОДНЫМ УЧАСТИЕМ)**

**12 февраля 2021 года
Тамбов**



**Тамбов
Издательский центр ФГБОУ ВО «ТГТУ»
2021**

Министерство науки и высшего образования Российской Федерации

Федеральное государственное бюджетное
образовательное учреждение высшего образования
«Тамбовский государственный технический университет»

THE WORLD OF SCIENCE WITHOUT BORDERS

**PROCEEDINGS
OF THE 8th ALL-RUSSIAN SCIENTIFIC AND PRACTICAL CONFERENCE
(WITH INTERNATIONAL PARTICIPATION) FOR YOUNG RESEARCHERS**

February 12, 2021
Tambov

МИР НАУКИ БЕЗ ГРАНИЦ

**МАТЕРИАЛЫ
8-й ВСЕРОССИЙСКОЙ НАУЧНО-ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ
МОЛОДЫХ УЧЁНЫХ (С МЕЖДУНАРОДНЫМ УЧАСТИЕМ)**

12 февраля 2021 года
Тамбов

Научное электронное издание



Тамбов
Издательский центр ФГБОУ ВО «ТГТУ»
2021

УДК 001+378
ББК 72+74.58
М63

Editorial Board:

Mishchenko E. S. – Doctor of Economics, Professor, Vice Rector for International Relations, Tambov State Technical University, Tambov

Gunina N. A. – PhD in Linguistics, Associate Professor, Head of the Department of Foreign Languages and Professional Communication, Tambov State Technical University, Tambov

Makeyeva M. N. – Doctor of Linguistics, Professor of the Department of Foreign Languages and Professional Communication, Tambov State Technical University, Tambov

Monastyrev P. V. – Doctor of Engineering, Head of the Institute of Architecture, Civil Engineering and Transport, Tambov State Technical University, Tambov

Nemtinov V. A. – Doctor of Engineering, Professor of the Department of Computer Integrated Systems in Mechanical Engineering, Tambov State Technical University, Tambov

Voyakina E. Yu. – PhD in Linguistics, Associate Professor of the Department of Foreign Languages and Professional Communication, Tambov State Technical University, Tambov

М63 Мир науки без границ [Электронный ресурс] : материалы 8-й всероссийской науч.-практ. конференции молодых учёных / Тамбовский государственный технический университет, 12 февраля, 2021. – Тамбов : Издательский центр ФГБОУ ВО «ТГТУ», 2021. – 1 электрон. опт. диск (CD-ROM). – Системные требования : ПК не ниже класса Pentium II ; CD-ROM-дисковод ; 8,6 Mb ; RAM ; Windows 95/98/XP ; мышь. – Загл. с экрана. – 100 шт.

ISBN 978-5-8265-2331-5

The 8th All-Russian Scientific and Practical Conference for Young Researchers hosted by Tambov State Technical University on February 12, 2021 focused on the problems related to the development of education, industry and research. Major topics included problems of humanities, social, and technical sciences in the modern world. The volume is a collection of papers submitted to the conference.

Издание представляет собой сборник материалов 8-й всероссийской научно-практической конференции молодых учёных, организованной ФГБОУ ВО «Тамбовский государственный технический университет» и проведенной 12 февраля 2021 г. Проблематика обсуждаемых вопросов касалась тенденций развития образования, производства и исследовательской деятельности, а также эффективных решений исследовательских задач гуманитарных, социальных и технических наук в современном мире.

УДК 001+378
ББК 72+74.58

Материалы предоставлены в электронном варианте и сохраняют авторскую редакцию

ISBN 978-5-8265-2331-5

© Федеральное государственное бюджетное образовательное учреждение высшего образования «Тамбовский государственный технический университет» (ФГБОУ ВО «ТГТУ»), 2021

CONTENTS

FOREWORD	8
I. ELECTRICAL ENGINEERING & POWER ENGINEERING	9
<i>Durnov A.A., Voevodkin S.A., Balashov A.A. The exergy analysis of a steam compression refrigeration unit</i>	9
<i>Kolesnikova E.S., Chubarov R.Y., Bazelyuk D.N. Improving the energy efficiency of a residential building heating system</i>	13
<i>Lutskov D.S., Kurepina D.S., Gorbunova A.Y. Determination of acrylate coating thickness on aluminum alloy products</i>	16
<i>Ponkratov D.Y., Gerasimov D.M. Traditional power engineering and problems of its development in current conditions</i>	19
<i>Terekhova A.A., Dmitrievsky B.S. An automated control system for operating modes of the electric power system</i>	22
<i>Vashenko S.S. Features of designing solar systems using meteorological databases</i>	24
II. RADIO-ENGINEERING & INSTRUMENT ENGINEERING	27
<i>Demytyev R.O., Muromtsev D.Yu. The development of the MIMO control system for thermal facilities</i>	27
<i>Kiryupin M.M. Principles of creating systems for the construction of spatial barriers against unmanned aerial vehicles penetration</i>	30
<i>Kudryashov M.A. Synthesis of a phased antenna array for meteorological radio monitoring systems</i>	33
<i>Raev K.D., Antonov E.A. The mathematical model of a transmitter with a nonlinear power amplifier and demodulation in a feedback loop</i>	36
<i>Tymchuk T.M., Ventzerova N.V., Potlov A.Y. The image quality control method for optical tomographs</i>	39
<i>Ventzerova N.V., Tymchyk T.M., Potlov A.Yu. The development of an algorithm for mathematical modeling of photons by the monte-carlo method</i>	42
III. OCCUPATIONAL SAFETY, ENVIRONMENTAL ENGINEERING & TRANSPORT TECHNOLOGY	45
<i>Apporotova Y.A., Starykh D.A. Ensuring labor protection in the educational process</i>	45
<i>Blinkova D.A. Organization of traffic in cities to improve the environmental situation</i>	48
<i>Ignatova N.A., Kazakova A.A. The problem of collection and disposal of automobile tires</i>	51
<i>Plotnikov V.O. Utilisation de titane et ses alliages dans l'aeronautique</i>	54
<i>Ryazanov I.V., Balabanov P.V. Modellierung des Betriebsverfahrens einer Chemosorbentenplatte auf der Basis von Peroxidverbindungen von Alkalimetallen unter erzwungener Konvektion</i>	57
<i>Sevostyanov M.A., Arzamastsev E.A. Studying traffic noise in the city of Tambov</i>	60
<i>Sivalnev D.V. The purification method of the engine oil in the internal combustion engine by using centrifugal oil filter</i>	63
<i>Terekhov V.V., Lozhkina E.B. Misfire detection in an internal combustion engine</i>	66
<i>Terekhov V.V., Zhalnin D.O., Fetisov I.N. Automated air traffic control systems</i>	69
IV. AGRICULTURAL ENGINEERING	72
<i>Andreev A.A. Organic fertilizers as a factor of increasing yield of agricultural crops</i>	72
<i>Glazkov A.Yu., Shemonaev I.A., Prokhorova V.O. Direction of improving the design of devices for determining the friction coefficients of bulk materials</i>	76
<i>Ivanov A.S., Sheludyakov N.V. A universal root crop chopper for cattle</i>	79

<i>Petrov M.S., Shemonaev I.A., Terekhov A.A. Overview of existing installations for determining the rest of friction coefficient</i>	83
<i>Terekhov A.A., Nozdrina A.O., Kadomtsev A.I. Ways of improving the device design and method for determining the elastic properties of plant stems</i>	86
<i>Zharikov V.S., Dorovskikh V.I., Vedishev S.M. A theoretical study of the nipple rubber impact on the nip during the compression state</i>	90
<i>Zorina O.A., Zorin A.S. Analysis of existing methods and means of drying</i>	95
V. BIOMEDICAL ENGINEERING	99
<i>Chereshnev V.O., Kuleshov I.V., Romanenko I.V. The study of reflected and least scattered photons in optical coherent tomography</i>	99
<i>Chereshnev V.O., Kuleshov I.V., Romanenko I.V. Structuring of tissues in optical coherence tomography using pixel intensity analysis</i>	102
<i>Chilikin G.O., Gromov Y.Y. Analytical and procedural models of the decision support system of a neurologist when choosing parameters and controls for detecting paroxysmal conditions</i>	105
<i>Sudakov D.E. The application of strip wavelet filters to study the brain visual core potentials</i>	108
VI. CHEMICAL ENGINEERING, BIO- AND NANOTECHNOLOGY	111
<i>Chernyshov I.A., Kazhaeva Y.A., Gridchina A.V. Transportation of petroleum products</i>	111
<i>Eskova M.A., Ustinskaya Y.V., Bryankina A.K. On the problem of modeling the periodic process of chlorella vulgaris cultivation</i>	113
<i>Fomin N.E., Burakova I.V. Technologies for producing the catalyst for the synthesis of carbon nanotubes</i>	116
<i>Gabibov N.D., Bakunin E.S., Isaev A.E. Studying the effect of modifiers on the properties of phenol-formaldehyde resin</i>	118
<i>Kabargina M.W. Entwicklungsmesstechnischer Tests von Produkten aus der Legierung 79 NM</i>	121
<i>Khrobak A.V., Dyachkova T.P., Shchegolkov A.V. The study of the carbon nanostructure influence on the electric conductivity of elastomers with temperature-dependent electric resistance</i>	125
<i>Korobov K.O. Mechanoactivation of carbon nanomaterials</i>	128
<i>Korpusov D.V. Methods for moisture control in pre-insulated pipes</i>	131
<i>Kuksov G.V., Kuznetsov M.S., Tatarintsev E.D. The effect of ultrasonic dispersion on dispersion characteristics of carbon nanomaterials</i>	134
<i>Kuryato N.A., Knyazeva L.G. Some issues of low carbon steel hydrophobization</i>	137
<i>Lazeev A.S. Current state of optimal control in electroplating</i>	141
<i>Lutovinova T.A., Funbayu M.A. Einfluss der Mikrowellenverarbeitung auf Struktur und Eigenschaften der nanomodifizierten Polymer-Kohlenstoff-Materialien basierend auf Fluoroplas</i>	144
<i>Meshkova E.A., Grachev A.S. A physical-mathematical model of recombination processes in a flame</i>	147
<i>Mikhailin M.I., Lazarev S.I., Khorokhorina I.V. The study of structural and kinetic transformations of the surface layers of ultrafiltration membranes</i>	151
<i>Mkrtychyan E.S., Kurnosov D.A., Zaytsev I.A. Grapheme-based airgel modified with iron oxide nanoparticles to extract organic pollutants from aqueous solutions</i>	154
<i>Motseothata C.B. Factors influencing the quality indicators of organic pigments</i>	157
<i>Nosova K.Y., Zarapina I.V. Study of steel protection against corrosion by motor oilwaste composition</i>	160
<i>Rybina A.A., Osetrov A.Yu. Improving the protective efficiency of oxide coatings</i>	163
<i>Ryzhkin V.Yu. Features of identification of microstructural inhomogeneities of the</i>	166

<i>nanofiltration membrane surface</i>	
<i>Safonova N.O. Formulation of the problem of mathematical description of power characteristics in the process of mechanical mixing of liquid media</i>	169
<i>Sibileva E.E. Optimization of belofor suspension drying on a spray dryer</i>	172
<i>Skomorokhova A.I., Glebov A.O., Aleksentsev D.S. A method for numerical calculation of effective modules of porous material elasticity</i>	175
<i>Streltsova A.G. Review of implementation methods and methods for calculating groundwater deferrization processes</i>	178
<i>Zarapina I.V., Zaytseva O.I. The use of used motor oils as anticorrosive conservation compounds to protect metals in sulfur-containing atmospheres</i>	182
<i>Zemtsova N.V. Electrophysical characteristics of a polymer-based material modified with CNT</i>	187
<i>Zhilo A.A. Improving the manufacturing technology of rubber products</i>	191
VII. MECHANICAL ENGINEERING	194
<i>Aldawood S.S. Development of a cylindrical vibration mill and its calculation method</i>	194
<i>Ivanchev Y.S. Defects arising from plastic deformation of metal and methods for their detection</i>	197
<i>Kardakova Yu.A., Rublev A.A., Vshivkov F.I. Design of heating plates for vulcanization presses: comparative analysis of approaches</i>	201
<i>Kazankov A.A. Design and research of massing operations of the stainless steel housing part</i>	204
<i>Mahmood M.A., Rodionov Yu.V. Improving energy-saving characteristics of liquid-ring vacuum pumps and the effect of heat and mass transfer processes on its working characteristics</i>	207
<i>Parskov V.A. A decision support system for process maintenance of horizontal boring machines</i>	210
<i>Rublev A.A., Kardakova Yu.A. Modernization of SP-49</i>	214
<i>Skvortsov V.I., Solomatina E.M. The problem of optimum galvanic process management</i>	218
<i>Usman F.J., Sokolov M.V. Development of an acoustic method for predicting wear of commercial cutting tools</i>	221
VIII. INFORMATION TECHNOLOGY	231
<i>Aydarov A.S., Sadovnich K.G. Information system for the police investigation department</i>	232
<i>Bayez M.Y., Ouammou Y. Développement des technologies vocales</i>	235
<i>Bronnikov A.A., Zobov A.A. The current state of development of computerized process control system for rectified ethyl alcohol production</i>	238
<i>Dobrovolsky D.V., Vopilin S.P., Rylyov D.O. The Alpha algorithm for intelligent analysis of mining electronic trading platform</i>	240
<i>Dolgov E.P. A device for motor activity registration to determine yeast hyperkinesis</i>	243
<i>Dubrovina O.V. Information technologies for blind users</i>	246
<i>Filimonova M.V., Tyuterev L.A. The information system of the human resources department for a penal settlement</i>	249
<i>Khrushchev I.I., Neretin D.V., Klinkov D.A. The application of SVD to initialize weights of the neural network</i>	252
<i>Khvorov V.A., Odintsov S.A., Semyonov D.E. Road traffic regulation using machine learning technologies</i>	255
<i>Koshelev E.V., Lomov A.D., Tulupov D.Yu. Dynamics of information conflict</i>	259
<i>Koshelev E.V., Milshina V.A. The subsystem for selecting a class of information system resource allocation tasks</i>	262

<i>Kupriyanov A.V. Digital technologies in an intelligent information-measuring system of thermophysical properties of solid materials</i>	265
<i>Mazaev N.F. Constant earnings on online-casinos while automating user actions</i>	268
<i>Melnikova D.D. Sécurité des réseaux de communication GSM</i>	271
<i>Nikolykin M.S., Sokolinskaya O.A., Mokrozub V.G. Adaptive video data transmission control in agricultural information systems</i>	273
<i>Pilyugina V.D., Varfolomeeva A.A. The information system for the juvenile inspector</i>	276
<i>Pokhvalenskii N.I., Krokhin A.A. Face recognition in control systems</i>	279
<i>Sadovnich K.G., Aydarov A.S. The information system for the bailiff</i>	283
<i>Tikhomirova A.A. Building a dynamic network model of the wireless access control system operation</i>	286
<i>Tyuterev L.A., Filimonova M.V. The information system for acceptance and processing of applications for conviction (non-conviction) records</i>	292
<i>Varfolomeeva A.A., Pilyugina V.D. Information technologies for the center of social services</i>	295
<i>Zaytsev A.E. Assessment of possibility of developing an integrated system for detection and recognition of aviation objects</i>	298
IX. CIVIL ENGINEERING AND ROAD CONSTRUCTION	301
<i>Betin G.V., Tarapon M.Y., Zelenin G.V. Conditions for construction and installation works on the design of urban developments</i>	301
<i>Klyueva V.V., Markin I. A. Energy efficiency of a residential building model depending on the area of external walls</i>	305
<i>Malin P.M. The modern state of road bitumen modification field</i>	309
<i>Sevostyanov A.V., Krylov D.N. The environmental humidity effect on expanded polystyrene density</i>	312
<i>Zarapina L.S. Relevant issues of cast mixture application when installing asphalt concrete pavement</i>	315
X. ARCHITECTURE AND TOWN PLANNING	319
<i>Kozhukhina A.I., Ledeneva G.L., Kozhuhina O.N. Modern architecture of a provincial town</i>	319
<i>Potapova A.A., Kozhukhina O.N., Proskuryakova O.V. The development of the hotel industry in Russia</i>	322
<i>Samotoylov A.O., Minakova A.A. Synergetics in architectural design</i>	325
<i>Sitnikova T.O., Balashova O.M. Rreconstruction and restoration problems of cultural heritage monuments</i>	328
<i>Shorina D.S. Restoration of the natural and cultural heritage site – the watermill in the Voronezh oblast</i>	330
XI. APPLIED LINGUISTICS & LANGUAGE PEDAGOGY	334
<i>Abdykarimova G.M., Abdykarimova M.M., Baltabayev A.B. Current problems of teaching students a foreign language</i>	334
<i>Abdykarimova M.M., Abdykarimova G.M., Yermek E.S. Written discursive competence as a component of the foreign-language communication competence</i>	338
<i>Apraksina O.N. Representation of the concept “Smart house/Smart home” in the English language picture of the world</i>	342
<i>Gladilina D.A., Polovinkina K.V. Irony and sarkasm in the context of the novel “Morality Play” by Barry Unsworth</i>	346
<i>Grigorieva V.S. Sprechakt “Bitte”. Kognitiver Ansatz</i>	350
<i>Gunina P.I., Gunina N.A. Communicative teaching of phrasal verbs: a theme-based approach</i>	354

<i>Korolyova L.Yu. Strategies of distance language learning</i>	360
<i>Lasskaya O.G., Logina T.V., Oreshina E.E. Ritual as an ethnocultural phenomenon</i>	365
<i>Menshova A.V., Naletova D.V., Vlasova K.V. The language picture of the world of the Renaissance epoch and modern France (lexical units denoting “men's clothing”)</i>	368
<i>Mordovina T.V. How to write an abstract to a scientific article: master students teaching</i>	374
<i>Morozova O.N. Translation activity in the context of vitagenic learning</i>	378
<i>Nurpeissova D.L., Damiev A.D. The system of distance learning at Kazakhstan universities</i>	382
<i>Voyakina E.Yu. Allusion techniques in the modern socio-political discourse</i>	386
<i>Voyakina E.Yu., Ilyina I.E. Non-verbal aspects of cross-cultural communication</i>	391
<i>Yurina I.A. La sociolinguistique comme méthode efficace de recherche sur la publicité virale</i>	398
XII. SOCIAL STUDIES	402
<i>Buslaev D.V., Popova M.K., Glivenkova O.A. The role of international communication in the context of globalization</i>	402
<i>Davino Ngua Edjang Obono. Accounting and audit of output and sales of finished products</i>	406
<i>Deev T.A. The military mobilization campaign in the Tambov region in the initial period of the Great Patriotic War</i>	409
<i>Kirichenko E.A., Israa Shihab Ahmed Ahmed. The role of forensic accounting and its connection with taxation system in Iraq</i>	412
<i>Kravchenko K.G. The concept and essence of territory marketing (on the example of the Tambov region)</i>	416
<i>Kuznetsova E.A., Frolov S.A. The impact of constitutional amendments on the redistribution of powers between authorities</i>	419
<i>Metalnikov A.Yu., Popov E.N. The role of the HR management system in marketing research</i>	424
<i>Oyono Ondo Fructuoso Oyono. Economic reading of financial statements</i>	427
<i>Petrenko A. Integration of commercial companies into mass events in the city of Tambov</i>	431
<i>Puzyreva K.Y. Separate factors influencing fraud in the sphere of compulsory health insurance</i>	434
<i>Shepeleva Yu.A. Choosing a preventive measure against accused minors of suspectsd</i>	438
<i>Shitikov A.A., Yartsev E.V., Mihaylova A.V. The economics of e-sport</i>	441
<i>Shlyannikova N.V. Investment attractiveness of an economic subject: theory and methodology</i>	444
<i>Talibova A.F. Formation of accounting reporting by small businesses in the Russian Federation</i>	447
<i>Ulybysheva M.A. The assessment of factors improving cost-effectiveness of enterprises</i>	450
<i>Yurina N.V. The state protection problems of cultural heritage objects</i>	453
<i>Zharikov R.V., Al-Yawar A.A. Improving the quality of products (services) of commercial organizations as a solution of crisis situations</i>	455

FOREWORD

The rapid development of science and technology, the timely creation and use of advanced methods and technologies is of particular importance. In the 21st century, the contribution of young researchers and their active participation in discussion of the problems of fundamental science, as well as the ability to present their ideas and findings of scientific research have become especially relevant.

It has become a tradition to hold the conference for graduate and postgraduate students “**The World of Science without Borders**” at Tambov State Technical University every year. The purpose of the event is:

- to discuss theoretical, methodological and practical problems of science;
- to facilitate the creation of research teams for effective collaboration on innovative projects;
- to provide conditions for harmonious interaction of education, science, industry and the socio-economic sphere;
- to make it possible for young researchers, graduate students, and undergraduates to be involved in research.

The mission of the conference is to remove the barriers on the way of disseminating innovative projects among young researchers across the globe.

More than 100 papers have been included in this volume featuring the scope of research interests of students at Tambov State Technical University and partner institutions including young foreign scholars. This selection will be of interest for everybody who is keen on keeping in touch with the science of the young in Russia.

*Nataliya Gunina,
PhD in Linguistics,
Head of Department of Foreign
Languages and Professional
Communication, TSTU*

The Exergy Analysis of a Steam Compression Refrigeration Unit

A. A. Durnov, S. A. Voevodkin, A. A. Balashov

Tambov State Technical University, Tambov, Russia

e-mail: dontpobeda@yandex.ru, voevodkin1998@mail.ru, balashovalexei@yandex.ru

Abstract

Exergy is the ultimate (largest or smallest) energy value which can be helpfully used (received or spent) in the thermodynamic process taking into account the restrictions imposed by the laws of thermodynamics. During irreversible processes, exergy, unlike energy, is irretrievably lost. Therefore, the sum of the exergy fluxes for any thermodynamic system entering the system with the energy and matter fluxes is always greater than the total exergy leaving the system. A significant part of the exergetic losses of the entire refrigeration unit are losses in the compressor. Losses in condensers of installations exceed exergetic losses in compressors as components of the greatest losses.

Keywords: exergy, work, energy.

Creating a reliable, easy-to-use method for evaluating the energy efficiency of industrial refrigeration units is an urgent problem of refrigeration equipment. A refrigeration unit is a complex of objects (machines, heat exchangers, tanks, etc.) connected to each other by communications (pipelines, cables, etc.) and intended to artificially reduce the temperature at the object (refrigerated room) and then maintain a low temperature for the required time.

In addition to the basic principles of refrigeration units (RU), the authors [1, 2, 3] also describe their classification. Refrigeration units are classified according to various characteristics:

- depending on the type of physical process used;
- depending on the type of energy used;
- depending on the scheme and type of thermodynamic cycle;
- depending on the nominal value of the supported temperature;
- depending on the purposes;
- depending on the working fluid used.

Steam compression refrigeration units with reciprocating compressors are widely used in everyday life, trade, public catering, and industry.

The advantages are as follows:

- this class of RU (refrigeration units) has the highest energy characteristics (efficiency, cooling coefficient);
- this class of RU has the highest ratio of condensation pressure P and boiling pressure P_0 , and, as a result, the greatest temperature difference between T_b and T_0 .

The disadvantages of this type of RU are:

- limited effectiveness;
- increased vibration level;
- steam compression refrigeration units with reciprocating compressors are less reliable than machines with screw chillers and centrifugal chillers (wear and a hazard of hydraulic impact).

The block-diagram of a steam compression refrigeration unit for the implementation of the Carnot cycle is shown on the Figure 1.

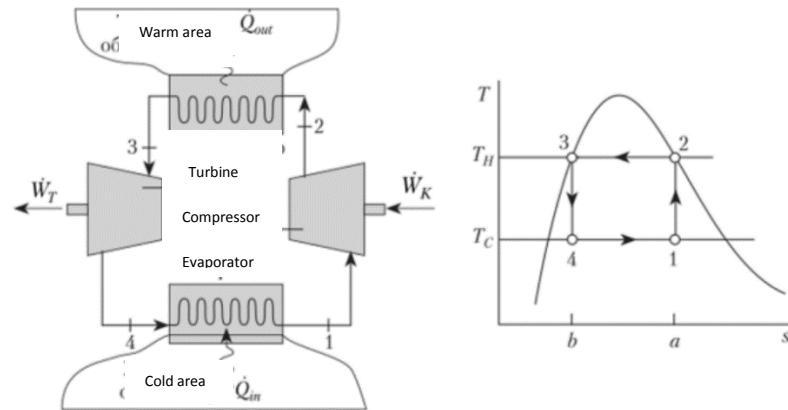


Fig. 1. The block-diagram of a steam compression refrigeration unit for the implementation of the Carnot cycle

Exergy is the ultimate (largest or smallest) energy value, which can be helpfully used (received or spent) in the thermodynamic process taking into account the restrictions imposed by the laws of thermodynamics, the maximum work that can be made by a macroscopic system under quasi-static process from a given state to balance with the environment (exergy of the process is positive), or the minimum work that must be expended on quasi-static process of the system from the equilibrium state with the environment in a given state (the exergy of the process is negative).

Different types of energy and its various manifestations have different practical suitability (as well as uneven economic value assigned to a unit of energy). The largest energy suitability also characterizes mechanical work, since any type of energy can be obtained in an equivalent amount at a reversible cost of work. Therefore, the ability to accomplish work is accepted as a general indicator of the quality (practical suitability) of various types of energy and various ways of transmitting it.

The practical energy suitability of a substance is nil if the parameters of its state correspond to the parameters of the components of the environmental substance. Therefore, the state of thermodynamic equilibrium of a substance with the environment should be taken as the initial state (zero level) in calculating the practical energy suitability of this substance. The maximum ability to accomplish work, calculated on the basis of the interaction with the environment, was called exergy.

During irreversible processes, exergy, unlike energy, is irretrievably lost. Therefore, the sum of the exergy fluxes for any thermodynamic system entering the system with the energy and matter fluxes is always greater than the total exergy leaving the system.

For continuous heat installations, in particular for refrigerating machines, the exergy balance assigned to a unit of mass is recorded as follows when their operation is steady:

$$\Sigma ex_{enti} = \Sigma ex_{exi} = \Sigma ex_{Di}, \quad (1)$$

where Σex_{enti} , Σex_{exi} are the sums of various types of exergy flows entering and leaving the system; Σex_{Di} is the sum of exergy losses in the system due to the irreversibility of the processes occurring in it.

The ratio of the useful exergy to the exergy spent on obtaining is called the exergy efficiency coefficient:

$$\eta_{ex} = \frac{ex_{us}}{ex_{sp}}, \quad (2)$$

where ex_{us} is useful exergy, ex_{sp} is spent exergy.

For refrigerating machines, the exergy of heat q_2 is the useful flow of exergy diverted from the cooled object, and the expended flow is the operation of the compressor.

Thus, for refrigerating machines [4]:

$$\eta_{ex} = \frac{ex_{q_2}}{l_c} = \frac{ex_{ex}}{ex} = \frac{ex_{ent} - ex_{Di}}{ex_{ent}}. \quad (3)$$

A significant part of the exergetic losses of the entire refrigeration unit are losses in the compressor. Losses in condensers of installations exceed exergetic losses in compressors as components of the greatest losses.

All cooled condensers in refrigeration units operate at high temperatures, and the air entering them is almost never filtered. They are often exposed to extreme environmental conditions, for example, in an industrial city. Capacitors with aluminum fins are particularly susceptible to corrosion in an atmosphere saturated with salts. Contamination on such heat exchangers is formed by suspended particles, insects and leaves, which, in combination with the high temperature of the heat exchanger, are “fried” on the heat exchanger.

Contamination of air-cooled condensers leads to the creation of an insulating layer on the surface of the heat exchangers, which causes a progressive increase in the condensation temperature.

As a result, the generated refrigerating capacity declines and electricity consumption increases. In addition, the compressor starts working at the high pressure ratio, and the gas temperature in the discharge area increases to such an extent that it can cause the oil to burn.

References

1. Dyachek P.I. Holodil'nye mashiny i ustanovki: Uchebnoe posobie [Refrigerating Machines and Installations: Textbook]. Rostov-on-Don: Phoenix, 2007, 424 p. (Rus)
2. Yavnel B.K. Kursovoe i diplomnoe proektirovanie holodil'nyh ustanovok i sistem kondicionirovaniya vozduha [Postgraduate and Diploma Design of Refrigeration Units and Air Conditioning Systems]. M.: Agropromizdat, 1988, 225 p. (Rus)
3. Lashutina N.G., Verhova T.A., Suedov V.P. Holodil'nye mashiny i ustanovki: Uchebnik dlya studentov vuzov [Refrigerating Machines and Installations: Textbook for College Students]. M.: Kolos, 2006, 440 p. (Rus)
4. Zlotin G.N., Zaharov E.A., Burov A.A., Ozhogin V.A., Fedyanov E.A. Cikly holodil'nyh mashin i metody analiza ih effektivnosti [Cycles of Refrigerating Machines and Methods for analyzing their Efficiency]. Volgograd: VSTU, 2006, 50 p. (Rus)

ЭКСЕРГЕТИЧЕСКИЙ АНАЛИЗ ПАРОКОМПРЕССИОННОЙ ХОЛОДИЛЬНОЙ УСТАНОВКИ

А. А. Дурнов, С. А. Воеводкин, А. А. Балашов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: dontpobeda@yandex.ru, vovodkin1998@mail.ru, balashovalexei@yandex.ru

Аннотация. Эксергия – предельное (наибольшее или наименьшее) значение энергии, которое может быть полезным образом использовано (получено или затрачено) в термодинамическом процессе с учётом ограничений, накладываемых законами термодинамики. В ходе необратимых процессов эксергия, в отличие от энергии, безвозвратно теряется. Поэтому сумма потоков эксергии для любой термодинамической системы, поступающих в систему с потоками энергии и вещества, всегда больше суммарной эксергии, уходящей из системы. Значительную часть эксергетических потерь всей холодильной установки составляют потери в компрессоре. Потери в конденсаторах установок превышают эксергетические потери в компрессорах, как составляющие наибольших потерь.

Ключевые слова: эксергия, работа, энергия.

Improving the Energy Efficiency of a Residential Building Heating System

E. S. Kolesnikova*, R. Y. Chubarov, D. N. Bazelyuk

Tambov State Technical University, Tambov, Russia

**e-mail: kolesnikova.eleona@yandex.ru*

Abstract

The use of weather-dependent automation in the boiler room leads to an increase in the energy efficiency of the heating system of buildings. This article describes the main models of temperature control of the coolant going to consumers using weather-dependent automation.

Keywords: boiler room automation, boiler rooms, effective control, efficiency of heat supply of residential buildings, weather-dependent automation.

Introduction

For the new construction of residential complexes, automated modular boiler rooms are increasingly used, which serve to heat either the entire area or a separate house (roof boiler rooms).

Since boiler rooms are developed and designed specifically for the chosen consumer, it should be noted that one of the main parameters of their operation is the creation of the required microclimate in apartments.

Automation methods

According to the standards, the apartment must have at least 20 °C. Such parameters can be created when releasing the heat carrier with a temperature schedule of 95/70, where the temperature of the heat carrier going to the consumer, 70 °C - returning to the boiler room, is 95 °C.

It should be noted that depending on the temperature on the street, the consumer needs a different amount of heat to maintain the specified microclimate in the apartment. In order to provide the consumer with the amount of heat he needs at the moment of time, weather-dependent automation is used in boiler rooms.

There are 2 main programming algorithms for a modular boiler house with weather-dependent automation.

The first method is based on the use of a temperature sensor and a controller installed on the boiler house itself. Thermometer reads readings of ambient temperature (street) and in case of temperature change, electric pulse is supplied to gate valve of 3-way crane, which opens or closes and mixes water with T3 and T2, thus giving consumers a more comfortable T1 temperature (Fig. 1).

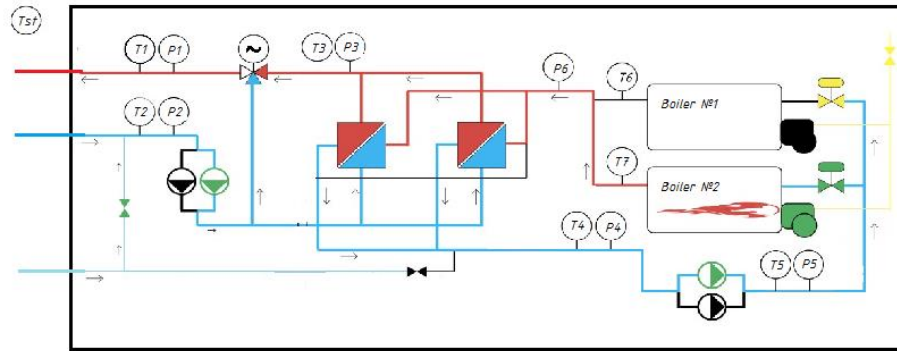


Fig. 1. Boiler room controlled by ambient temperature

It should be noted that the equation of dependence of the opening angle of 3 running crane α , on the temperature of T_{st} (street temperature). Street, is deduced by experiment, and is not strictly determined.

$$\cos \alpha = f(T_{st})$$

Another way to control the temperature of the heat carrier supplied to consumers is to install temperature sensors directly into the consumer apartments (Fig. 2).

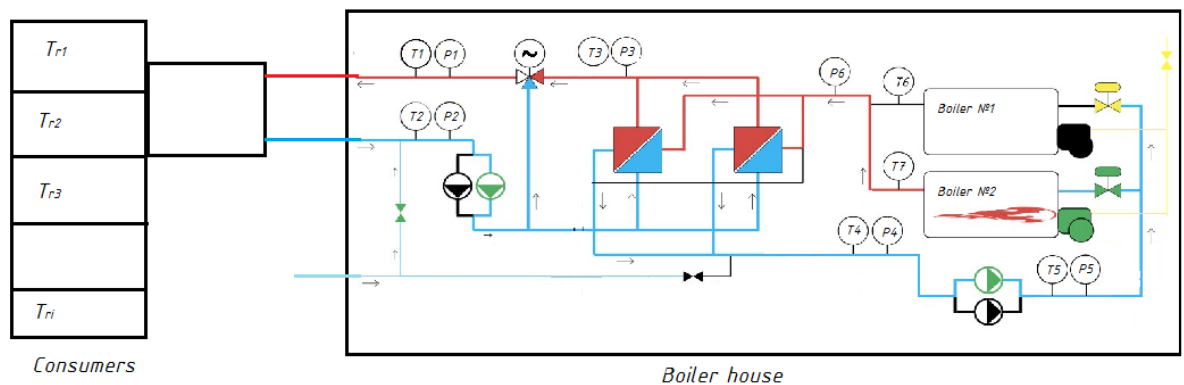


Fig. 2. Boiler room temperature-controlled room for consumers

By reading the temperature of room T_{r1} , T_{r2} , ... T_{ri} there is a similar dependence:

$$\cos \alpha = f(T_{r1}, T_{r2}, \dots T_{ri})$$

Based on the energy calculation of buildings, a clearer dependence of the rotation angle of the 3-way crane on the room temperature is created.

But this method will be valid only for boiler rooms intended for a certain house, as if we consider the totality of the area:

First, the energy efficiency class of the building will differ, as there is a possibility of the presence of earlier buildings. Because of this, the temperature control of the coolant will not be effective, because the main task will be to heat colder rooms, which will lead to an increase in the temperature of other consumers (early buildings) and the goal of creating the required microclimate of the premises will be violated.

Second, the laying of networks controlling the operation of thermometers in the apartments of consumers requires big investments for their creation and operation.

Third, it is possible that already in residential buildings residents will oppose the installation of temperature sensors in their apartments.

Conclusion

Having analyzed the above calculations and graphs, it should be noted that weather-dependent regulation is a justified measure that increases the energy efficiency of heat supply, as well as the degree of comfort of the consumer. It is also worth noting that there are a number of problems that require the development of individual solutions for each object separately.

References

1. Giants V.P., Kolakhov S.V. Avtomaticheskoe regulirovanie sistem otopeniya zhilyh zdaniy [Automatic regulation of heating systems of residential buildings]. Series: Housing, Moscow, 1985, 43 p. (Rus)

2. Falikov V.S., Vitalev V.P. Avtomatizaciya teplovyh punktov [Automation of thermal points]. M.: Energoatomizdat, 1989, 256 p. (Rus)

3. Shadek E., Marshak B., Krykin I., Gorshkov V. Kondensacionnyj teploobmennik-utilizator – modernizaciya kotel'nyh ustanovok [Condensation heat exchanger-recycling – modernization of boiler plants Industrial and heating boiler rooms and mini-CHP]. Promyshlennye i otopitel'nye kotel'nye i mini-TEC, 2014, 3 (24). (Rus)

4. Kudinov A. Energoberezhenie v teplogeneriruyushchih ustanovkah [Energy saving in heat generating plants]. M.: Mechanical Engineering, 2012, 139 p. (Rus)

ПОВЫШЕНИЕ ЭНЕРГОЭФФЕКТИВНОСТИ СИСТЕМЫ ТЕПЛОСНАБЖЕНИЯ ЖИЛЫХ ЗДАНИЙ

Е. С. Колесникова*, Р. Ю. Чубаров, Д. Н. Базелюк

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: kolesnikova.eleona@yandex.ru*

Аннотация. Основным видом повышения энергоэффективности котельной во время ее эксплуатации является полная или частичная автоматизация. Погодозависимая автоматика помогает контролировать температуру подаваемого потребителям теплоносителя, либо регулировать работу котлов, позволяя экономить топливо.

Ключевые слова: автоматизация котельной, зависимость от погоды автоматизация, котельные, эффективный контроль, эффективность теплоснабжения жилых зданий.

Determination of Acrylate Coating Thickness on Aluminum Alloy Products

D. S. Lutskov, D. S. Kurepina, A. Y. Gorbunova

Tambov State Technical University, Tambov, Russia
e-mail: dmitrii_luckov250898@mail.ru; kurepina.dash@yandex.ru; nastja-jarmizina@rambler.ru

Abstract

The results of experimental determination of the acrylic polymer coating thickness on aluminum alloy products are presented.

Keywords: thermal conductivity, non-destructive testing, polymer coating.

Introduction

Non-destructive testing of the thickness of coatings made of materials with low thermal conductivity is important because the thickness of the coating layer and the uniformity of its distribution on objects of various purposes are decisive factors that affect the properties of the product.

Modern information and measurement systems (IMSs) for thermal control equipped with computers are able to solve problems in a non-destructive way, realizing an adequate mathematical model for determining the thickness of coatings on metal substrates. The theoretical substantiation of the method of non-destructive testing of the thickness of coatings in two-layer polymer-metal products under the thermal effect of constant power from a circular flat heater in the form of a disk built into the substrate of the measuring probe is presented in detail in [1, 2]. It should be noted that a mathematical model of heat transfer in a two-layer product has been developed and investigated, which describes the regularities of changes in the temperature field created by the action of a flat infinite constant-power heater, which is used in the process of operating an IMS with a circular local heater for regularization of heat flows [3].

The design of the measuring probe, the composition of the IMS and the sequence of actions, in accordance with the algorithm for determining the thickness of the coating layer according to the developed model, are described in [4, 5].

Experimental part

During the experiment, two-layer polymer-metal products made of AMG aluminum alloy with a thin-layer coating of acrylic enamel were chosen as the object of research.

Aluminum grade AMG has high resistance to corrosion, strength and plastic properties. It is used in the manufacture of industrial parts, building structures, vehicle cladding and hydraulic equipment. Acrylic heat-resistant enamel has good

heat resistance and does not change its properties when heated to +100, and therefore, it is used for painting household heating radiators, a number of parts, structures,

The experimental study was carried out with the following operational characteristics of the IMS: time step of temperature measurement - 0.25 s; probe support material - Ripor; heater radius - 8 mm; heater current $I = 0.31$ A; voltage $U = 8$ V. Measurements were carried out five times on each sample. The results were processed using the Lab VIEW and Microsoft Excel software packages (Fig.1).

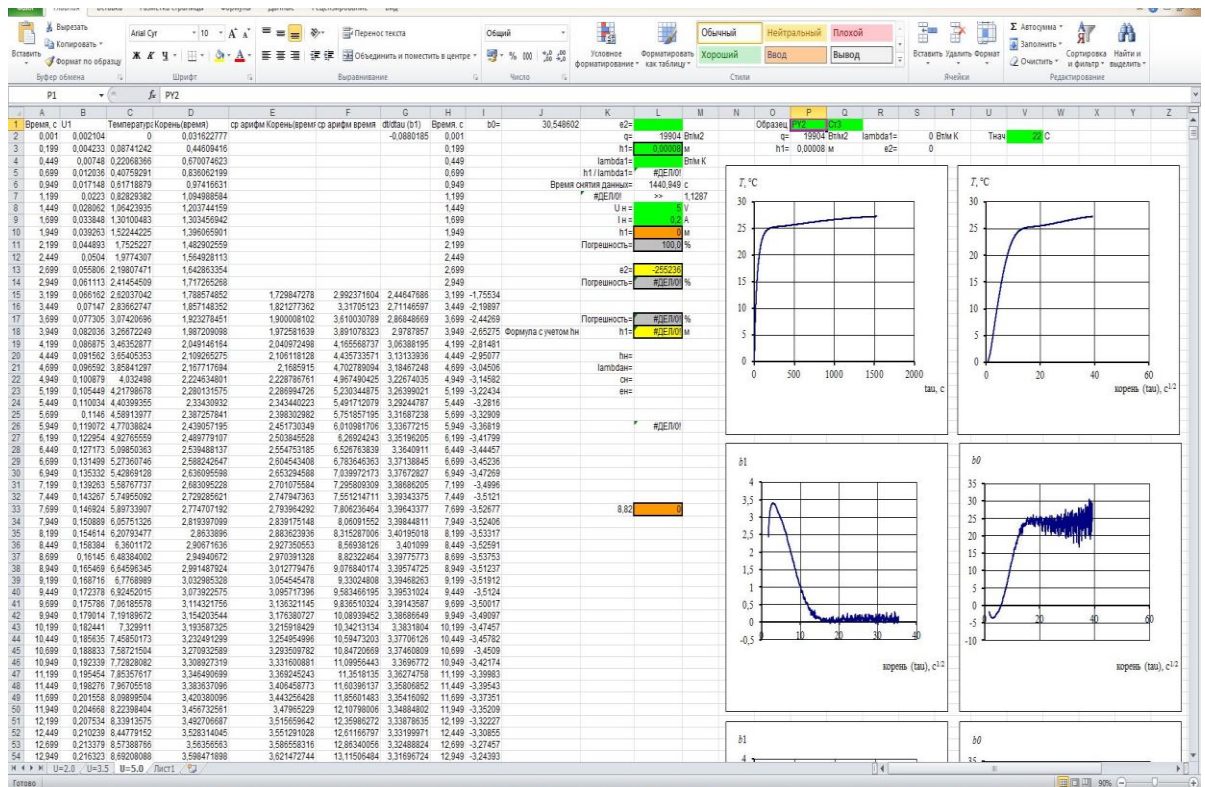


Fig. 1. General view of the IMS software "Measurement Result"

In the course of the experiment, thermograms were recorded on the surface of the coating of a two-layer polymer-metal product under thermal action from a circular flat heater of constant power. Working areas were identified on the thermograms, which were used to determine the coefficients of the mathematical model b_0 . The working area was determined statistically using the Durbin-Watson criterion as a flat top of the dependence $b_0 = f(\sqrt{\tau})$, which made it possible to significantly increase the accuracy of determining the coefficient of the mathematical model b_0 for the experiments.

The thickness of the coatings of the articles was calculated through the device constant obtained from the calibration experiment. The theoretical and imitative substantiation of the method indicates that the regularization mode of the thermal process is realized at the working section with one-dimensional heat propagation in a flat half-space [1, 2, 6].

Table 1. Experimental results

№ опыта	h_i , мм	b_0	h_1 , мм	$\delta = \left \frac{h_i - h_1}{h_i} \right , \%$
1	0.23	82.50	0.24	4.3
2	0.29	96.50	0.28	3.4
3	0.31	102.0	0.29	6.4
4	0.36	113.5	0.34	5.6

Table 1 presents the results of experiments to determine the thickness of the coatings. Here: h_{1i} is the value of the coating thickness measured with a micrometer, δ is the relative error.

Conclusion

Thermal analysis of two-layer polymer-metal objects, the bases of which are made of AMG aluminum alloy, and acrylic heat-resistant enamel of the Prestige company was used as coatings, showed that the error in determining the thickness of the coating is up to 6.5%, which is acceptable for such measurements.

References

1. Rogov I.V., Zhukov N.P., Mainikova N.F., Luneva N.V. Teoreticheskoe obosnovanie termicheskogo metoda nerazrushayushchego kontrolya dvuslojnyh izdelij [Theoretical substantiation of the thermal method of non-destructive testing of two-layer products]. Questions of modern science and practice. University named after I.V. Vernadsky, 2009, 9 (23), pp. 93 - 99. (Rus)
2. Zhukov N. P., Mainikova N.F., Rogov I.V. Metod nerazrushayushchego opredeleniy [Method of non-destructive determination of the thickness of protective coatings]. Bulletin of Tambov State Technical University, 2017, 23(1), pp. 6-11. (Rus)
3. Zhukov N. P., Mainikova N.F. Measuring and computing system for non-destructive thermophysical control. Devices and systems. Management, control, diagnostics, 2005, No. 2, pp. 153.
4. Zhukov N. P., Mainikova N.F. Measuring and computing system for non-destructive testing of thermophysical properties. Instruments and experimental techniques, 2005, No. 4, pp. 164 - 166.

ОПРЕДЕЛЕНИЕ ТОЛЩИНЫ АКРИЛАТНОГО ПОКРЫТИЯ НА ИЗДЕЛИИ ИЗ СПЛАВА АЛЮМИНИЯ

Д. С. Луцков*, Д. С. Курепина, А. Ю. Горубнова

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: dmitrii_luckov250898@mail.ru

Аннотация. Представлены результаты экспериментального определения толщины акрилового полимерного покрытия на изделиях из сплава алюминия.

Ключевые слова: теплопроводность, неразрушающий контроль, полимерное покрытие.

Traditional Power Engineering and Problems of its Development in Current Conditions

D. Y. Ponkratov*, D. M. Gerasimov

Tambov State Technical University, Tambov, Russia

*e-mail: *dponkratov775@gmail.com*

Abstract

Energy is an industry consisting of a set of large natural and artificial subsystems that serve to transform, as well as distribute and use all energy resources. The paper deals with the problems of the current development of the energy industry.

Keywords: traditional energy, energy resources, capacity.

Providing energy production by converting the primary energy of the fuel into secondary energy, such as electrical or thermal energy, this is the purpose of the article. At the same time energy production often occurs in several stages:

- generation and concentration of energy resources, such as extraction, processing and enrichment of nuclear fuel;
- transfer of resources to power plants, such as the delivery of fuel oil to a thermal power plant;
- conversion of primary energy into secondary energy by power plants, for example, chemical energy of coal into electrical and thermal energy;
- transfer of secondary energy to consumers, for example, through power lines.

A characteristic feature of the power industry is its availability. It has passed a variety of tests in different operating conditions. Most of the world's electricity comes from traditional power plants with electrical capacity exceeding 1,000 MW.

The main type of energy is electric, which can be safely considered the basis of our civilization. Conversion of primary energy into electrical energy occurs at power plants such as thermal, hydroelectric or nuclear power plants. The production of energy of the type we need and its transfer to consumers takes place in the process of energy production, in which several stages can be distinguished:

1. Obtaining and concentration of energy resources: extraction and enrichment of fuel, concentration of water pressure with the help of hydraulic structures, etc.;
2. The transfer of energy resources to energy-converting plants; it is carried out by land and water transportation or by pumping water, oil, gas, etc. through pipelines.;
3. Conversion of primary energy into secondary energy, which has the most convenient form for distribution and consumption in these conditions (usually into electrical and thermal energy);
4. Transmission and distribution of converted energy;
5. Energy consumption carried out both in the form in which it is delivered to the consumer, and in the converted form [2].

Consumers of the produced energy are industry, transport, agriculture, housing and communal services, the sphere of life and service. From 100% of the used primary energy will get 40% of useful energy used and 60% of thermal energy. Traditional electric power industry nowadays is divided into the following areas: thermal power engineering, hydropower and nuclear (nuclear power) engineering.

There are also some technological problems, including:

- high share of depreciation of fixed assets;
- use of outdated technologies in the production and transport of electricity;
- threat of loss of technological sovereignty;
- low energy efficiency in the production and transport of electricity;
- *lack of experience in designing and operating power facilities based on innovative technologies;

As well as economic problems of energy:

- low investment attractiveness;
- lack of funds to eliminate the high degree of depreciation of production assets;
- high levels of tariffs for electricity production and transportation, especially for energy-intensive consumers;
- low motivation to reduce the costs of transport of electricity;
- low profitability of distribution networks in areas with low consumption density.

As for the consequences of energy development, in the case of previous energy production, emissions will increase to 11 GT of carbon per year by 2050, which will contribute a significant share of the total carbon cycle in the biosphere.

To date, the level of emissions exceeds the readings of the compensated natural control systems of the biosphere. Of the 5.5 GT of carbon emitted by industry into the atmosphere, about 3.3 GT accumulates in it as carbon dioxide, which will remain in it for many hundreds of years. Over the past 200 years, the concentration of carbon dioxide in the atmosphere has increased by 30%. Forecasts show that by 2050 the CO₂ content in the atmosphere will multiply.

Because of the accumulation of carbon dioxide and other gases during the production of energy leads to effective heating of the earth's surface and in the course of this absorption of thermal radiation from the Earth's surface. Currently, the greenhouse effect is the main problem in the production of energy in the course of excess carbon dioxide gives an effective surface heating in the region of 2.45 W/m². By 2050, the greenhouse gas effect will reach the level of 5-6 W / m² and will be comparable to those natural changes in the level of solar radiation, which led to significant climatic changes in the geological past. Paleoclimatic data in the study make it clear that the climate can change rapidly, in a time comparable to the life of one generation. The seriousness of the environmental situation is becoming increasingly obvious to the general population and today the first, as yet indecisive steps have been taken to reduce carbon dioxide emissions into the atmosphere.

Due to this, a radical restructuring of the current energy system is necessary. We have about 50 years to replace the old energy system based on the burning of

fossil energy resources with a system using other environmentally friendly and renewable energy sources. The most predicted is that the new energy system will use a combination of different energy sources: solar energy, biomass production, nuclear fusion reactors and thermonuclear energy, and only the combined efforts of people working in various fields of scientific research in the energy sector are able to solve this global problem in such a short time [1].

Russian and foreign scientists have already said that new sources have already been created – such as thermonuclear (obtaining energy by merging the nuclei of chemical elements in heated plasma). So far, the most profitable “fuel” in such a reaction is hydrogen. Due to the thermonuclear reaction “works”, for example, as the Sun. In addition, there is a scientific project to create a so-called small “sun”. On Earth, scientists of the largest countries have been trying for more than 50 years. The power system as a whole has very different properties than individual sources, after several major accidents that occurred in the United States, Canada, Russia, Japan; it became clear that failures in certain parts of the networks can lead to a serious crisis of the entire system. The era of the largest centralized sources that “feed” large areas is a thing of the past. The development of the electric power industry will be due to the relationship between large and small sources. In the course of this, the latter become increasingly competitive. They are quickly erected, have a short payback period (1.5-3 years to 8-10 for traditional CHP) and save the system from such consequences as dangerous "chain reactions". Small sources are convenient in linking to specific facilities that are far from large power plants. If we are talking about mass or powerful energy consumers, it is simply impossible to do with a network of small sources, it is not necessary to divide the energy of the future into separate segments. It is necessary to develop all the ways of direction, without dwelling on any one. It is possible that the existing part of electrical sources will need to be diversified. In the future, a “certain bias” in coal-fired electricity is inevitable. But to reject other carriers is not necessary. Purely technologically, the transfer of all sources to gas or coal will be spent and is unlikely to be possible.

References

1. Traditional energy [Electronic resource]. URL: <http://www.energycenter.ru/article/342/33/>
2. Klimenko A.V., Zorina V.M. Teoreticheskie osnovy teplotekhnicheskogo teplotekhnicheskogo eksperimenta [Theoretical bases of heat engineering heat engineering experiment]. M.: MEI Publishing house, 2001, 564]. (Rus)

ТРАДИЦИОННАЯ ЭНЕРГЕТИКА И ПРОБЛЕМЫ ЕЕ РАЗВИТИЯ В СОВРЕМЕННЫХ УСЛОВИЯХ

Понкратов Д. Ю.*, Герасимов Д. М.

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: dponkratov775@gmail.com

Аннотация. Рассмотрено обеспечение производства энергии путем преобразования первичной энергии топлива во вторичную энергию, такую как электрическая или тепловая энергия. Обсуждаются проблемы современного развития энергетической отрасли.

Ключевые слова: традиционная энергетика, энергетические ресурсы, мощность.

An Automated Control System for Operating Modes of the Electric Power System

A. A. Terekhova*, B. S. Dmitrievsky

Tambov State Technical University, Tambov, Russia

*e-mail: terekhova.aa@tstu.ru

Abstract

The purpose of this study is to analyze the automated control system for operating modes of the electric power system. The study will consider the tasks to be solved when implementing an automatic control system and constitutive model. The relevance of the study is that the use of an automatic control system increases the reliability of the electric power system.

Keywords: automated control system, operating modes, electric power system.

Automation of electric power systems is their equipping with special devices and systems of control the production, transmission and distribution of electric energy in normal and emergency modes without human intervention. Many scientists around the world are studying the automated control system for electric power systems. This research topic is very relevant, because automation of various technological processes is used everywhere. In addition, this research area is one of the most rapidly growing in the world. In Russia, automation of the electric power system began to develop in the early 20th century.

Automated control of electric power systems is described in the works of A.V. Demyshev, A.V. Uglov, and I.A. Byrkov. As A.V. Demyshev notes the use of an automated control system in the electric power industry will reduce the time and cost of the control system, and further simplify its maintenance. A.V. Uglov describes the features of relay protection, automation of electric power systems of nuclear power plants and defines the main purposes of the relay protection system and emergency automation. I. A. Byrkov considered mathematical models of electric power system.

Automated control systems are used at all stages of the functioning of the electric power system (EPS): the production of electrical energy, its transmission, distribution and consumption. Such control systems are subject to strict requirements to ensure the performance speed and reliability. When implementing an automated control system in the electric power system the following tasks are solved:

- simplify interaction between system elements;
- simplified collection and structuring of information about system elements;
- ability to control changes in system parameters;
- analysis of changes in parameters and their impact on the system operation;
- reduction in the total amount of information transmitted when managing the modes of operation of the EPS.

This technical problem can be solved by dividing the system into subsystems. Subsystems are connected by means of communication and optimization modules.

Also, the control system for operating modes of the EPS contains software and hardware complexes, control points connected to each other by means of

communication in the form of a digital network, satellite or Internet connection, which are made in the form of remote technological central control points connected to the control system of the EPS element by remote data transmission.

Managing the modes of operation of the EPS to automatically identify the States of the EPS and monitor its parameters. The parameters of the EPS operation mode include the values of frequency, currents in branches, voltages in nodes, phase angles, full, active and reactive power transmission, as well as values that characterize the asymmetry of a three-phase system of voltages or currents and the non-sinusoidality of voltage and current changes during the main frequency period.

Identification of EPS states and parameter monitoring is performed for each dedicated subsystem. In comparison with a centralized control system, such an automated system for managing the modes of operation of the EPS significantly reduces the total amount of transmitted information used to solve the problem of managing a large EPS. Respectively, the speed of the control system and the overall efficiency and reliability of the EPS operation are significantly increased. These advantages are achieved due to the parallel and distributed organization of the information and computing process for solving the control problem in the EPS and finding the optimal mode of its operation.

The use of an automatic control system can significantly improve the main indicators of the quality of the power plant, such as reliability and performance. Monitoring the main parameters of the electric power system allows you to identify the system operation mode in a timely manner and respond to its changes.

The automatic control system for operating modes of the electric power system allows finding the optimal operating mode of the system and the optimal operating parameters. Timely monitoring of parameters will eliminate the possibility of emergency operation modes and minimize the negative consequences if they exist.

References

1. Efremov I.A., Taran A.S., Filippova T.A. The principle of improving the efficiency of operating modes of electric power systems. Reports of Tomsk state University of control systems and Radioelectronics, 2012, vol. 1, 1(25), pp. 199-203.

2. Auev B.I. Metody i modeli effektivnogo upravleniya rezhimami edinoj elektroenergeticheskoy sistemy Rossii [Methods and models of effective management of modes of the unified electric power system of Russia]. Abstract. dis. Dr. Techn. Science. Moscow, 2008. (Rus)

СИСТЕМА АВТОМАТИЗИРОВАННОГО УПРАВЛЕНИЯ РЕЖИМАМИ ФУНКЦИОНИРОВАНИЯ ЭЛЕКТРОЭНЕРГЕТИЧЕСКОЙ СИСТЕМЫ

А. А. Терехова*, Б. С. Дмитриевский

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: terehova.aa@tstu.ru

Аннотация. Целью данного исследования является анализ автоматической системы управления режимами работы системы электроэнергетики. В исследовании будут рассмотрены задачи, которые необходимо решить при внедрении системы автоматического управления и конститутивной модели. Актуальность исследования заключается в том, что использование системы автоматического управления повышает надежность электроэнергетической системы.

Ключевые слова: автоматизированная система управления, режимы функционирования, электроэнергетическая система.

Features of Designing Solar Systems Using Meteorological Databases

S. S. Vashenko

Tambov State Technical University, Tambov, Russia
e-mail: vashhenko98@list.ru

Abstract

The aspects of designing solar systems using global meteorological databases are considered. Various ways of converting solar energy and data sources for analysis and calculations to create the required system are analyzed.

Keywords: solar energy, database, solar system.

Currently, the issue of alternative energy sources for humanity occupies a leading place in terms of relevance. Every year, a huge amount of coal, oil and gas is extracted and processed. But for how many years will the world have enough natural resources, which are extracted every year in more and more volume? In the modern world, an increasing number of people and states in general are turning their attention to alternative energy sources.

One of the types of alternative energy sources is solar energy. Solar energy is the direction of energy based on the direct use of solar radiation to produce energy in any form. The sun is an inexhaustible source of environmentally friendly energy, that is, it does not produce any harmful waste and does not harm the environment.

Solar energy can be converted to electrical or thermal energy. For this purpose, various types of solar systems are used. A solar system is a set of technical devices designed to convert the energy of the sun's rays into electrical or thermal energy. The complex includes a receiving device, which can act as solar panels and collectors and devices that ensure the operation of the system, such as a controller, inverter, heat exchanger or battery. The principle of operation can be formulated as follows:

1) Electrical energy can be obtained by using photovoltaic cells, which act as receivers of sunlight.

2) Thermal energy is generated by converting solar energy using various collectors. The sun's rays heat the heat carrier circulating in the solar collector, with the subsequent transfer of the resulting heat to the heating system or hot water supply. [4].

For example, the solar system for providing hot water and heating will include: a solar collector, a pumping station, a boiler, an expansion tank, sensors and pipelines. Cold water from the storage tank through a pipeline through a pumping station equipped with a controller for adjusting the operation of the complex in

automatic mode enters the collector, which under the influence of sunlight converts them into thermal energy for heating water. At the outlet of the collector through another pipeline, hot water is returned to the storage tank through the pumping station. The expansion tank is used to ensure the normal operation of the system. The solar system uses pressure and temperature sensors to obtain accurate information about the temperature and pressure of water in the collector and storage at a given time.

The operation of the solar system depends on many parameters that significantly affect the operation of the entire system. For example, the size of the solar collector, the requirements for this system, the territorial location in which the solar system is used, weather conditions, the time of year, as well as the intensity of solar radiation during the day. In Russia, the calculated values of total, direct and scattered solar radiation are accepted according to reference books [1, 2]. Reference books contain information on hourly, monthly and annual values of direct, scattered and total solar radiation, duration of sunshine for all regions of Russia with observation periods from five to 30 years. These directories have a number of disadvantages: limited circulation, tabular form of providing information, a small number of observation points for data collection, the lack of some characteristics and the need to replenish information since 1990.

At the moment, there are several worldwide databases that do not have many of the disadvantages of their paper predecessors. Take for instance the NASA power database (NASA prediction of worldwide energy resources), which contains meteorological and solar-related parameters and allows access to daily averaged data (Fig. 1) [3].

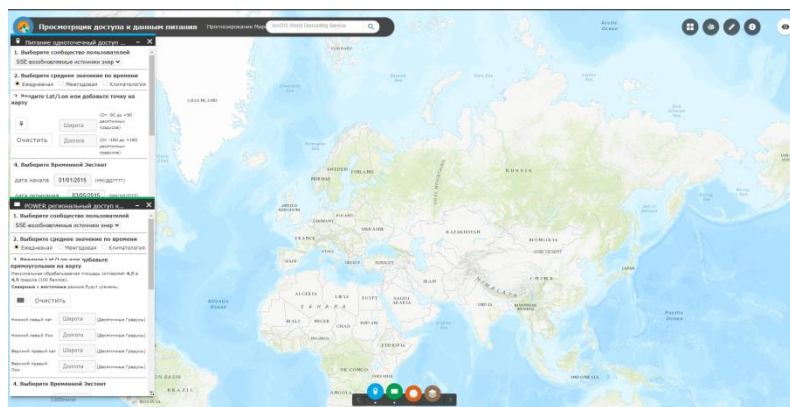


Fig. 1. NASA POWER World Database

Fig. 1 shows the main database window. It is an interactive map of the globe and has a certain number of tools for obtaining the required information. The database provides the ability to receive data in various output file formats, such as ASCII, CSV, GeoJSON, and netCDF. This feature simplifies the use of data for work in other programs and systems, eliminating the need to rewrite and create parameter tables manually. After selecting the desired area or location, time period,

output data format and parameters of interest, the platform provides a file containing the required indicators for download, as shown in Fig. 2 [3].

The object of the study was the educational building of Tambov State Technical University; the system automatically fills in information about latitude and longitude in the report. The coverage period was selected: 31.12.2014-03.04.2015. And the parameter index of clarity of insolation was selected, which is represented by a graph of the selected time period (the period of coverage of the averaged data from 31.12.2014 to 03.04.2015). The output format is GeoJSON.

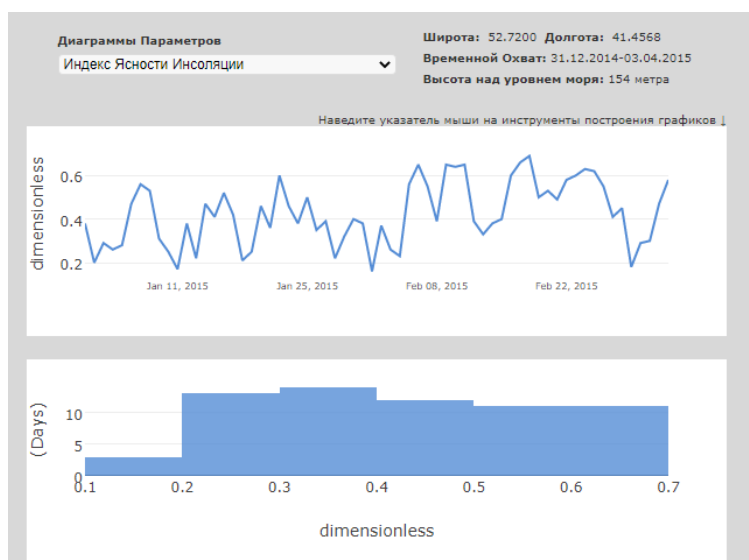


Fig. 2. Output Data Report

As a result, owing to modern global databases of meteorological data, the design of alternative power systems becomes much more accessible and easier.

References

1. Valov M.I. Kazandjan B.I. Sistemi solnechnogo teplosnabjenia [Solar heating systems]. M.: Isd-vo MEI, 1991. (Rus)
2. NASA website «POWER Data Access Viewer» [Electronic resource]. URL: <https://power.larc.nasa.gov/data-access-viewer/> (Accessed 10.12.2020). (Rus)
3. Butuzov B.A., Butuzov B.B. Ispolzovanie solnechnoy enegii dlia proizvodstva teplovoi energii [Using solar energy for heat production]. M.: Intekhenergo-izdat / Teploenergetik, 2015. (Rus)

ОСОБЕННОСТИ ПРОЕКТИРОВАНИЯ ГЕЛИОСИСТЕМ С ИСПОЛЬЗОВАНИЕМ МЕТЕОРОЛОГИЧЕСКИХ БАЗ ДАННЫХ

С. С. Ващенко

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: vashhenko98@list.ru

Аннотация. Рассматриваются аспекты проектирования гелиосистем с использованием глобальных метеорологических баз данных. Изучены различные способы преобразования солнечной энергии и источники данных для проведения анализа и расчетов для создания требуемой системы.

Ключевые слова: солнечная энергия, база данных, гелиосистема.

УДК 519.876.2
ББК 30В6

The Development of the MIMO Control System for Thermal Facilities

R. O. Dementyev*, D. Yu. Muromtsev

Tambov State Technical University, Tambov, Russia

*e-mail: sharygin2014@yandex.ru

Abstract

Energy-saving control systems are widely used in modern industry in solving practical problems of automation and control of complex multi-dimensional technological objects. Modern multi-dimensional technological control objects, as a rule, are complex distributed systems that are characterized by mutual dependencies of input and output variables. In many cases, such objects are largely poorly organized, so it is not possible to build a clear structure of the management system.

Keywords: energy-saving control systems, technological control objects, optimal control systems, synthesis of optimal control, thermal control, industrial multi-channel programmable microcontrollers, control signal generators, digital-to-analog converter, executive device, sensors, status signal generators, analog-to-digital converter.

The development of the structure of the optimal control system for MIMO thermal objects can be divided into several important stages [3]:

1. It is necessary to determine the OS strategy.

2. It is necessary to construct an optimal control synthesis control algorithm for any changes in the variable values.

An important component of the energy-saving system is the choice of a region in space that synthesizes variables, corresponding variables, and further comparison with the volume of solving optimal control problems [2]. The synthesis algorithm should be based on the operation of the controller to the values of the variable for which there is no solution RAM. The practical implementation of thermal control can be implemented using an intelligent system based on microprocessors.

The management goals are:

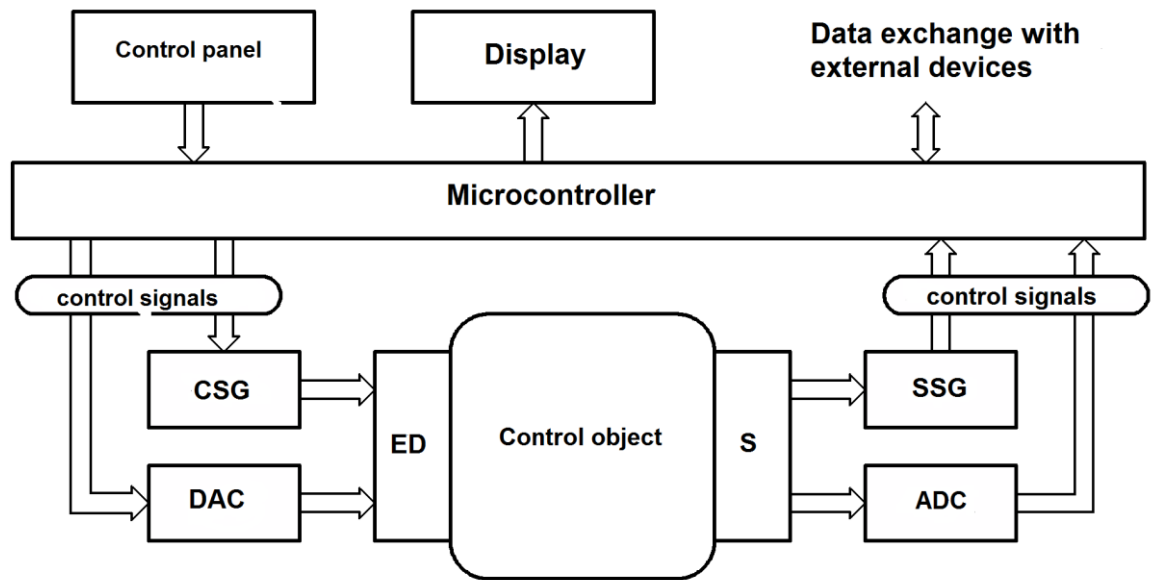
(1) minimizing energy costs;

(2) increasing productivity;

(3) improving the quality of products.

In accordance with the solution, an algorithm for calculating optimal control is developed, which is performed by the executive bodies. The results of this effect are compared with the expected outcomes at the end. When considering an energy-saving control system, it is necessary to distinguish industrial multi-channel

programmable microcontrollers [1], in most cases – MICROCONT-P2, which allow for simultaneous control of small groups of microcontrollers at different thermal effect installations. Controllers, in most cases, are connected to the internal wireless control network IMC-Industrial Mobile Communication.



*Fig. 1. Typical structure of a microcontroller-based control system:
CSG- control signal generators, DAC- digital-to-analog converter, ED- executive device, S- sensors, SSG- status signal generators, ADC- analog-to-digital Converter*

A significant increase in the reliability of the system as a whole is achieved through the use of data transmission technology, the features of the IEEE 802.15.3 standard, which is important for the use of industrial control and monitoring systems. The data transfer rate is 250 kbit / s. In addition, the network includes wired control panels that allow you to immediately adjust the heat treatment cycles. For centralized control of the thermal regime in the equipment, the software and hardware platform is implemented in the industrial Ethernet network. This integration allows transmitting data and important information about the operation of equipment groups or heat treatment sections with the possibility of uninterrupted visual monitoring in remote access mode.

Thus, energy-saving control of industrial projects is aimed at the choice of energy-saving measures and technologies with maximum efficiency to achieve the set targets with resource constraints. At the same time, the efficiency indicator of management processes should be calculated taking into account its technical, economic, social and environmental component in the conditions of uncertainty of the project processes and the external environment.

References

1. Muromtsev D.Yu., Gribkov A.N., Shamkin V.N. Metodika vibora algoritma sinteza upravlyauchih vozdeistvii mnogomernim tehnologicheskim oբectom na mnojestve sostoyanii functionorovaniya [Method of selecting an algorithm for synthesizing control actions by a multidimensional technological object on a set of functioning States]. 2017, pp. 109-118. (Rus)
2. Muromtsev D.Yu., Tyurin I.V., Grebennikov R.V. Konstruirovaniye energosberegaučių [Design of energy-saving regulators for small power facilities]. 2010, pp. 236-245. (Rus)
3. Muromtsev D.Yu. Structura bazi znanii intellectualnoi sistemi energosberegaučių sistemi mnogomernim tehnologicheskim oբectom [Structure of the knowledge base of the intelligent system of energy-saving management of a multidimensional technological object]. 2018, pp. 160. (Rus)

РАЗРАБОТКА СТРУКТУРЫ МНОГОМЕРНОЙ СИСТЕМЫ УПРАВЛЕНИЯ ТЕПЛОВЫМИ ОБЪЕКТАМИ

Р. О. Дементьев*, Д. Ю. Муромцев

Тамбовский государственный технический университет, Тамбов, Россия

**email: sharygin2014@yandex.ru*

Аннотация. Энергосберегающие системы управления широко применяются в современной промышленности при решении практических задач автоматизации и управления сложными многомерными технологическими объектами. Современные многомерные технологические объекты управления, как правило, представляют собой сложные распределенные системы, характеризующиеся взаимными зависимостями входных и выходных переменных. Во многих случаях такие объекты в значительной степени плохо организованы, поэтому не представляется возможным выстроить четкую структуру системы управления.

Ключевые слова: энергосберегающие системы управления, технологические объекты управления, оптимальные системы управления, синтез оптимального управления, терморегулирование, промышленные многоканальные программируемые микроконтроллеры, ГУС - генераторы управляющих сигналов, ЦАП - цифроаналоговый преобразователь, ИС - исполнительное устройство, Д-датчики, ГСС-генераторы сигналов состояния, АЦП - аналого - цифровой преобразователь.

Principles of Creating Systems for the Construction of Spatial Barriers against Unmanned Aerial Vehicles Penetration

M. M. Kiryupin

Tambov State Technical University, Tambov, Russia

e-mail: mik6339@yandex.ru

Abstract

The article provides an overview of the methods and existing solutions used to build an effective system that ensures the construction of a spatial barrier from the penetration of unmanned aerial vehicles in order to protect information and prevent unauthorized entry into the territory by third parties.

Keywords: unmanned aerial vehicles, antenna systems, radar.

Currently, unmanned aerial vehicles (UAVs) have gained great popularity, both in everyday consumer society and in the spheres of special and military purposes, which, due to their compactness, relatively low cost and ease of control, are able to solve the tasks assigned to them. These tasks include: manned aerial photography at low altitude with limited piloting conditions, monitoring the investigated area in order to protect or conduct reconnaissance activities, as well as autonomous or manned delivery of various cargoes, both in civilian and in the field of special and military purposes.

UAVs can be divided into several types. The first type of UAVs are vehicles that are controlled completely autonomously, relying on a route laid down in a control device by a human operator on the ground and capable of navigating in space exclusively by navigation systems, such as Beidou, Galileo, Glonass, GPS, as well as with direct using a radio or laser altimeter. These types of UAVs have a significant advantage in terms of flight duration and range.

The second type of UAV is controlled vehicles using radio signals, with the possibility of a control signal in L (1-2 GHz), S (2-4 GHz), C (3.4-8 GHz), as well as X (7-10.7 MHz) frequency bands within the line of sight, and orientation in space by means of navigation systems. In addition to the mentioned frequency ranges, simple UAV models can operate on the basis of networks of mobile operators from the 2nd to the 4th generation at the frequencies: 780-960, 925-960 MHz, 1.7-2.2-2.5-2, 7 GHz, as well as standards related to high-speed broadband access such as Wi-Fi, WiMAX, LTE.

To counteract these aircraft, it is necessary to organize the installation of spatial barriers, which will allow promptly carry out protective actions aimed at combating unauthorized UAVs. To implement the spatial barrier, the systems intended for this use the fundamental methods of electronic suppression (EW), which can affect both the satellite radio navigation systems used on the aircraft, and directly on the radio lines that directly control the object. These systems use the following types of REB. In the case of successful detection of the frequency, implemented by the control of the object, the required signal-to-noise ratio is formed on the interference generating unit, forms the following types of interference: noise interference, harmonic interference simulating interference, which is directed at the frequency. This interference “blinds” or deceives

the irradiated device, which subsequently fails. This method is used for single raids of “simple” UAVs controlled by a small number of signals.

The second type of interference guidance is implemented over the entire operating frequency range, in which the following types of interference are superimposed: barrage noise interference or high-power white noise, or narrow-band noise or harmonic interference, which performs “sliding” over a given frequency range.

Once within the range of the interference, the UAV loses communication, which is responsible for control, from which the device loses control and, in the best case, the return path algorithm is implemented, and in the worst case, it crashes. This method is effective for repelling a massive UAV raid.

Before using the REB methods, the system for setting up a spatial barrier uses a radio monitoring system, which is the main element of the system [1]. This element is responsible for scanning the zone for the objects in it. When the aircraft is detected, the scanning phase begins to determine the operating frequency. The received information is transmitted by means of signal processing and analysis, through the processing device to the block responsible for the formation of interference, according to the data provided from the radio monitoring system.

The functioning of the entire system works as follows. According to the signals from the head processor responsible for radio monitoring, it forms scanning beams. By means of the transmitter, it forms probing signals, which are emitted by an antenna with a certain directional pattern for scanning the air [1]. The receiver processes and amplifies the signals reflected by the target and received by the antenna. These signals come in a mixture with noise and interference, their selection is carried out using matched filters of concentrated selection and digital filters located in the receiver. The rest of the signal processing is performed in the central processor, with the algorithm for detecting the useful signal, and then the signal is sent either to the display device, or a signal is generated for the block of interference. Operating frequencies and time intervals in the system are set using the synthesizer block.

For the operation of the complexes for setting up a spatial barrier, the use of effective antenna systems is required. In these complexes, most often, this task is assigned to antenna systems, based on antenna arrays, such as a phased array antenna (PAR), an active phased antenna array (APAR), a passive phased antenna array (PPAR), an adaptive antenna array (AAR) etc. [2]. The listed antenna systems allow, due to their broadbandness, to cover various frequency ranges, and due to the formation of the necessary directional pattern (DP), to effectively scan the environment or to suppress all possible UAV control channels, due to the operational restructuring of the beam within the limits we need.

Rebuilding the directional pattern beam in the direction of the target intended for suppression in these types of antenna systems is carried out by means of electric beam scanning. This method is implemented as follows. The energy emitted by the entire array is concentrated in a certain direction, in which the signal from different parts of the antenna are added, having the most effective phase ratio under the action of control devices [3]. The control is carried out at the expense of phase shifters controlled by a

high-speed electronic system, in which certain algorithms can initially be laid to direct the beam to the target, and intelligent systems capable of self-learning during the operation of the entire system can be used.

Of the above types of headlights, the most effective version is the active phased array antenna (APAR). Conducting a comparative analysis of the above antenna systems, we can come to the following conclusion. At a time when the PPAR, in addition to the antennas themselves, must have a separate phase shifter for each element of the array, which most often does not differ in small dimensions, as a result of which a restriction is imposed on the size of the antenna system. In APAR, each element included in the array already contains both an antenna and a phase shifter with a receiver and transmitter at the same time.

This advantage is achieved due to the miniature implementation of all of the above systems on one substrate simultaneously, which makes it possible to assemble an antenna array of the order of a thousand of such antennas. The application of this solution gives a significant increase in the efficiency of the antenna system, due to the broadbandness of the array and its ability to solve several problems simultaneously: to search and detect targets, in parallel with this, to form interference aimed at suppressing an unauthorized object. Also, this type of lattice significantly increases the reliability of the system, as well as reduces the energy consumption of the complex.

The use of effective antenna systems in complexes for creating a spatial barrier against UAV penetration, operating both for detecting and suppressing aircraft in L (1-2 GHz), S (2-4 GHz), C (3.4-8 GHz) as well as X (7-10.7 MHz) frequency ranges, will improve the efficiency of these systems, by reducing the mass-dimensional parameters of the complex, reducing the energy consumption, as well as the speed of the entire system.

References

1. Bakulev P.A. Radiolokacionnye sistemy [Radar systems]. M.: Radiotekhnika, 2004. (Rus)
2. Zyryanov Yu. T., Fedyunin P. A., Belousov O. A., et al. Antenny [Antennas]. -St. Petersburg: Lan, 2020, 412 p. URL: [electronic // Lan: electronic library system. - URL: https://e.lanbook.com / book / 133478](https://e.lanbook.com/book/133478) (Accessed: 10.09.2020). (Rus)
3. Voskresenskiy D.I., Granovskaya R.A., Davydova N.S. Antenny i ustrojstva SVCH (Proektirovanie fazirovannyh antennyh reshetok). [Antennas and microwave devices (Designing phased antenna arrays)]. M.: Radio and communication, 1981. (Rus)

ПРИНЦИПЫ СОЗДАНИЯ СИСТЕМ ОРГАНИЗУЮЩИХ ПОСТРОЕНИЕ ПРОСТРАНСТВЕННОГО БАРЬЕРА ОТ ПРОНИКНОВЕНИЯ БЕСПИЛОТНЫХ ЛЕТАТЕЛЬНЫХ АППАРАТОВ

М. М. Кирюпин

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: mik6339@yandex.ru

Аннотация. Приведён обзор применяемых методов и существующих решений для построения эффективных системы обеспечивающих построение пространственного барьера от проникновения беспилотных летательных аппаратов, с целью защиты информации и пресечения несанкционированного проникновения на территории третьими лицами.

Ключевые слова: беспилотные летательные аппараты, антенные системы, радиолокационные системы.

Synthesis of a Phased Antenna Array for Meteorological Radio Monitoring Systems

M. A. Kudryashov

Tambov State Technical University, Tambov, Russia
e-mail: maximkudryashov969@gmail.com

Abstract

The main aspects of the choice of radiators and the geometric shape for the antenna array are considered. The choice of the method for constructing a phenomenological model has been substantiated. The main characteristics of the simulated antenna system are given. The use of the obtained antenna array in the meteorological radio sounding systems is substantiated.

Keywords: antenna, antenna array, radio monitoring systems.

Introduction

At present, the widespread use of meteorological stations designed to monitor atmospheric parameters requires the use of efficient and small-sized radar stations. Many stations of this type exist, but they have large dimensions due to the antenna system, and the systems do not have sufficient speed of information receiving, which is required in adverse weather conditions.

In order to more quickly monitor radiosondes or have multiple channels for receiving information, they are based on antenna systems based on mechanically driven antenna arrays. This is their disadvantage, since the switching speed and the speed of forming the required directional pattern directly depends on the speed of the mechanical drive. Also, the positioning accuracy becomes insufficiently high. Therefore, to solve this problem, it is necessary to use efficient antennas of the system, in particular, digital phased antenna arrays with electric beam scanning.

Modeling

Based on previous studies, in the course of this work we will use a quadrifilar spiral radiator, since it is well suited for use in an antenna system with specified parameters. Its advantages are simplicity of design, small dimensions, and also, its undoubted advantage is its polarization. Radiators with linear polarization are not suitable for such an antenna system, since their advantages will not be fully disclosed due to multiple reflections. Circular polarization will help protect against multiple reflections and, regardless of the angle between the antenna on the probe and the receiver, the signal always hits the antenna [1].

Next, we move on to modeling the phased antenna array (PAA) by constructing a phenomenological model. By the concept of a phenomenological model of a PAA, we mean a model that correctly shows the main phenomena occurring in the simulated antenna system, however, due to the fact that not all parameters of the antenna system are taken into account in the simulation, the simulation result cannot be considered extremely reliable.

Using the method of constructing phenomenological models will make it possible to synthesize complex antenna systems and complexes without the use of full-scale modeling methods and without building physical models, since this approach shows results as close as possible to a real physical model, in which the discrepancy with the physical model is less than five percent. In turn, using the proposed method, it is possible to quickly synthesize antenna structures that will have good repeatability and linearity of electrodynamics characteristics when transforming phenomenological models into physical ones [2].

To solve the set tasks, a cylindrical phased antenna array will be built. The main advantages of the gratings of this form are: the possibility of wide-angle scanning by the beam without changing the shape and width in the azimuthally plane; elevation scanning; convenient placement of convex antenna systems on some objects. And also, due to the spatial rotation of the axes, the emitters have a weaker mutual coupling, compared to flat and linear antenna arrays. As a result of modeling, we plan to obtain the following characteristics: electronic scanning from 180 to 360 degrees in azimuth; the deviation of the beam from the normal in the vertical plane should be about -35–90 degrees; number of emitters in the PAA from 15 to 30, to have an effective multibeam radiation pattern.

Based on the above facts, we synthesize an antenna array that can solve the problems of modern meteorological radars. This antenna array consists of three rings, including eight emitters each. The model of this array is shown in Fig. 1.

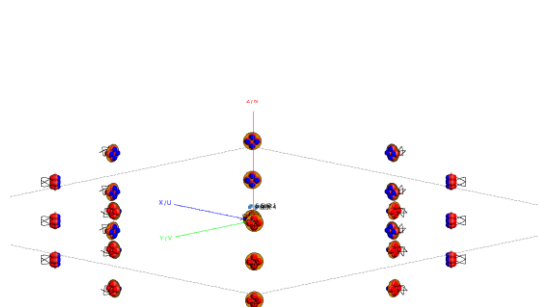


Fig.1 Cylindrical antenna array structure

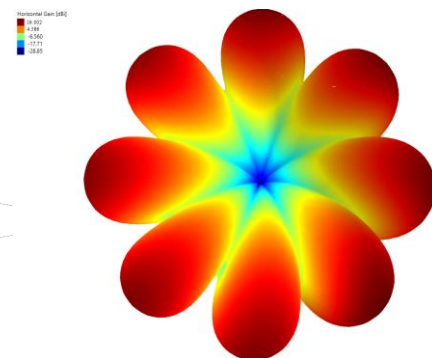


Fig. 2 Antenna array radiation pattern

Antenna array has a gain of about 16 dBi, which can be seen in its radiation pattern in Fig. 2.

Conclusion

As a result of antenna array modeling, it can be concluded that the use of such an antenna array in meteorological radar complexes will improve the following characteristics of aerological radar:

- 1) electronic scanning within 360 degrees in azimuth;
- 2) electronic control of the position of the directional pattern beam in azimuth and elevation;
- 3) adaptive phased antenna array beam control in the vertical plane is carried out by forming the required phase distribution of the field in the antenna aperture;

4) the deviation of the beam from the normal in the vertical plane can be from minus 50° to 85° (from minus 5° to 120° relative to the horizon).

Thus, the use of a phased cylindrical antenna array based on quadrifilar emitters for meteorological complexes will make it possible to build effective radar systems with good weight, size and electrical characteristics.

References

1. Voskresensky D.I. *Ustroistva SVCh i anteny. Proektirovanie fazirovannih antennih reshetok.* [Microwave devices and antennas. Design of phased antenna arrays.] M.: Radiotekhnika, 2012, p. 744 (Rus)

2. Belousov O.A., Kurnosov R.Yu., Gorshkov P.A., Ryazanova A.G. *Sintez tsilindricheskoy fazirovannoy antennoy reshetki na osnove logoperiodicheskikh vibratornih antenn dlya system shirokopolosnogo dpstupa standarta IEE802.11, IEE802.16.* [Synthesis of a cylindrical phased antenna array based on log-periodic dipole antennas for broadband access systems of the IEE802.11, IEE802.16 standards.]. TSTU Transactions, 2015, No. 21, pp. 266-272. (Rus)

3. Nemtinov V., Zazulya A., Kapustin V., Nemtinova Y. *ANALYSIS OF DECISION-MAKING OPTIONS IN COMPLEX TECHNICAL SYSTEM DESIGN.* Journal of Physics: Conference Series. 2019. T. 1278. № 1. p. 012018.

СИНТЕЗ ФАЗИРОВАННОЙ АНТЕННОЙ РЕШЕТКИ ДЛЯ СИСТЕМ МЕТЕОРОЛОГИЧЕСКОГО РАДИОМОНИТОРИНГА

М. А. Кудряшов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: maximkudryashov969@gmail.com

Аннотация. Рассмотрены основные аспекты выбора излучателей и геометрической формы для антенной решетки. Обоснован выбор метода построения феноменологической модели. Приведены основные характеристики смоделированной антенной системы. Обосновано применение полученной антенной решетки в комплексах метеорологического радиозондирования.

Ключевые слова: антенна, антенная решетка, системы радиомониторинга.

The Mathematical Model of a Transmitter with a Nonlinear Power Amplifier and Demodulation in a Feedback Loop

K. D. Raev*, E. A. Antonov

Tambov State Technical University, Tambov, Russia

*e-mail: faleot1998@mai.com

Abstract

The purpose of this study is to develop a mathematical model of a transmitter with a nonlinear power amplifier and demodulation in the feedback and analyze its loop. In the course of the study, the program block of the transmitter amplifier and graphs of the results are presented. The model has been developed in the Mathcad software environment.

Keywords: Amplifier, demodulation, transmitter.

Introduction

Many types of signals used in radio communications require linear power amplification in the transmitter due to the presence of amplitude modulation, such as signals with quadrature amplitude-phase modulation or signals at the output of an OFDM modulator.

There are methods for constructing nonlinear power amplifiers that provide linear signal amplification, namely power amplification with demodulation in the feedback loop in the transmitter.

Input unit

A voice message was recorded for the input unit. Since the tone channel has a bandwidth from 300 Hz to 3400 kHz, the bandwidth is assumed to be approximately 3 kHz. Fig. 1 shows a fragment of a voice message and the corresponding modulated signal.

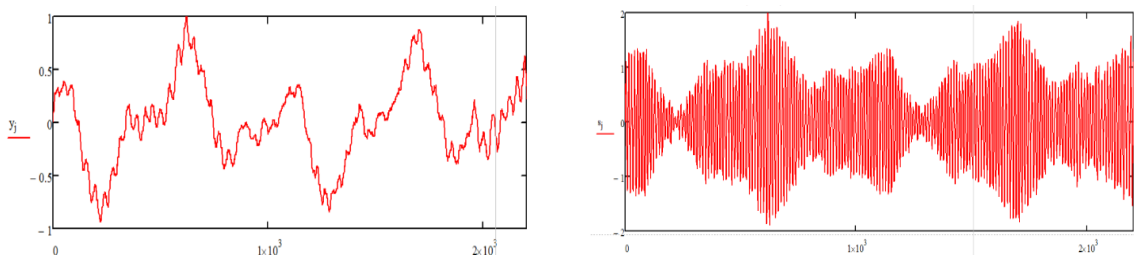


Fig. 1. A fragment of a voice message before and after amplitude modulation

Amplification unit

Subsequently, the signal passes through the power amplifier unit, for which the threshold values (PR1 and PR2) and the gain coefficients K1, K2 and K3 are set. Fig. 2 shows the program block of the amplifier and a conditional curve indicating the signal gain distribution.

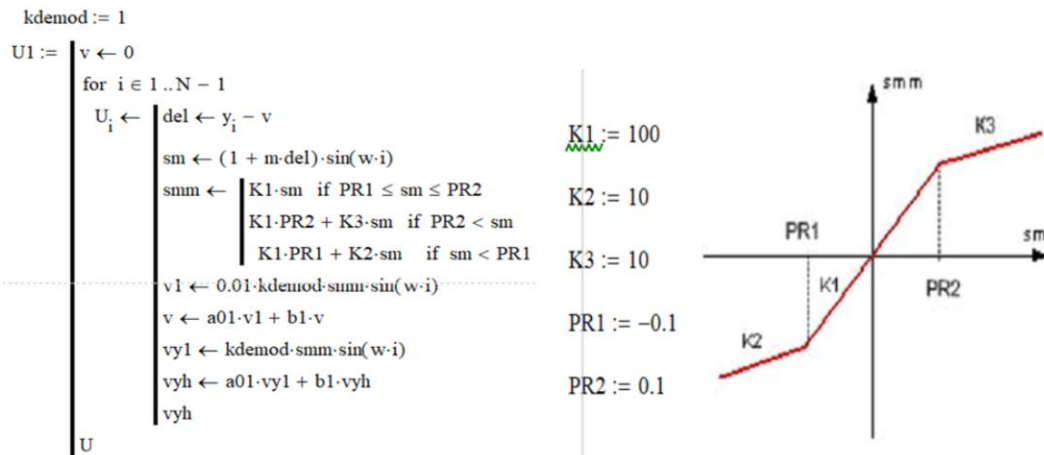


Fig. 2. Program unit and amplitude characteristic of signal amplification

The program unit is a “for” loop, in which the gain is set for each value of the signal amplitude.

The conditions that determine the gain are set using the “if” statement. For example, for the part of the signal that is between the threshold values, the gain K1 is applied, for the part of the signal greater than the upper threshold value, the coefficient K3, and for the part of the signal that is less than the lower threshold value, the coefficient K2. In this case, the threshold values themselves are also enhanced with the coefficient K1.

The gain unit allows you to output and display on graphs signals at all points of the circuit, as well as display signal distortions during amplification.

The amplitude characteristic of this graph is presented in the form of a broken line, the slopes of which are set by the coefficients, which makes it possible to reduce the peak factor due to the fact that the part of the signal that exceeds the threshold values is amplified with a much lower coefficient.

Research results graphs

Based on this unit, a graph is built showing the modulated signal relative to the threshold values of the power amplifier. This graph is shown in Fig. 3.

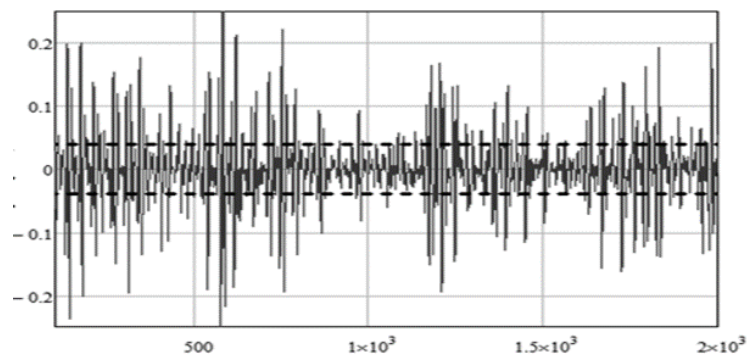


Fig. 3. Graph of the modulated signal at the input of the power amplifier with the given threshold values

The result of the non-linear power amplifier is shown in a graph comparing the input and output signals, which is shown in Fig. 4.

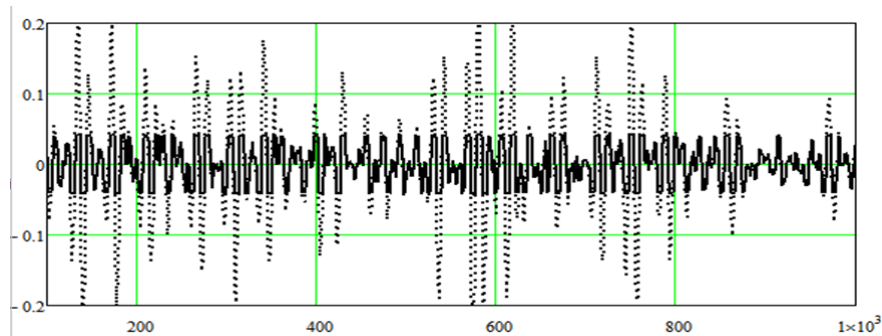


Fig. 4. Signal at the input and output of a non-linear power amplifier

As can be seen in the graph, due to different gains, it was possible to reduce the value of the signal peak factor.

The result of the operation of the entire transmitter circuit displays a graph of the baseband signal at the input and output of the receiving side, which is shown in Fig. 5.

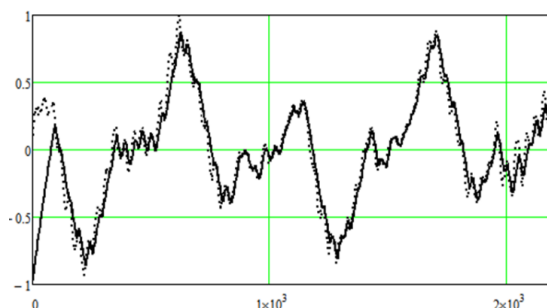


Fig. 5. Modulated signal at the input and output of the receiving side

Conclusion

As a result of the study, we can conclude that this transmitter has a high efficiency due to the linear amplification of the signal in the nonlinear amplifier.

References

- 1 Galkin V.A. Cifrovaya mobilnaya radiosvyaz' [Digital mobile radio]. M.: Telekom Publ., 2007, 432 p. (Rus)
- 2 Pudovkin A.P. Danilov S.N, Panasyuk Yu.N. Perspektivnye metody obrabotki informacii v radiotekhnicheskikh sistemah [Promising methods of information processing in radio engineering systems]. St. Petersburg: Ekspertnye resheniya, 2014, 256 p. (Rus)

МАТЕМАТИЧЕСКАЯ МОДЕЛЬ ПЕРЕДАТЧИКА С НЕЛИНЕЙНЫМ УСИЛИТЕЛЕМ И ОБРАТНОЙ СВЯЗЬЮ

К. Д. Раев*, Е. А. Антонов

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: faleot1998@gmail.com

Аннотация. Целью данного исследования является разработка математической модели передатчика с нелинейным усилителем и обратной связью, а также его анализ. В ходе исследования будут представлены блок программирования усилителя передатчика и графики полученных результатов. Разрабатывалась модель в программной среде Mathcad.

Ключевые слова: усилитель мощности, демодуляция, модуляция.

The Image Quality Control Method for Optical Tomographs

T.M. Tymchuk*, N.V. Ventzerova, A.Y. Potlov

Tambov State Technical University, Tambov, Russia

*e-mail: tymtan98@yandex.ru

Abstract

A method of optical tomography is considered. The method for quality control of images of optical tomographs is proposed. The method of controlling the image quality of optical tomographs based on different pressure of the probe on the object has been considered.

Key words: image quality control, optical tomography, test object.

Introduction

Optical tomography is one of the methods of optical biomedical diagnostics. This type of diagnostics uses light in the visible and near infrared wavelength range. Light in this range tends to penetrate well into biological tissues, providing information about structural and dynamic changes in tissues. For a high-quality study, diagnosis and development of new methods of medical imaging, it is necessary to control the quality of images of devices.

In this paper, an image quality control method is considered based on the interpretation of the image at different pressure of the probe on the image.

Method development

The image quality obtained with an optical tomograph depends on the spatial resolution, contrast and the presence of artifacts. Spatial resolution is the number of pixels in an image in spatial units. This value characterizes the size of the object in the image. Spatial resolution is divided into depth resolution and lateral resolution. The longitudinal resolution of the optical tomograph system is 1 - 15 μm . A one-dimensional A-scan (longitudinal image) is constructed based on sequentially received signal values. With the help of the probe device, the optical beam moves laterally over the tissue surface, obtaining a depth profile at each lateral position, that is, a two-dimensional B-scan. The lateral (lateral) resolution is determined by the spatial magnitude (size) of the optical beam. Lateral resolution is 1 to 20 μm . On the optical tomograph image, the contrast between different tissue structures arises due to the different scattering properties of its elements [1]. The formation of contrasting optical tomograph images of healthy integumentary tissues, such as skin or mucous membranes, using the OCT method is associated with the morphological structure of tissues. Artifacts in visualization methods are the appearance of formations in the image that do not correspond to any structure. The appearance of artifacts in optical tomograph images may be due to the following errors in the study: incorrect adjustment of the position of the upper border of the image on the monitor screen; violation of contact of the end window

of the probe and biological tissue due to a defect in pressing; displacement of the surface of the probe and the investigated object relative to each other; contamination of the end window of the probe.

The proposed method includes the use of a test object for the subsequent assessment of the image quality of optical tomographs with different microprobe pressure on the tissue under study (Fig. 1).

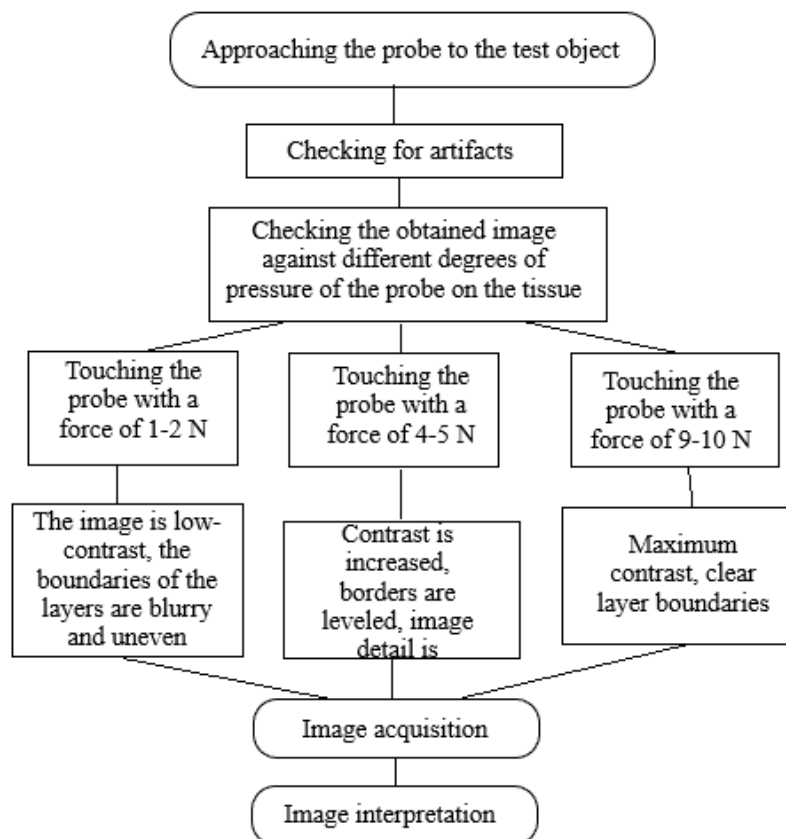


Fig. 1. A method for assessing the image quality of optical tomographs

At the first stage, a probe is brought to the object of study and the resulting image is viewed for the presence of artifacts: the wrong position of the upper border of the image on the screen (should be equal to 1/6-1/7 of the total height of the frame), contact with the investigated area does not allow full viewing of the tissues, that is, the contact is not accurate, there is an element of displacement of the probe relative to the surface of the object, there is contamination of the probe[2].

The second stage is to obtain an image at different pressure forces of the probe on the surface of the object under study (Fig. 2). With minimal contact with the probe, that is, with a force of 1-2 N, the image should be low-contrast, the boundaries of the layers will be blurry and uneven.

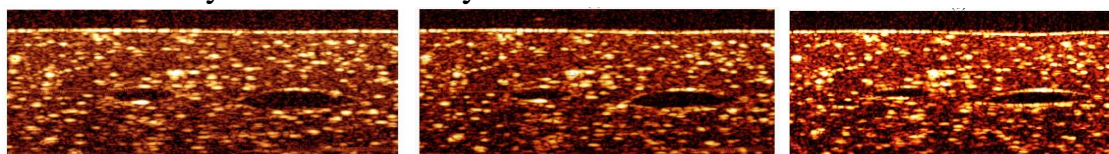


Fig. 2. Images with varying pressure on tissue

With a moderate touch of the probe at a force of 4-5 N, the contrast will be higher, the boundaries of the layers will be clearer and the image detail will also increase. With a significant touch of the probe at a force of the order of 9-10 N, there will be maximum contrast and clear boundaries of the layers.

The last step is the interpretation of the image, which will show whether the resulting image meets the specified standards, and also gives information about its technical condition.

If the layers of the test object are visible: horizontally oriented zones with a homogeneous signal, having clear, contrasting boundaries with neighboring zones, in which the signal intensity is different. Layers can be characterized by such parameters as signal level in the layer, layer thickness. Based on the identification of the image, conclusions can be drawn about the structuredness (lack of structure) of the image, the preservation (violation) of the order of the elements, the contrast of layers and clear boundaries. In this case, we can talk about the correct operation of the optical tomograph. In other outcomes, it is necessary to repeat the experiment and, if the study yielded the same results, it can be concluded about the technical condition of the apparatus and the quality of the resulting image.

Conclusion

In this article, a method for assessing the quality of images of optical tomographs was developed, based on different pressure of the probe on the test object, which is characterized by ease of use and interpretation for doctors and medical staff.

References

1. Potlov A.Y., Frolov S.V., Proskurin S.G. Visualization of anatomical structures of biological tissues by optical coherence tomography with digital processing of morphological data. Biomedical engineering, 2020, pp. 9-13.
2. Frolov S.V., Potlov A.YU., Frolova T.A. Informacionnyj analiz endoskopicheskikh zondov dlya opticheskoy kogerentnoj tomografii [Information analysis of endoscopic probes for optical coherent tomography]. Cifrovaya transformaciya v energetike, 2020, pp. 394-397. (Rus)

МЕТОД ОЦЕНКИ КАЧЕСТВА ИЗОБРАЖЕНИЯ ОПТИЧЕСКИХ ТОМОГРАФОВ

Т. М. Тымчук*, Н. В. Венцера, А. Ю. Потлов

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: tymtan98@yandex.ru

Аннотация. Рассмотрен метод оптической томографии. Предложен метод контроля качества изображений оптических томографов. Методика контроля качества изображения оптических томографов, основанная на различной степени давления зонда на объект.

Ключевые слова: контроль качества изображения, оптическая томография, тест-объект.

The Development of an Algorithm for Mathematical Modeling of Photons by the Monte-Carlo Method

N.V. Ventzerova*, T.M. Tymchyk, A.Yu. Potlov

Tambov State Technical University, Tambov, Russia

*e-mail: natalia.ventzerova@gmail.com

Abstract

This paper presents and describes the Monte Carlo algorithm for modeling optical properties inside biological tissue. Pros and cons of radiation transfer theory are given. The result of the algorithm operation created on the basis of Monte Carlo simulation is shown.

Keywords: Monte Carlo method, mathematical model, optical parameters of biological tissue.

Introduction

In connection with the intensive development of optical technologies, new optical methods of optical tomography are being created. These methods allow developing tissues at the level of cell layers and in real time. One of these methods is optical coherence tomography (OCT). This method is based on imaging the internal structure of scattering objects, based on low-coherence interferometry using broadband radiation sources, visible or near infrared wavelength range. However, further development of such systems requires phantom for monitoring the technical condition of optical tomographs with advanced capabilities.

Thus, the development and study of a method for creating realistic phantom for optical tomography is a significant and urgent scientific problem. The solution to this problem will be the step-by-step creation of a tissue-imitating phantom [1]. At one of the stages of which a mathematical model of biological tissue is implemented to simulate the migration of photons in tissue.

Knowledge of the optical properties of biological tissues is an important aspect in the development of adequately mathematical models of light propagation in biological tissues. Models based on the theory of radiation transfer (TPI) are widely used in modern biomedical optics, as well as simpler methods for solving the transport equation, such as the two-stream Kubelka-Munk theory, three-, four-, and seven-stream models, or the Monte Carlo method [2].

Description of the mathematical modeling algorithm

At the moment, the best way to simulate the interaction of optical radiation and biological tissues is the Monte Carlo method. This method is characterized by high accuracy, which makes it possible to use it in modeling physical processes.

By definition, the Monte Carlo method is a numerical method for solving mathematical problems and statistical modeling of processes by obtaining and transforming random numbers. The Monte Carlo method is based on computer simulation of a “random walk N of the number of photons” [3].

The development of a mathematical model contains of several stages:

The first phase is to define the goals of the modeling. In this work, the goal of mathematical modeling is: to study the process of optical radiation passing through the layers of a phantom that imitates human biological tissues (Fig. 1).

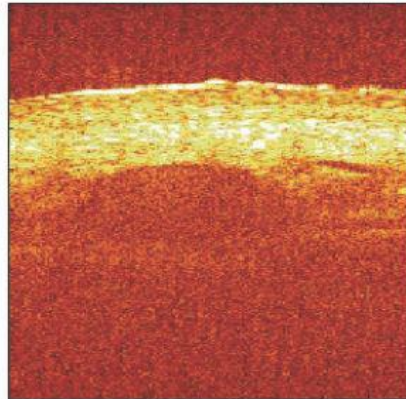


Fig. 1. OCT scan of the upper layers of a child's skin

The second phase is when the input parameters of the model are determined, as well as the ranking of the input data according to the degree of importance. In the optics of biological tissues, important parameters are: absorption coefficient, scattering coefficient, refractive index, anisotropy parameter, radiation wavelength, tissue thickness and photon weight.

The third phase is the formulation of the model, which has a specific mathematical representation.

The fourth phase is the choice of a method for studying a mathematical model, in other words, the choice of a numerical method when programming the model. In this work, the Monte Carlo method was chosen as such a numerical method. This method is flexible and capable of delivering accurate results in a reasonable amount of time [2].

The fifth phase is the construction of the algorithm, compilation and debugging of the program.

The program works as follows: first, the initial parameters of the environment are set (indicated in the second stage of building a mathematical model). Next, the step size of the photon for the first case and its movement are calculated. If a photon is absorbed, then it is placed in a data array (there is the same array for scattered photons), which records the number of absorbed photons and starts the next one. If the photon is scattered, then its new direction of motion and coordinates are calculated, and the possibility of internal reflection is also checked. The calculation continues until the photon is absorbed, or leaves the detector or hits it. Then the program ends it is work.

The sixth stage is testing the program. Programs are tested using a test phantom, the answer to which is known in advance (Fig.2).

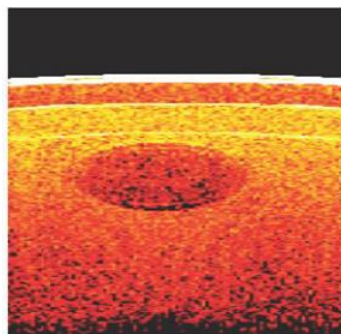


Fig. 2. The result of modeling an OCT image of the structure of the upper layers of the child's skin

Conclusion

In this paper, a mathematical model of radiation transfer in biological tissue has been developed for the subsequent creation of a skin phantom for the needs of optical tomography.

References

1. Frolov S.V., Potlov A.Yu., Petrov D.A., Proskurin S.G. Modelirovanie strukturnogo izobrazheniya biologicheskogo obekta, polychennogo s pomochy opricheskoy kogerntnoy tomographii metodom Monte-Carlo na osnove vokselnoy geometrii sredi [Modeling of a structural image of a biological object obtained using optical coherence tomography by the Monte Carlo method based on the voxel geometry of the medium]. *Quantovaya Electronica*, 2017, No. 4, pp. 347-354. (Rus)
2. Potlov A.Yu., Frolov S.V., Proskurin S.G. Chislennoe modelirovanie migratsii fotonov v odnorodnykh i neodnorodnykh tsilindricheskikh phantomah [Numerical modeling of photon migration in homogeneous and inhomogeneous cylindrical phantoms]. *Optics i Spectroscopy*, 2020, 128(6), pp. 832-839. (Rus)
3. Zaitsev S.M., Bashkatov A.N., Tuchin V.V., Genin E.A. Opticheskoe prosvetlenie kak sposob yvelicheniya glybini detektirovaniya nanochastiz v koze pri OCT-vizyalizatsii [Optical Clearing as a Way to Increase the Detection Depth of Nanoparticles in the Skin in OCT Imaging]. *Izv. Sarat. un-that. Nov. ser. Physica*, 2018, 18(40), pp. 275-284. (Rus)

РАЗРАБОТКА АЛГОРИТМА МАТЕМАТИЧЕСКОГО МОДЕЛИРОВАНИЯ МИГРАЦИИ ФОТОНОВ МЕТОДОМ МОНТЕ-КАРЛО

Н. В. Венцера*, Т. М. Тымчук, А. Ю. Потлов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: natalia.ventzerova@gmail.com

Аннотация. В работе представлен и описан алгоритм метода Монте-Карло для моделирования оптических свойств внутри биологической ткани. Плюсы и минусы теории переноса излучения. И приведен результат работы алгоритма, созданный на основе Монте-Карло моделирования.

Ключевые слова: Метод Монте-Карло, математическая модель, оптические параметры биоткани.

OCCUPATIONAL SAFETY, ENVIRONMENTAL ENGINEERING & TRANSPORT TECHNOLOGY

УДК 62-783

ББК 30H

Ensuring Labor Protection in the Educational Process

Y. A. Apporotova, D. A. Starykh

Tambov State Technical University, Tambov, Russia

e-mail: apporotova.y@mail.ru, dstar30@mail.ru

Abstract

The article deals with the issues of labor protection in conditions of high-risk activity. Recommendations are given for the systematization of labor protection based on the experience of employees of the Department of Technological Institute “Chemistry and Chemical Technologies” at Tambov State Technical University. The study reveals the influence of safety measures on the quality of the educational process and the corporate culture of the university.

Keywords: chemical laboratories and equipment, labor protection, safety requirements, safety briefing.

Occupational safety issues are currently important in any branch of human activity and are deeply rooted in history, when people tried to protect themselves, preserve their health and the health of their loved ones. In the Soviet period, when labor became a fundamental element in the development and formation of an individual, the problems of its protection took on a state scale.

In Russia, at the present stage, the state is faced with the task of improving the welfare of citizens in the context of economic growth and increasing the country's competitiveness and defense capability. In Russia, first of all, these include the Federal Law “On the Fundamentals of Labor Protection in the Russian Federation” and the Labor Code of the Russian Federation [1]. Despite the fact that labor protection is not a new phenomenon, there is a need to improve not only its legal mechanism, but also scientific and technical, taking into account the development prospects. This task cannot be solved without the participation of educational organizations that are responsible for the training of labor protection specialists, their qualifications and professional level. Training of high-level specialists makes it possible to introduce modern legal, scientific and technical developments in the field of labor protection, which increases the level of safety, literacy, both among employees of organizations and among the population of the country as a whole. The educational activity of the department of the Technological Institute “Chemistry and Chemical Technologies” of TSTU is an activity of increased danger, as a result of which not only laboratory equipment, but also various kinds of chemicals can become a potential threat. The Institute pays great attention not only to the educational process, but also to labor protection, teaching, administrative and managerial, auxiliary personnel, students and graduate students. Through visual aids, briefings among staff, students and graduate students, restrictions on access to chemical reagents, the safety of labor protection is increased, both during laboratory work and during daily educational work [3].

To ensure the safety of all participants in the educational process, there are a number of clear requirements and rules for labor protection, which cover all aspects of behavior at the institute, directly the educational process, handling laboratory equipment, chemicals and reagents. These rules include statutory regulations, fire, and social and hygiene requirements. They apply not only to laboratories, lecture halls and classrooms for practical classes, but also to the classrooms of teachers, all such premises, as well as the territory surrounding the institute. The director is responsible for the observance of labor protection rules at the institute, who, when planning the organization of work, indicates to the executors the mandatory requirements for compliance with labor protection, checks the frequency of instructing employees, and also monitors the implementation of safety requirements and the activities of responsible employees in the field. Labor protection in an educational institution aims primarily to create healthy and safe working conditions for students. However, the teaching staff of the institute must not only prepare for the strict fulfillment of the requirements of the work and rest regime of students, but also their own [4].

Labor protection is combined with various branches of science, not only chemistry, physics, but also psychology, otherwise it is impossible to assess the consequences of careless handling of reagents and laboratory equipment. The development of the chemical industry requires new research in this area with the use of innovative technologies. At the same time, it is possible to avoid the undesirable consequences of the research only with strict adherence to safety rules.

Occupational safety requires special attention at the Institute when working with first-year students. At school, laboratory work is performed under the supervision of a teacher. The list of hazardous substances is narrower than at the university, and the duration of practical lessons is shorter. A freshman handles reagents and technical equipment according to usual standards, so accidents can be more severe: explosions are more powerful, and poisonings are deeper.

It is undeniable that violation of discipline by students can also lead to undesirable consequences, even if the violation of labor protection rules was unintentional. Instructions (introductory, primary, repeated, unscheduled, target) play a huge role in the organization of labor protection at the institute. Each instruction does not just contain a number of necessary requirements, which also plays the role of a psychological component of the organization of labor protection.

Not only the student, but also the teacher can establish themselves in the safety of the experiment technique. Such complacency is harmful for a teacher, who is obliged to be a role model and comply with all labor protection standards, not forgetting about his duty. An integral part of the educational program of higher professional education is the industrial practice of students, the basis for which is the industrial enterprises of the city. Before the practice, students are required to instruct on safety measures with the preparation of the relevant documents. At the workplace, it is necessary to have a briefing journal filled by student trainees and the head of the practice responsible for compliance with labor protection standards. In addition to familiarization with the safety requirements, students are introduced to the equipment operation and the main technological processes.

From the moment students enroll as trainees at workplaces, they are subject to labor protection rules and internal labor regulations and other local regulations in force in the organization. If a hazard is detected or the trainee uses incorrect work techniques, the manager is obliged to take appropriate measures, and, if necessary, stop work [5].

Thus, labor protection is an important process affecting the quality of educational activities. Therefore, it is necessary to consider the organization of safety of employees and students of the Institute from the point of view of a systematic approach. A systematic approach to the organization of labor protection provides for the consideration of this activity as a system consisting of many components that are in constant interconnection and interaction. There is no point in having a fire extinguisher if an institute employee does not know how and when to use it. Only the presence of feedback between management and performers, systematic monitoring of compliance with safety regulations can lead to an increase in the quality of labor protection. The systematic work of the institute on occupational safety and health ensures not only the desire of employees for professional achievements and self-realization, but also satisfaction with their activities. A well-established organization of labor protection is the basis for the effective development of the corporate culture of the university as a whole.

References

1. Grigor'ev D.V. Voprosy ohrany truda v period provedeniya arheologicheskoy praktiki [Occupational safety issues during archaeological practice]. Aktual'nye problemy ohrany truda i social'no trudovyh otnoshenij: mater. Regional'noj nauch.-prakt. konf. (April 22-24, 2015). Krasnoyarsk: KGPU im. V.P. Astaf'eva, 2015, pp.7. (Rus)
2. Karepova N.G. O bezopasnyh usloviyah truda pri prohozhdenii uchebnoj praktiki studentami special'nosti 050100.62 Pedagogicheskoe obrazovanie, profil' «tekhnologiya» [On safe working conditions during the passing of educational practice by students of specialty 050100.62 Pedagogical education, profile "technology"]. Aktual'nye problemy ohrany truda i social'no trudovyh otnoshenij: mater. Regional'noj nauch.-prakt. konf. (April 22-24, 2015). Krasnoyarsk: KGPU im. V.P. Astaf'eva, 2015, pp. 22. (Rus)
3. Petrova M.S., Petrov S.V., Vol'hin S.I. Ohrana truda na proizvodstve i v uchebnom processe [Labor protection at work and in the educational process]. M.: ENAS, 2006. 232 p. (Rus)
4. Chelovechkova I.Yu. Ohrana truda v Rossii. Istoriya voprosa [Labor protection in Russia. History of the issue]. Aktual'nye problemy ohrany truda i social'no trudovyh otnoshenij: mater. Regional'noj nauch.-prakt. konf. (April 22-24, 2015). Krasnoyarsk: KGPU im. V.P. Astaf'eva, 2015, pp. 66. (Rus)

ОБЕСПЕЧЕНИЕ ОХРАНЫ ТРУДА В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ

Ю. А. Аппорова, Д. А. Старых

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: apporotova.y@mail.ru, dstar30@mail.ru

Аннотация. Рассмотрены вопросы охраны труда в условиях деятельности повышенной опасности. Приводятся рекомендации по систематизации охраны труда на основе опыта работы сотрудников кафедры Технологического института «Химия и химические технологии» ТГТУ. В работе раскрывается влияние техники безопасности на качество образовательного процесса и корпоративную культуру университета.

Ключевые слова: инструктаж по технике безопасности, охрана труда, требования безопасности, химические лаборатории и оборудование.

Organization of Traffic in Cities to Improve the Environmental Situation

D. A. Blinkova

Tambov State Technical University, Tambov, Russia
e-mail: dashatomson01@mail.ru

Abstract

The article deals with environmental problems associated with the low capacity of intersections and crossings in cities. Emissions of harmful substances from cars operating in normal mode and at a reduced speed are analyzed. The main ways to improve the ecological state by increasing the capacity were suggested.

Keywords: ecology, harmful emissions, traffic capacity, traffic intensity.

Currently, there is a rapid growth of road transport, which contributes to the development of environmental and transport problems in large cities. Increased traffic of vehicles and an insufficient level of road network capacity lead to congestion, which, in turn, affects the environmental situation of the city.

Traffic jams are a serious problem in major cities. Toxic substances released into the atmosphere are directly related to fuel consumption. And fuel consumption depends on the speed of the vehicle. At low speed, the vehicle's fuel consumption increases by 3-4 times, which leads to a sharp increase in the emission of harmful substances into the air [2, p. 34].

Every year, a single passenger car absorbs an average of more than 4 tons of oxygen from the atmosphere and emits about 800 kg of carbon monoxide, about 40 kg of nitrogen oxides and almost 200 kg of various hydrocarbons - unburned or not completely burned fuel components.

The amount of harmful emissions emitted into the atmosphere by one car during the day is shown in Table 1.

Table 1. The amount of harmful substances from one car

Chemicals	Truck	Passenger car	Buses
CO	502.2	225.0	227.9
NO ₂	70.4	43.8	17.7
C (soot)	19.3	-	3.0
SO ₂	4.5	-	0.7
Pb	0.2	0.27	0.003

When the engine runs at low speed or when accelerates at the start (traffic jams or the red traffic light), the share of hydrocarbons increases. When you press the gas pedal, unburned particles are distributed: about 10 times as much as when the engine is running normally.

The exhaust gases of an engine that runs on normal gasoline and under normal operation contain an average of 2.7% carbon monoxide. When the vehicle speed decreases, this share increases to 3.9%, and at low speed, it increases to 6.9%.

At a certain level of traffic intensity and car exhaust on the territory of the city there are accumulations of two types of pollution. The first one consists of aerosols of transport origin, which are delayed in the atmosphere for a long time; these aerosols are able to absorb chemicals that contribute to the growth of malignant tumors. The second one consists of lead compounds that occur during the combustion of leaded gasoline. These compounds can accumulate in the body, getting into it not only through the respiratory tract, but also through the skin. Lead compounds also destroy the Central nervous system and blood-forming organs [3, p. 42].

In order to reduce environmental damage from transport, it is necessary to increase the capacity at intersections and stretches. This is possible with the following actions:

- traffic light regulation based on the “green wave” principle: “green wave” makes it possible for vehicles to pass without stopping at intersections that are consistently located on the highway, reduces fuel consumption, traffic noise and gas pollution;

- introduction of one-way traffic: one-way traffic increases the capacity of the motorway;

- organization of roundabouts at intersections: ring intersections prevent the intersection of traffic flows, eliminate the need for traffic light regulation [1, p. 10];

- reconstruction of intersections on the same level: the construction of sewer intersections will increase road safety and road capacity. Setting intersections at different levels will reduce the number of conflict points, which will also improve the environmental situation [5].

- selection of reverse lanes: reverse traffic will allow you to adjust traffic depending on different times of day;

- construction of duplicate roads: the construction of driveways along the main roadway for organizing entrances and exits to adjacent courtyards will reduce congestion;

- construction of underground and aboveground pedestrian crossings;

- division of traffic flows by vehicle type: the formation of uniform traffic flows helps to equalize the speed of movement;

- setting the width of the roadway that allows you to divide the flow of cars by composition. The optimal width of the road ensures that traffic is loaded at a sufficiently high speed;

- improvement of the evenness of the road surface and its coupling qualities;
- introduction of automated traffic management systems: they allow you to organize traffic depending on information about the state of traffic flows, which helps to increase the capacity of the road network [4, p. 54].

In such circumstances, environmental problems arise due to the growth of motorization. The negative consequences of air pollution from car emissions are reflected in the deterioration of human health, as well as natural vegetation, increased corrosion of metal structures, and destruction of buildings and structures. Environmental problems that arise as a result of car operation must be addressed comprehensively, not only in the manufacture of vehicles, but also in the design of the city's road network. With the help of the proposed measures, it is possible to improve the ecological state of the environment.

References

1. Gavrikov V.A., Anokhin S.A. Organizaciya dorozhnogo dvizheniya: rekomendacii [Organization of road traffic: guidelines]. Tambov: TSTU, 2017, 36 p. (Rus)
2. Denisov V.N., Rogalev V.A. Problemy ekologizacii avtomobil'nogo transporta [Problems of ecologization of automobile transport]. S-P.: ECO, 2004, 194 p. (Rus)
3. Kirillov N.G. Problemy ekologii avtomobil'nogo transporta v Rossii [Problems of ecology of automobile transport in Russia]. Moscow, 2007. (Rus)
4. Gavrikov V.A., Anokhin S.A., Guskov A.A., Zalukaeva N.Yu. Organizaciya dorozhnogo dvizheniya [Organization of road traffic]. Tambov: TSTU, 2020. (Rus)
5. Andrianov K.A., Matveeva I.V., Voyakina E.Yu. Issledovanie transportnoj situacii v g. Tambove i ocenka eyo vozdejstviya na okruzhayushchuyu sredu [The study of transportation situation in tambov and assessment of its environmental impact]. Nauka i obrazovanie dlya ustojchivogo razvitiya ekonomiki, prirody i obshchestva: sbornik dokladov Mezhdunarodnoj nauchno-prakticheskoj konferencii. 150-letiyu so dnya rozhdeniya V.I. Vernadskogo, 2013, pp. 3-7.

ОРГАНИЗАЦИЯ ДОРОЖНОГО ДВИЖЕНИЯ В ГОРОДАХ С ЦЕЛЮ УЛУЧШЕНИЯ ЭКОЛОГИЧЕСКОЙ ОБСТАНОВКИ

Д. А. Блинкова

Тамбовский технический государственный университет, Тамбов, Россия
e-mail: dashatomson01@mail.ru

Аннотация. Рассмотрены экологические проблемы, связанные с низкой пропускной способностью перекрёстков и перегонов в городах. Проанализированы выбросы вредных веществ автомобиля, работающего в нормальном режиме и на пониженной скорости. Были предложены основные пути улучшения экологического состояния с помощью повышения пропускной способности.

Ключевые слова: вредные выбросы, интенсивность движения, пропускная способность, экология.

The Problem of Collection and Disposal of Automobile Tires

N. A. Ignatova, A. A. Kazakova*

Tambov State Technical University, Tambov, Russia

*e-mail: alinika1998@mail.ru

Abstract

In the Russian Federation, the number of unauthorized landfills and landfill areas where worn-out car tires are stored increases every year. This causes significant harm to the environment, as rubber products are classified as waste of hazard class 4. In this paper, we propose a system for collecting tires in specialized collection points, as well as information support with the help of local governments.

Keywords: automobile tires, ecology, vehicles, waste management.

Scientists have been sounding the alarm about an imminent environmental disaster for several decades. The studies carried out in various fields lead to the conclusion that we are already facing global climate and environmental changes under the influence of human activities. The pollution of the oceans due to the leakage of oil and oil products, as well as garbage has reached enormous proportions, which affects the decline in populations of many animal species and the ecosystem as a whole. The growing number of cars every year leads to a large emission of carbon dioxide into the atmosphere, which, in turn, leads to land drainage, heavy rainfall on the continents, and a decrease in the amount of oxygen in the air. Many people have already realized the danger and are very sensitive to negative changes in nature and major environmental problems, but we still perceive the possibility of a disaster as something unrealizable and distant.

It is necessary to take measures to preserve and clean the soil, air and water as soon as possible. Many scientists see the solution to the world's environmental problems at the legislative level. First of all, it is the correct exploitation of natural resources. If we learn to use correctly what is given by nature, we will be able to preserve and increase its wealth for more than one generation.

Every year, the number of vehicles in use in Russia is growing, which leads to a steady increase in the volume of worn-out tires. The service life of tires is 5 years from the date of manufacture, according to GOST 4754-97 and GOST 5513, but depending on the quality of the product, operating conditions, this period may increase or decrease [1].

Every year in Russia, more than 1 million tons of waste tires are produced, and no more than 10% of the total amount is recycled. The remaining volume is usually taken to landfills, where various harmful substances are released into the air and soil under the influence of natural factors. It is worth noting that rubber waste is classified as a hazard class 4, has a high fire hazard, and is practically not subject to destruction under the influence of climatic factors.

The problem of recycling is faced not only by motorists, but also by professional organizations that transport passengers and cargo [2]. Most often, car tires are stored in the garage, on the territory of motor transport companies and service stations. After that, the tires end up in landfills, including unauthorized ones.

In total, there are about 50 enterprises in Russia that accept used passenger and truck tires, most of which are located in the Moscow, Nizhny Novgorod, Chelyabinsk and Sverdlovsk regions. This increases the share of recycled tires in these regions to 20-25%.

Basically, a simple recycling mechanism is used. First, the tires that are cleaned of dirt are sent to cutting machines that allows you to turn whole tires into rubber crumbs with metal shavings, which are removed using a strong magnet. The result is a crumb of various diameters, depending on the purpose of its further use [3].

It is also possible to destroy tires by burning in special furnaces equipped with filters to minimize emissions of harmful substances into the atmosphere, resulting in heat energy [4].

For comparison, in Europe, it is forbidden to bury worn-out tires in landfills. For businesses and individuals, there is a network of collection points for tires for further processing. The amount of disposal costs is usually already included in the cost of each new car tire [5]. Compliance with environmental requirements is monitored by the state. These measures can increase the share of recycled tires to 80%.

Waste management on the territory of Russia and CIS countries is regulated by the model law of 31.10.2007 No. 29-15 "On production and consumption waste", which obliges individuals and legal entities to hand over used car tires for recycling to licensed enterprises engaged in centralized collection and disposal. At the moment, the law is not fully implemented, which in turn leads to the creation of unauthorized landfills in natural areas, burials, and burning of rubber in localities.

The authors propose to include in the cost of new car tires the cost of their processing and introduce a system for the delivery of used tires. This will help to clean up the residential areas from landfills, reducing the emissions of harmful substances into the atmosphere, and also reduce the number of fires caused by the burning of used tires. By submitting tires to special pick-up points, car owners will receive a refund of part of the money that was included in the price of a new tire. Note that the amount of the disposal fee should not exceed 10% of the original price. This will motivate individuals and businesses to transfer worn-out rubber products for recycling.

It is also proposed to introduce mandatory social advertising in all municipalities of the subjects of the Russian Federation, which talks about the responsibility for non-compliance with legislation in the field of waste (used car tires), as well as the addresses of organized tire collection points, the rules for recycling and the benefits of this useful habit. It includes informing citizens

through radio and television broadcasting, as well as through installed city screens in the center of cities.

Every year people will become more aware of the issue of ecology, so it is necessary to develop various programs that will help the world to become cleaner. Summing up, we can say: respect for nature is not just words, but a necessity.

References

1. Guskov A.A., N. Y. Zalukaeva, V.S. Goryushinsky Ekologicheskaya bezopasnost' na transporte [Environmental safety in transport] Tambov: TSTU, 2018. (Rus)
2. Anokhin S.A., Zalukaeva N.Y., Guskov A.A, Gavrikov V.A. Infrastruktura avtotransportnogo kompleksa [Infrastructure of the motor transport complex] Tambov: TSTU, 2018. (Rus)
3. Kuzina G.V., Koptyakova S.V. Problemy i perspektivy razvitiya proizvodstva po pererabotke iznoshennykh avtomobil'nykh shin [Actual problems of modern science, technology and education]. Ekonomika, 2010. (Rus)
4. Penshin N.V., Lavrikov I.N. Organizatsiya funktsionirovaniya rynka transportnykh uslug [Organization of the functioning of the transport services market] Tambov: TSTU, 2017. (Rus)
5. Andrianov K.A., Matveeva I.V., Voyakina E.Yu. Issledovanie transportnoj situacii v g. Tambove i ocenka eyo vozdejstviya na okruzhayushchuyu sredu [The study of transportation situation in tambov and assessment of its environmental impact]. Nauka i obrazovanie dlya ustojchivogo razvitiya ekonomiki, prirody i obshchestva: sbornik dokladov Mezhdunarodnoj nauchno-prakticheskoy konferencii. 150-letiyu so dnya rozhdeniya V.I. Vernadskogo, 2013, pp. 3-7.

ПРОБЛЕМА СБОРА И УТИЛИЗАЦИИ АВТОМОБИЛЬНЫХ ШИН

Н. А. Игнатова, А. А. Казакова*

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: alinika1998@mail.ru

Аннотация. В Российской Федерации с каждым годом возрастает количество несанкционированных свалок, территорий полигонов, на которых хранятся изношенные автомобильные шины. Это наносит существенный вред окружающей среде, так как резинотехнические изделия относятся к отходам 4 класса опасности. В данной работе предлагается система сбора покрышек в специализированные пункты приема, а также информационная поддержка с помощью органов местного самоуправления.

Ключевые слова: автомобильные шины, транспортные средства, утилизация отходов, экология.

Utilisation de titane et ses alliages dans l'aéronautique

V. O. Plotnikov

Institut de l'aviation de Moscou, Moscou, Russie
e-mail vadimpltnkv@yandex.ru

Résumé

Le présent article donne un aperçu de l'emploi du titane et de ses alliages dans le domaine de l'aéronautique depuis le XIX^{ème} siècle jusqu'à aujourd'hui. Est suivie une courte histoire de la découverte du titane et de ses propriétés mécaniques qui est considéré actuellement comme un matériau de base pour la construction des moteurs d'avion. Sont énumérés les découvreurs du titane. Sont accentuées les potentialités de l'utilisation industrielle du titane, surtout par les constructeurs de turboréacteurs et d'équipements aéronautiques. Est soulignée la réduction des coûts de production qui provoque l'intérêt des fabricants.

Mots-clés: alliage; équipement aéronautique; moteurs d'avion; titane; turboréacteur.

Le titane représente 0.6% de la croûte terrestre et se classe au 4^{ème} rang des métaux les plus abondants après le fer, l'aluminium et le magnésium. Donc, l'étude de ses propriétés, des ses alliages et de l'emploi industriel présente une actualité particulières pour les sciences techniques et pour l'expérience pratique.

C'est en 1791, que William Gregor, chimiste britannique, découvrit le titane. En examinant le sable de la rivière Helford dans la vallée de Menachan, il isola ce qu'il nomma sable noir.

Quatre ans plus tard, un chimiste berlinois, Martin Heinrich Klaproth, identifia le même métal et le nomma oxyde de titane. C'est la mythologie grecque qui lui fournit ce nom. Les titans étaient les enfants d'Ouranos et de Gaïa. Leur père les haïssaient car ils voulaient s'emparer de son trône. Il les a détenu en captivité dans la croûte terrestre, d'où le nom de titane.

En 1910, Matthew Albert Hunter isola du titane pur à 99% en chauffant du tétrachlorure de titane (TiCl₄) avec du sodium. La méthode trouvée par Hunter pour produire du titane ne fut suivie d'aucun développement industriel.

Wilhelm Justin Kroll, chimiste luxembourgeois, est reconnu comme le père de l'industrie du titane. En 1932 il produisit des quantités importantes de titane en combinant le TiCl₄ avec du calcium. Au début de la seconde guerre mondiale, il s'enfuit aux Etats-Unis où optimisa son extraction en réduisant le TiCl₄ et en changeant le calcium par du magnésium. Aujourd'hui, cette méthode est la plus employée. Elle est connue sous le nom du processus de Kroll.

Après la deuxième guerre mondiale, les alliages de titane ont été considérés comme des matériaux de base pour la construction des moteurs d'avion.

L'intérêt pour le titane s'est renouvelé après la seconde guerre mondiale. En Europe, la production à grande échelle n'a débuté qu'en 1951 au Royaume-Uni. En France, l'éponge de titane a été produite pendant plusieurs années et en 1963 la

production a cessé. Au Japon, la production d'éponge a commencé en 1952 avec deux sociétés qui ont eu une capacité importante de production à partir de 1954.

L'Union Soviétique a commencé à produire de l'éponge de titane en 1954. Sa production a considérablement augmenté et en 1979 elle est devenue le premier producteur mondial d'éponge de titane.

Aux Etats-Unis, le développement de l'alliage de titane progresse rapidement puisqu'en 1950 il est stimulé par la reconnaissance de l'ajout d'aluminium qui le renforce. D'autres éléments ont été additionnés au titane, comme l'étain.

Parallèlement au Royaume-Uni, un alliage a été développé pour les hautes températures des moteurs aéronautiques et en 1956 l'alliage Ti-4Al-4Mo-2Sn-0,5Si (plus tard IMI 550) fit son apparition. Ce fut la première fois qu'on utilisa du silicium comme élément d'addition et ceci pour améliorer la résistance au fluage. Le premier alliage de titane β , a été développé aux États-Unis dans le milieu des années 1950. Au début des années 1960, sa haute résistance mécanique et sa dureté ont été utilisées pour fabriquer la peau d'un avion espion légendaire, le SR-71. Dès lors l'utilisation du titane dans l'aéronautique ne fait qu'augmenter.

Les études sur l'usinabilité du titane ont commencé dès le début des années 1950 avec l'augmentation de l'utilisation de celui-ci, notamment dans l'industrie aéronautique. Le titane et ses alliages présentent une valeur ajoutée pour le concepteur étant donné leurs bonnes propriétés physiques: masse volumique faible, bon comportement à haute température, etc., notamment le Ti6Al4V qui est le plus utilisé dans le domaine aéronautique. A l'heure actuelle, les outils carbures revêtus et non revêtus présentent un bon compromis durée de vie / prix. La plupart des fabricants les préconisent pour l'usinage du titane et de ses alliages.

Dans un contexte de concurrence mondiale, les constructeurs de turboréacteurs et d'équipements aéronautiques doivent répondre sans cesse à des défis techniques, économiques et environnementaux pour satisfaire les demandes des clients qui veulent utiliser les meilleurs produits conformes aux réglementations et au coût de possession le plus bas. Le cas du turboréacteur illustre les progrès réalisés ces dernières années pour amener à maturité industrielle.

La réduction de masse passe en priorité par le développement de composites à matrice organique dont la densité est inférieure à 2 pour remplacer des composants en alliages d'aluminium ou de titane dans les parties les plus froides. L'utilisation de ces composites dans les turboréacteurs est néanmoins limitée aujourd'hui uniquement à des pièces de la soufflante en raison de la résistance limitée en température de la matrice polymère. Des recherches sont menées pour essayer de déterminer des compositions de résine plus réfractaire qui permettraient d'étendre l'emploi de ces composites à certaines pièces des compresseurs basse pression en remplacement des alliages de titane.

Pour les modules plus chauds du turboréacteur, les composés intermétalliques TiAl de densité 3,9 trouvent aussi leur place en raison de leurs propriétés de résistance spécifique élevée jusqu'à des températures approchant 800 C: les aubes des derniers étages dans les turbines basse pression peuvent être notablement

allégées par l'emploi d'aluminium de titane en substitution à des alliages de nickel coulé. Toutefois la mise en œuvre industrielle de ces matériaux est particulièrement délicate et nécessite de nombreuses mises au point pour assurer tant la robustesse des procédés de fabrication que la maîtrise des coûts de production des pièces.

Les alliages de titane constituent toujours une solution incontournable qui permet de ne pas augmenter la masse des compresseurs. Il ne se développe plus de nouvelle nuance dans ce domaine mais la maîtrise des microstructures des alliages utilisés est un souci constant du motoriste afin de pouvoir les utiliser au maximum de leurs capacités. Les aciers et superalliages à base nickel font quant à eux toujours l'objet de développement de nouvelles nuances plus performantes: certains aciers de nouvelle génération offrent ainsi une résistance exceptionnelle grâce à des mécanismes de double durcissement.

Disons en conclusion que des actions doivent être entreprises à tous les niveaux. Les équipements aéronautiques sont également concernés par la réduction de masse qui est une voie d'amélioration des performances. Il convient de remarquer que l'introduction de ces nouveaux matériaux a nécessité une maîtrise accrue des coûts de fabrication pour ne pas diminuer l'important avantage technique qui a conduit à leur choix.

Références

- 1 Ramirez Ch. Critères d'optimisation des alliages de Titane pour améliorer leur usinabilité. Paris, 2017. Disponible à partir de: <http://www.theses.fr/2017ENAM0006>. (Accédé le 1 décembre 2020).
- 2 Matériaux aéronautiques d'aujourd'hui et de demain. Suite au forum organisé par l'Académie de l'air et de l'espace (AAE), l'Association aéronautique et astronautique de France (3AF) et l'Académie des technologies, à la SAGEM, Paris, le 30 novembre 2012. Disponible à partir de: <https://academieairespace.com/wp-content/uploads/2017/03/Mat%C3%A9riaux-a%C3%A9ronautiques-pour-demain.pdf> (Accédé le 1 décembre 2020).

ИСПОЛЬЗОВАНИЕ ТИТАНА И ЕГО СПЛАВОВ В АВИАСТРОЕНИИ

В. О. Плотников

Московский авиационный институт, Москва, Россия

e-mail: vadimpltnkv@yandex.ru

Аннотация. Представлен краткий обзор использования титана и его сплавов в авиационной промышленности, начиная с XIX века по настоящее время. Прослеживается короткая история открытия титана и его применения для изготовления авиационных двигателей. Перечислены первооткрыватели титана. Акцентируются механические свойства титана, дающие возможности промышленного применения сплавов титана при конструировании авиационных двигателей, в частности, турбореактивных двигателей. Подчеркивается снижение себестоимости продукции, что вызывает интерес производителей.

Ключевые слова: сплав; авиационное оборудование; авиационные двигатели; титан; турбореактивный двигатель.

Modellierung des Betriebsverfahrens einer Hemosorbenten Platte auf der Basis von Peroxidverbindungen von Alkalimetallen unter erzwungener Konvektion

I. V. Ryazanov*, P. V. Balabanov

Tambov State Technical University, Tambov, Russia

*e-mail: senior.ryazanov2012@yandex.ru

Abstract

Es wird eine Installation vorgeschlagen, mit deren Hilfe experimentelle Kurven der Abhängigkeit der Oberflächentemperatur der Filter-Absorptionsplatte von der Zeit erhalten wurden. Die erhaltenen Ergebnisse wurden verwendet, um das mathematische Modell der Platte aus filterabsorbierenden Elementen des FPE in Form einer Übertragungsfunktion zu bestimmen. Um die Zuverlässigkeit und Sicherheit der Verwendung von Schutzausrüstung zu gewährleisten, müssen die Überwachungssysteme für die Ressource der Schutzeigenschaften (RPS) (FPE) angewendet werden.

Schlüsselwörter: Ressource, Schutzeigenschaften, filterabsorbierende Elemente, mathematisches Modell.

Derzeit ist das Problem der Luftreinigung dringend. Dies ist auf die erhöhte technologische Aktivität und häufigere Naturphänomene zurückzuführen, die mit der Freisetzung von Verunreinigungen einhergehen, die sich negativ auf die menschliche Gesundheit auswirken. Zur Luftreinigung und zum Schutz der Atemwege werden häufig Mittel verwendet, die filterabsorbierende Elemente (FPE) auf der Basis fester Sorptionsmittel enthalten. Der rechtzeitige Austausch von FPE bietet eine hochwertige Luftreinigung und einen zuverlässigen Schutz der Atemwege. Gleichzeitig zeigt die weltweite Praxis die geringe Effizienz der Schutzausrüstung beim planmäßigen Austausch der PSA, da sich die Parameter der gereinigten Luft während des Betriebs erheblich ändern können.

Um die Zuverlässigkeit und Sicherheit der Verwendung von Schutzausrüstung zu verbessern, ist es daher erforderlich, Systeme zur Überwachung der FPE-Ressource (RPS = Resource of Protection Properties) anzuwenden. Der Betrieb solcher Systeme basiert auf verschiedenen physikalischen Prinzipien der Messung der Zwangsstörung. Insbesondere wird in Werken [1, 2] ein chemischer Indikator verwendet, der seine Farbe mit zunehmender Konzentration der absorbierten Substanz ändert. In Arbeiten [3, 4] wurde die Beziehung zwischen der Dielektrizitätskonstante des FPE und dem quantitativen Sorptionswert verwendet. Mit zunehmender Konzentration der absorbierten Substanz ändert sich die Resonanzschwingungsfrequenz des Sorptionsmittels, was ein Maß für seine Restressource ist. In [5] wird die Methode zur Messung des Widerstands der Sorptionsmittelschicht aufgrund der Absorption der Komponente (chemische Widerstände) verwendet. In [6] werden Halbleitersensoren verwendet, die die

Konzentration der absorbierten Komponente am Ein- und Ausgang der PSA messen. Das thermische Verfahren [7] ist auch zur Überwachung der OCD [7] bekannt, die die berührungslose Messung der Sorbensoberflächentemperatur ermöglicht, die eine Funktion der Absorptionsrate und der Restkapazität für die absorbierte Komponente ist.

Als FPE wurden chemische Sorptionsmittel auf der Basis von Superoxiden und Hydroxiden von Alkali- und Erdalkalimetallen (Na, K, Ca) verwendet, die als Hauptbestandteile von umluftunabhängigen Atemgeräten und Luftregenerationseinheiten vom kollektiven Typ für Bergleute, Feuerwehrleute und das Militär verwendet werden.

Um die Steuerung der Luftregenerationsprozesse solcher Objekte effektiv zu steuern, wird ein Modell des Betriebs der Chemiesorbensplatte benötigt. Um dieses Forschungsproblem als Kontroll- und Managementobjekt zu lösen, wurde ein experimenteller Stand entwickelt (siehe Abbildung 1).

In einer bedingt abgedichteten Kammer 11 (d.h. es entsteht ein Rückstau, der das Eindringen von Außenluft verhindert) mit einem Volumen von 0,17 m³, konstanter Luftfeuchtigkeit und Lufttemperatur wird die Kohlendioxidkonzentration aufrechterhalten. Thermohygrometer 4 CENTER 313 Gasanalysator 12 KHOBBIT-T-CO₂ dient zur Steuerung dieser Parameter. Kohlendioxid wird aus einem Zylinder 1 zugeführt, der mit einem Ventil 2 mit einem Reduzierstück 3 ausgestattet ist. Eine Regenerationsplatte mit den Abmessungen (L, H, h) 95 × 95 × 0,8 mm wird in die Kammer gegeben. Mittels eines Lüfters 8, der von einer Quelle 8 B5-8 gespeist wurde, wird ein Gas-Luft-Gemisch geblasen und die Temperaturdifferenz zwischen der durchschnittlichen integralen Temperatur der Oberfläche der Platten und ihrer Anfangstemperatur in Intervallen aufgezeichnet. Hierzu wird eine Fernsehkamera 6 Flir A320 verwendet, die Daten an einen Computer 5 Lenovo überträgt.

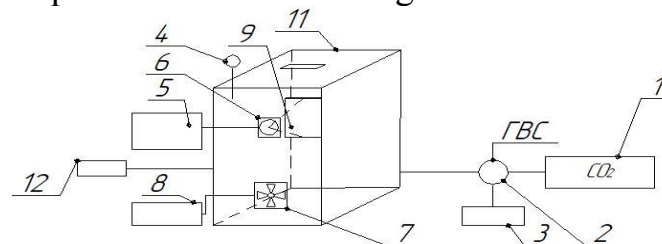


Abbildung 1. Funktionsdiagramm des Versuchsstandes

Für die Abhängigkeit der Plattenoberflächentemperatur von der Zeit wurden experimentelle Kurven erhalten (Abbildung 2). Die erhaltenen experimentellen Ergebnisse wurden verwendet, um das mathematische Modell der FPE-Platte in Form einer Übertragungsfunktion zu bestimmen, für die die Simoyu-Methode verwendet wurde [8]. Die dynamischen Eigenschaften des Objekts werden ungefähr durch die Übertragungsfunktion der folgenden Form dargestellt, wobei der Übertragungskoeffizient des Objekts und die Zeitkonstanten erhalten sind.

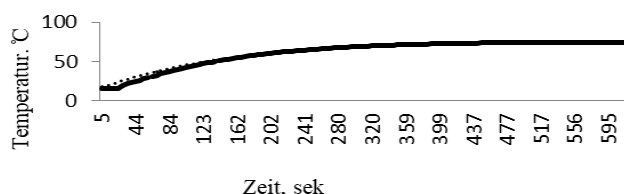


Abbildung 2. Diagramm der Abhängigkeit der Oberflächentemperatur der PSA von der Zeit

Die durchgezogene Linie ist das Einschwingverhalten, die gepunktete Linie ist die experimentelle Kurve. Das Ergebnis der Arbeit ist ein experimenteller Stand, der Bedingungen für die Absorption von Kohlendioxid durch eine chemisorbierende Platte schafft und auch die Möglichkeit einer berührungslosen Kontrolle ihrer Temperatur bietet. Es werden experimentelle Zeitabhängigkeiten der Plattenoberflächentemperatur erhalten, die verwendet werden, um ein mathematisches Modell der Platte in Form einer Übertragungsfunktion zu erhalten.

Referenzliste

1. Lee A. Greenawald, Gerry R. Boss, Aaron Reeder, Suzanne Bell. Entwicklung eines Schwefelwasserstoff-Indikators für das Ende der Lebensdauer von Atemschutzpatronen unter Verwendung von Cobinamid. Sensoren und Aktoren B, 2016, vol. 230, pp. 658-666, doi.org/10.1016/j.snb.2016.02.129.
2. Gromov O.B., Dyachenko A.N., Zernaev P.V. Methode zur Diagnose des Sorbenzustands. Pat. 2459204 RF.
3. Mason A., Wiley S., Shaw A., Al-Shammaa A. I., Thomas A., Keel H. Bestimmung der Restlebensdauer von Aktivkohle unter Verwendung eines Resonators mit einem Mikrowellenresonator. Journal of Physics: Conference Series, 2011, 307(1), pp. 1-6. DOI: 10.1088 / 1742-6596 / 307/1/012041.
4. Cerro G., Ferrigno L., Ferdinandi M., Laracca M. Metrologische Eigenschaften einer neuen Mikrosensorplattform zur Überwachung von Aktivkohlefiltern. IEEE Instrumentation and Measurement Transactions, 2018, pp. 1-12, doi: 10.1109 / TIM.2018.2843218.
5. Bernard P., Karon S., Saint-Pierre M., Lara J. Betriebsanzeige, einschließlich eines porösen Wellenleiters für eine Atemschutzpatrone. Pat. No. 6375725 USA.
6. Hajime H., Ishidao T., Ishimatsu S. Entwicklung eines neuen Atemschutzgeräts für organische Dämpfe mit einem Durchbruchdetektor unter Verwendung eines Halbleitersensors. Angewandte Gesundheit und Umwelt am Arbeitsplatz, 2003, 18(2), pp. 90-95, doi: 10.1080 / 10473220301438.
7. Kondroshov S.N. Die Methode der automatisierten zerstörungsfreien Prüfung thermophysikalischer Eigenschaften ist das Filtern, Absorbieren, Absorbieren und Zerstören. 2419783 RF.

МОДЕЛИРОВАНИЕ ПРОЦЕССА РАБОТЫ ПЛАСТИНЫ ХЕМОСОРБЕНТА НА ОСНОВЕ ПЕРЕКИСНЫХ СОЕДИНЕНИЙ ЩЕЛОЧНЫХ МЕТАЛЛОВ В УСЛОВИИ ВЫНУЖДЕННОЙ КОНВЕКЦИИ

И. В. Рязанов, П. В. Балабанов

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: senior.ryazanov2012@yandex.ru

Аннотация. Предложена установка, с помощью которой были получены экспериментальные кривые зависимости температуры поверхности фильтрующе-поглощающей пластины от времени. Полученные результаты были использованы для определения математической модели пластины фильтрующе-поглощающих элементов ФПЭ в виде передаточной функции. Для обеспечения надежности и безопасности использования средств защиты необходимо применять системы мониторинга ресурса защитных свойств (РЗС) (ФПЭ).

Ключевые слова: ресурс, защитные свойства, фильтрующе-поглощающие элементы, математическая модель.

Studying Traffic Noise in the City of Tambov

M. A. Sevostyanov, E. A. Arzamastsev

Tambov State Technical University, Tambov, Russia
e-mail: sevmaxx@mail.ru, arzamastsev.egor@mail.ru

Abstract

Measurements of the noise impact of vehicles using a sound level meter are presented. A brief description of the measurement technique is given. Measures are indicated to reduce the noise impact on the environment on the city's road network.

Keywords: environment, road transport, roadway, noise, traffic flows, road network.

The urgency of the problem of the spread of environmental pollution is high. Constant noise is the main type of environmental pollution, which disrupts human activity and adversely affects his health. The grade of noise influence on a person depends on. The impact of noise on a person depends on the noise level, its characteristics and spectrum, exposure time, resonance phenomena. Vehicle traffic is a recognized and significant source of noise.

To assess the acoustic impact of road transport, traffic flows in general were considered, rather than individual means of transport. The measurements were carried out in accordance with the methodology for assessing the actual noise characteristics of traffic flows consisting of cars and trucks, buses, trolleybuses, motor vehicles, as well as other types of vehicles on highways, on the street-road network of the city. The measuring point was located at a distance of 4 m from the edge of the roadway, 1.2 m above ground level. Measurements of the level of traffic noise were carried out using a sound level meter MEGEON-92130 in the amount of 20 pieces; the duration of each measurement is one minute. The measurement period was chosen during peak and peak-to-peak times: weekdays, in the afternoon from 14:00 to 14:20 and in the evening from 17:40 to 18:00.

To analyze the noise level on the street and road network of the city of Tambov, the following sections were selected: B. Vasilyeva Street in the area of Bld. No. 4; the intersection of Sovetskaya Street - Chichkanova Street (Kikvidze stop, odd side of Kikvidze Street); Sovetskaya Street - Moskovskaya Street (Moskvskaya stop, odd side of Sovetskaya Street).

Based on CH. 2.2.4 / 2.1.8.562-96 the level of traffic noise cannot exceed 70 dB. According to the results of measurements in the indicated areas, parameters exceeding the maximum permissible concentration were obtained. This is due to the use of public transport at the stopping point, traffic congestion at the traffic light facility, and low traffic capacity.

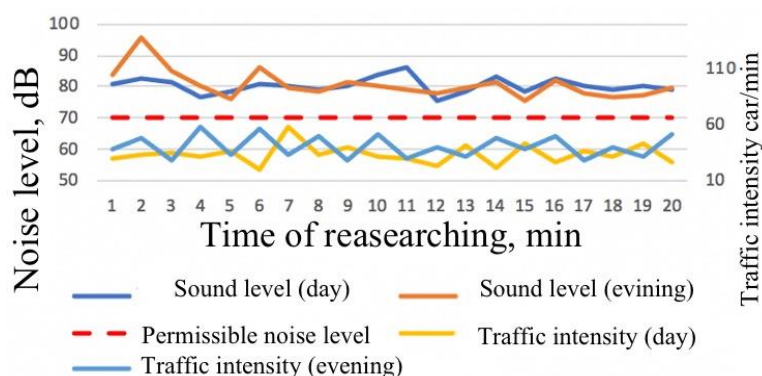


Fig. 1. Intersection of Sovetskaya St. – Chichkanova St. (Chichkanov stop, the odd side of Sovetskaya St.)

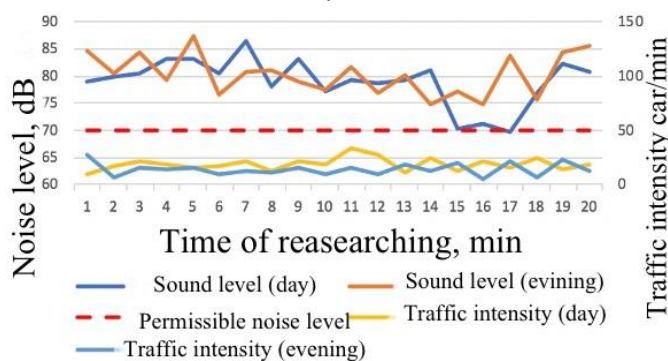


Fig. 2. Kikvidze St. (Kikvidze stop, the odd side)

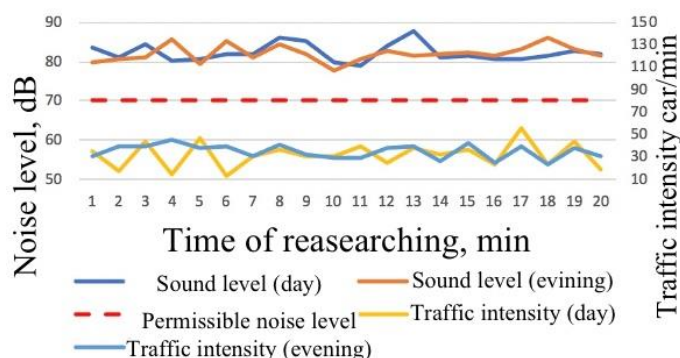


Fig. 3. Sovetskaya St. – Moskovskaya St. (the odd side of Sovetskaya Street)

In accordance with the data obtained and the analysis of the reason for exceeding the traffic noise standards at the city's road traffic network, the following measures can be formulated to reduce the negative impact of road transport on the environment:

- moving the stopping object at a distance of 5-6 m from the edge of the carriageway;
- optimization of public transport traffic;
- construction of an underground pedestrian crossing;
- prohibition of turning to the left;
- replacing the rolling stock of public transport used in urban environments with a newer and quieter one;
- reduction of the speed limit to 40 km/h;

- planting trees and bushes;

The set of these measures will reduce the level of traffic noise at the city road traffic system by an average of 5-10 dB.

References

1. Guskov A.A., Zalukaeva N.Yu., Goryushinsky V.S. Environmental safety in transport [Electronic resource]: textbook. Tambov: TSTU, 2018. (Rus)
2. Anokhin S.A., Zalukaeva N.Yu., Guskov A.A., Gavrikov V.A. Infrastruktura avtotransportnogo kompleksa [Infrastructure of the motor transport complex]. Tambov: TSTU, 2018. (Rus)
3. Kulakova A.G., Guskov A.A., Krutsenko E.M. Environmental problems of motor transport. New science: history of formation, current state, development prospects. Int. scientific-practical conf., 2017, pp. 24-27.
4. Screamer S.N. Calculation and experimental assessment of traffic noise in urban conditions. Science and technology in the road industry. 2019, 3 (89), pp. 39-42.
5. Andrianov K.A., Matveeva I.V., Voyakina E.Yu. Issledovanie transportnoj situacii v g. Tambove i ocenka eyo vozdejstviya na okruzhayushchuyu sredu [The study of transportation situation in tambov and assessment of its environmental impact]. Nauka i obrazovanie dlya ustojchivogo razvitiya ekonomiki, prirody i obshchestva: sbornik dokladov Mezhdunarodnoj nauchno-prakticheskoy konferencii. 150-letiyu so dnya rozhdeniya V.I. Vernadskogo, 2013, pp. 3-7.

ИССЛЕДОВАНИЕ ТРАНСПОРТНОГО ШУМА В ГОРОДЕ ТАМБОВЕ

М. А. Севостьянов, Е. А. Арзамасцев

Тамбовский государственный технический университет, Россия
e-mail: sevmaxx@mail.ru, arzamastsev.egor@mail.ru

Аннотация. Приведены измерения шумового воздействия транспортных средств с использованием шумомера. Представлена краткая характеристика методики измерения. Указаны мероприятия, снижающие шумовое воздействие на окружающую среду на улично-дорожной сети города.

Ключевые слова: окружающая среда, автомобильный транспорт, проезжая часть, шум, транспортные потоки, улично-дорожная сеть.

The Purification Method of the Engine Oil in the Internal Combustion Engine by Using Centrifugal Oil Filter

D. V. Sivalnev

Tambov State Technical University, Tambov, Russia
e-mail: dmitrijsivalnev3826@gmail.com

Abstract

This paper describes one of the ways to improve a centrifugal oil filter with a further increase in its efficiency for separation of gaseous, liquid or bulk bodies of different densities.

Keywords: clearing, oil, centrifugal filter.

Centrifugal purifiers are widely used in automobile engines for oil purification.

The centrifugal purifier (reactive oil centrifuge) does not require periodic replacement of the filter element and provides a very thorough purification of the oil from mechanical impurities. Such a purifier is used only for fine oil purification, and it works in parallel with a coarse filter, or the purifier completely replaces coarse and fine filters installed in the lubrication system.

The disadvantage of this centrifugal oil filter is the low quality of oil purification, the inability to control its performance when the engine is running.

The technical result of the invention is to improve the quality of oil purification, due to centrifugation and monitoring the performance of centrifugal oil filter.

Further modernization makes it possible to achieve an improvement in the quality of oil purification, due to centrifugation and control of the performance of the centrifugal oil filter.

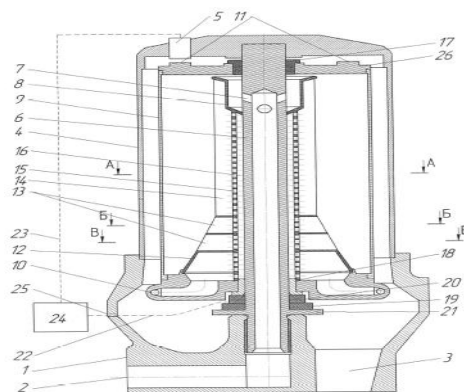


Fig. 1. A general view of a centrifuge for oil purification

The centrifugal oil filter contains a frame 1 with an inlet 2 and an outlet 3, an outer cylindrical body 4 with an inductive sensor 5, a hollow fixed axis 6 with feed holes 7 and a cylindrical guide cup 8 installed on it, a cylindrical rotor 9, with nozzles 10 and two lugs 11, bump stop 12, cone turbines 13, cylindrical turbine 14, outlet pipe with holes 15 and outlet channel 16, sleeve bearings 17, 18, rolling

bearing 19, weight sensor 20, protrusion of a hollow fixed axis 21, connecting wires 22, 23, operability recorder 24, side opening of the filter frame 25, rotor cover 26.

The centrifugal oil filter works as follows. Under pressure, the oil through the inlet 2 of the frame 1 enters through the hollow fixed axis 6 and the feed holes 7 into the guide cylindrical cup 8, which evenly distributes the flow of the incoming oil closer to the walls of the cylindrical rotor 9, which is mounted on the sliding bearings 17, 18 and rests through weight sensor 20 on the rolling bearing 19 and the protrusion of the hollow fixed axis 21.

The execution of 4 feed holes 7 in the hollow fixed axis of the filter allows the passage of oil at the required flow rate. Changing the number of feed holes, both to a smaller and a larger side will lead to a decrease in the quality of oil purification.

Making holes at an angle of at least 35° improves the quality of oil purification by increasing the oil flow rate, since the oil will be directed directly to the top of the guide cup 8.

Under the action of centrifugal forces, contaminants are thrown onto the wall of the cylindrical rotor 9, after the stream of purified oil passes through the inter-blade space of the conical 13 and cylindrical 14 pipes, through the holes in the outlet pipe 15, into the outlet channel 16, through the baffle 12 and is thrown out through the nozzles 10, creating a rotating moment, untwisting cylindrical rotor 9 to 5000-6000 rpm.

The conical 13 and cylindrical 14 turbines transmit the rotational energy of the liquid, as it passes through the space between the blades, to the axis of rotation to the rotor drive, summing it up to the energy of the jet drive.

In the upper part of the filter, where the oil enters after the guide glass, the flow rate is initially high; therefore, it is sufficient to have a cylindrical turbine 14 with 4 blades.

As the oil approaches the conical turbines 13, the flow rate decreases, so the two turbines 13 in the lower part of the filter are made conical with an increased number of blades $n + 2$.

The execution of cylindrical and conical turbines in this way allows maintaining a high oil flow rate evenly throughout the entire volume of the filter, as a result, the emulsion particles will be in a suspended state, as a result of which the quality of oil purification will increase.

Further, the purified oil flows down the inner walls of the outer cylindrical body 4 and flows through the outlet pipe 3 into the crankcase of the internal combustion engine.

When the rotational speed of the rotor 9 drops to a certain level, a control lamp on the instrument panel turns on, warning that it is necessary to clean the centrifugal oil filter.

The proposed device allows to improve the quality of engine oil purification by 20-25% and to improve the control over its performance.

References

1. Luk'yanenko V.M., Taranets A.V. Promyshlennyye tsentrifugi: Uchebnik. M.: Feniks, 1974, 376 p. (Rus)
2. Morozova O.N., Lomovskikh A.Ye., Shmakov S.I. Vliyaniye vodotoplivnoy emul'sii na ekonomicheskiye i ekologicheskiye pokazateli DVS. Problemy tekhnicheskogo obsluzhivaniya v APK, 2018, pp. 42-46. (Rus)
3. Morozova O.N., Lomovskikh A.Ye., Tomilov A.A., Sviridov A.A. Sposob ochistki motornogo topliva v sisteme pitaniya avtomobilya. Vysokiye tekhnologii. Mezhdunarodnyy nauchno-tekhnicheskyy zhurnal, 2016, №11, pp. 67-71. (Rus)
4. Morozova O.N., Lomovskikh A.Ye., Shmakov S.I. Sistema prigotovleniya i podachi vodnoy dispersnoy benzinovoy emul'sii. Problemy tekhnicheskogo obsluzhivaniya v agropromyshlennom komplekse, Kinel': RIOSGSHA, 2019, pp. 61-66. (Rus)

МЕТОД ОЧИСТКИ МОТОРНОГО МАСЛА ДВИГАТЕЛЕЙ ВНУТРЕННЕГО СГОРАНИЯ С ПОМОЩЬЮ МАСЛЯННОГО ЦЕНТРОБЕЖНОГО ФИЛЬТРА

Д. В. Сивальнев

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: dmitrijsivalnev3826@gmail.com

Аннотация. Описан один из способов улучшения центробежного масляного фильтра с дальнейшим повышением его КПД для разделения газообразных, жидких или объемных тел разной плотности.

Ключевые слова: очистка, масло, центробежный фильтр.

Misfire Detection in an Internal Combustion Engine

V. V. Terekhov, E. B. Lozhkina

Tambov State Technical University, Tambov, Russia
**e-mail: lozhkina.ekaterina2016@gmail.com, vladislav0913@gmail.com*

Abstract

The article studies reliable, compact automobile engine misfiring detection system. In accordance with the principles of the present invention, there is provided a simple, reliable, compact and inexpensive automobile engine misfire detection system which includes a single basic capacitive pressure transducer, made of two closely spaced insulating plates whose opposed faces contain conductive layers, and one of which plates is a flexible diaphragm of low mechanical hysteresis.

Keywords: misfiring, internal combustion engine, misfire detection system, pressure transducer, diaphragm, back pressure.

A simple, reliable, compact and inexpensive automobile engine misfiring detection system includes a basic capacitive pressure transducer, attached to a bleeder pipeline equidistantly from each point where the exhaust manifold is attached to the engine, and made of two closely spaced insulating plates whose opposed faces contain conductive layers, and one of which plates is a flexible diaphragm of low mechanical hysteresis. The transducer is thus coupled to a variable exhaust gas pressure source which under normal operating conditions remains at a substantially constant pressure level. The output signal from the transducer has its high-frequency AC component attenuated by a low-pass filter, whose output in turn has its DC component substantially removed by capacitive blocking, after which the remaining AC output is then amplified by a circuit including an operational amplifier. This AC-amplified signal is then compared with a “reduced-magnitude average” reference signal (produced by an AC-to-DC conversion side-circuit followed by magnitude-level adjustment). The comparator output triggers a one-shot monostable multivibrator used to produce an on-off switching signal which operates an LED alarm signal notifying the driver of engine misfiring and also sends an electronic signal to the car's central processor.

A real-time misfiring detection system for internal combustion engine is applicable to an exhaust gas pressure of an exhaust manifold means of an engine which is normally substantially constant or within a narrow range, except for small magnitude fluctuations.

This invention relates to practical detection of large abrupt changes in magnitude, called discontinuities, of exhaust gas pressure in conventional reciprocating internal combustion automobile engines, such as occasioned by combustion misfirings.

Under the leadership of a government agency, the EPA, and with the aid of modern vehicle electronics, most of the pollution from automobile exhausts has been eliminated. In a well-running car, engine fuel is burnt efficiently, producing in the process the normal exhaust gases.

In an engine that misfires, however, unburnt fuel is expelled as well, contributing measurably to atmospheric pollution. In addition, of course, misfiring causes a significant loss of power of the engine, and may result in severe damage to the engine.

A means of detecting misfiring in an engine is therefore very desirable, so that corrective action can be taken.

Back pressure in the exhaust system of a car increases with engine speed (measured in revolutions per minute or "rpm") and is relatively constant for a given rpm. For a V-8 engine, as an example, this pressure, measured just before the catalytic converter, goes up to 10 psig at the highest rpm.

The continuous succession of firings in the car engine produces relatively small pressure pulsations around the back pressure. In the event of a misfire the back pressure decreases from lack of enough exhaust from the misfiring cylinder and recovers its normal level when gasses from the cylinder that fires next are forced into the exhaust system, causing much larger pressure pulsations. This difference between the amplitudes of normal and misfire pressure pulsations, hereinafter called a pressure discontinuity, forms the basis of the present invention for detection of misfires.

Accordingly, there has been a need for a simple, compact, reliable and inexpensive real-time pressure discontinuity analysis system capable of detecting such exhaust-gas pressure abnormalities and alerting either a human operator or/and another automatic correction system to the occurrence of a misfire event.

In accordance with a further aspect of the invention, a system for misfire detection and analysis includes a pressure transducer for providing electrical signals corresponding to input pressure, a comparator, and a detection use circuit. Applied to the inputs of the comparator are an AC signal corresponding to the AC component of the output of the pressure transducer, and a DC reference signal which is a function of the average magnitude of the AC component of the output of the pressure transducer. Circuitry is also provided for energizing the detection use circuit only when a pressure discontinuity occurs, causing the AC component to exceed a predetermined level.

Other objects, features, and advantages will become apparent from a consideration of the following detailed description and from the accompanying drawings.

It is clear that the foregoing detailed description and the accompanying drawings relate to the presently preferred illustrative embodiment of the invention. However, various changes may be made without departing from the spirit and the scope of the invention. Thus, by way of example and not of limitation, the transducer per se may be made of other materials than those mentioned

hereinabove. Furthermore, it is possible to use a variable-resistivity sensor instead of a variable-capacitance sensor; for example, the facing surfaces of the plate and diaphragm can be coated with film resistive layers whose resistivity changes as the diaphragm is flexed. In addition, the parts need not have the precise configuration described hereinabove, but may have alternative arrangements. Further, instead of the structural parts made of metal, they may in many cases be formed of high strength composite materials.

References

1. Morozova O.N., Lomovskikh A.Ye., Shmakov S.I. Vliyaniye vodotoplivnoy emul'sii na ekonomicheskiye i ekologicheskiye pokazateli DVS. Problemy tekhnicheskogo obsluzhivaniya v APK, 2018, pp. 42-46. (Rus)
2. Morozova O.N., Lomovskikh A.Ye., Tomilov A.A., Sviridov A.A. Sposob ochildki motornogo topliva v sisteme pitaniya avtomobilya. Vysokiye tekhnologii. Mezhdunarodnyy nauchno-tekhnicheskyy zhurnal, 2016, №11, pp. 67-71. (Rus)
3. Ioainom S. A. Ekspluatatsiya mashinno-traktornogo parka, 2-ye izd. M: Kolos, 1984. (Rus)
4. Morozova O.N., Lomovskikh A.Ye., Shmakov S.I. Sistema prigotovleniya i podachi vodnoy dispersnoy benzinovoy emul'sii. Problemy tekhnicheskogo obsluzhivaniya v agropromyshlennom komplekse. Kinel': RIOSGSHA, 2019, pp. 61-66. (Rus)

ОБНАРУЖЕНИЕ ПРОПУСКА ЗАЖИГАНИЯ В ДВИГАТЕЛЕ ВНУТРЕННЕГО СГОРАНИЯ

В. В. Терехов, Е. Б. Ложкина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: lozhkina.ekaterina2016@gmail.com, vladislav0913@gmail.com

Аннотация. В статье рассматривается надежная, компактная система обнаружения пропусков зажигания в двигателе внутреннего сгорания. Система состоит из одного основного емкостного преобразователя давления, выполненного из двух близко расположенных изоляционных пластин, противоположные поверхности которых содержат проводящие слои, и одна из пластин которой представляет собой гибкую диафрагму с низким механическим гистерезисом.

Ключевые слова: двигатель внутреннего сгорания, пропуск зажигания, система обнаружения пропуска зажигания, датчик давления, диафрагма, обратное давление.

Automated Air Traffic Control Systems

V. V. Terekhov*, D. O. Zhalnin, I. N. Fetisov

Tambov State Technical University, Tambov, Russia

*e-mail: Vladimir98.98@mail.ru

Abstract

The purpose of this paper is to study the automated air traffic control (ATC) system. During the study, a block diagram of the system will be presented. The relevance of this work is that air traffic is constantly evolving and requires solving a large number of problems.

Keywords: Automated ATC systems, automation of the flight.

Introduction

The accuracy and reliability of the system operating the aircraft plays an important role in ensuring increased regularity and safety of flights. Unfortunately, conventional ATC methods are becoming ineffective, as high air traffic cannot be handled due to limited human capabilities.

The importance of automation system

Dispatcher's work by its nature does not fundamentally change, but due to the rapidly increasing information load, an ordinary person will no longer be able to process such volume of information. A huge amount of data constantly arrives at the dispatcher via various channels and in various forms from all aircraft. An increase in the number of dispatchers will not be a solution to this problem, as this will create new difficulties in their unification and coordination. Therefore, to simplify and facilitate the work, it is needed to eliminate such tasks as: collecting data, storing and processing information. This helps to focus their activities on the most important ATC decisions. This problem is solved by automating ATC processes using innovative radio electronic means and computers.

System configuration

The ATC AS performs various functions to process a large amount of data and consists of a number of separate complexes and subsystems. The structural diagram of the ATC AS is shown in Fig. 1.

An important link of the ATC AS is the dispatcher who closes the control loop. Depending on the type of system and the degree of automation, each of the subsystems may have a different structure and functions, but for all ATC ASs these subsystems perform common tasks and have distinctive features.

SFCI includes information sensors of various types, which are used to measure aircraft coordinates, receive meteorological information, messages from neighboring ATC centers. Information used in automated ATC systems is subdivided into static and dynamic. Static information does not change during system operation and includes aircraft and route parameters. It is introduced into

the aircraft at the stage of preparing the system for operation, but if necessary, correction is possible during operation. Dynamic is the information that changes including aircraft coordinates, flight altitude, tail number or flight number, remaining fuel, messages about an emergency or radio equipment failure, meteorological data. All this data must continuously enter the system during the entire operation time (1).

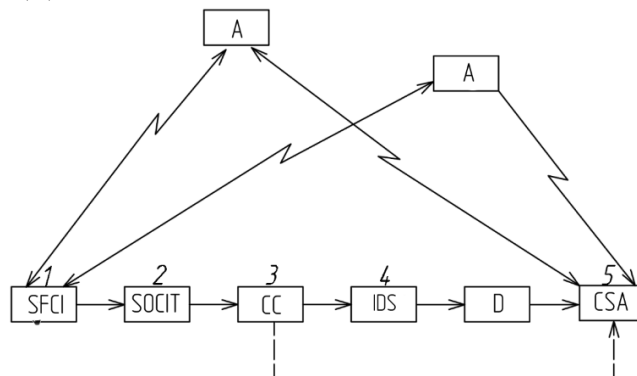


Fig. 1. Block diagram of ATC AS:

1 - subsystem for collecting information; 2 - subsystem of communication and information transmission; 3 - computer complex; 4 - information display subsystem; 5 - communication subsystem with the aircraft.

Flight plans occupy an intermediate position between static and dynamic information, since they can be corrected during the flight. The flight plan must contain the aircraft number, route number, time of departure, overflight of checkpoints and arrival at the destination, fuel supply and information on the presence of the transponder on board. It is necessary to promptly enter into the system the plans for off-route movements, which are transmitted from other ATC centers. Flight plans for scheduled flights are entered in advance and are rarely changed. The signals from individual SFCI sensors are of a different nature. Some signals are analog, others are discrete. In this case, the methods of encoding discrete signals may be different. To convert all signals from the SFCI to a single form suitable for input to the aircraft, the SOCIT communication and information transmission subsystem is used. At the output of this subsystem, all information is presented in digital codes, with which the aircraft digital computer operates. Additionally, SOCIT provides communication of the control center personnel with all interacting services (1).

Aircraft processes all information coming from various sensors and forms data arrays for IDS. With a high degree of automation, aircraft also solves the problems of analyzing the air situation. Sensor signals are processed in two stages. The initial processing of information, called primary, is performed in the SFCI and SOCIT. The main purpose of this processing is to clear signals from interference and receive data in the form of machine code. The next stage is carried out in the aircraft and is called secondary processing, the main purpose of which is to obtain the fullest possible data on the trajectories of all aircraft in the control zone.

IDS is designed to display the received data in a form that is convenient for human perception. In ATC AS, coordinate information is displayed graphically, i.e. analogue, and additional - digital. Information display is shown in Fig. 2.

IDS allows the dispatcher to actively interact with the aircraft. CSA provides the transfer of control commands to the aircraft, the exchange of messages between the aircraft crews and the ATC service, as well as the receipt and input into the aircraft of some data from the aircraft (2).

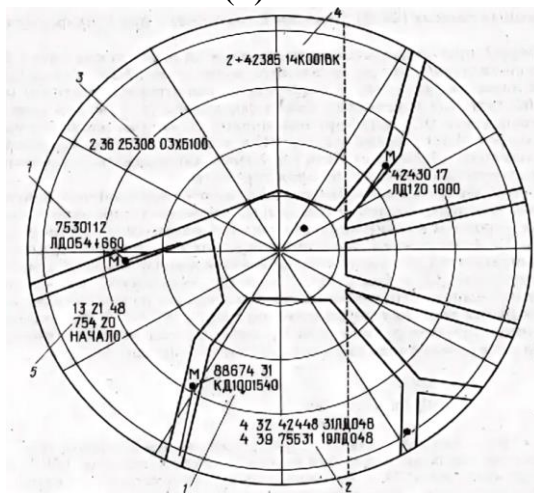


Fig. 2. Combined plan indicator:

1 - support forms; 2 - form of waiting for an arriving aircraft; 3 - form of waiting for the departing aircraft; 4 - tabular form; 5 - system data table

Conclusion

As a result of this work, we can conclude that this system still requires human intervention and can not work without human control.

References

1. Khivrich I.G., Belkin A.M. Avtomatizirovannoe vozhdenie vozdushnyh sudov [Automated aircraft driving]. Moscow, Transport Publ., 1985, 382 p. (Rus)
2. Troyanovskiy A.D., Kluga, B.Y. Bortovoe oborudovanie radiosistem blizhney navigacii [Onboard equipment of short-range navigation radio systems]. Moscow, Transport Publ., 1990, 182 p. (Rus)

АВТОМАТИЗИРОВАННЫЕ СИСТЕМЫ УПРАВЛЕНИЯ ВОЗДУШНЫМ ДВИЖЕНИЕМ

В.В. Терехов*, Д.О. Жалнин., И.Н. Фетисов

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: Vladimir98.98@mail.ru

Аннотация. Целью данной работы является изучение автоматизированной системы управления воздушным движением (УВД). В ходе исследования будет представлена структурная схема системы. Актуальность данной работы заключается в том, что авиасообщение постоянно развивается и требует решения большого количества задач.

Ключевые слова: автоматизированные системы УВД, автоматизация полета.

УДК 630 * 232.322.43
ББК 40.715

Organic Fertilizers as a Factor of Increasing Yield of Agricultural Crops

A. A. Andreev

Tambov State Technical University, Tambov, Russia
e-mail: fenex2014@gmail.com

Abstract

Crop yields and product quality depend on farming, weather conditions, level mechanization and chemicalization and other factors, among which it is crucial to increase crop yields through the use of a sufficient number not only mineral, but first and foremost, organic fertilizers and their correct use in combination with the high culture of farming.

Key words: soil fertility, organic fertilizers, manure, compost.

Introduction

An important place in increasing soil fertility is given to organic fertilizers, which contain all the nutrients necessary for plants - nitrogen, phosphorus, potassium, calcium, magnesium, as well as trace elements - boron, molybdenum and others. Under the influence manure and other organic fertilizers, the physical properties of the soil, its water and air regime are improved, the harmful effect of soil acidity and high salt concentration on plant growth and the vital activity beneficial microorganisms are reduced. Organic fertilizers are of great importance as an additional source of carbon for plants due to the enrichment of the surface layer air with carbon dioxide. All these properties contribute to maintaining the high level potential soil fertility, obtaining high and stable yields, creating a solid forage base [1, 2].

Currently, yeast, biogas, liquid fuel, an additive to animal feed are obtained from manure, worms, flies, duckweed, salvinia, chlorella are grown, alcohol, which is used instead gasoline in engines and vegetable oil to replace diesel fuel [3]. Our opinion differs in that manure must be used as compost where it is obtained from - from the soil through a plant and an animal. Otherwise, we will be left without fertile soil, without a crop harvest, and maybe climate change [4].

Results and its discussion

Obtaining biogas at first glance is a good event. But if we consider this issue more deeply, we will see that there are experimental samples of the "Cobos" type and nothing else. Firstly, this process is periodic, since it requires loading manure and unloading the resulting product. The installations are very expensive. Moreover, at a temperature of 45 ... 50 ° C, not all helminths, salmonella and other parasitic elements are destroyed, and this is the main requirement. It is difficult to maintain a constant temperature regime. During composting, organic waste is

heated to a temperature of 60 ° C, which has a detrimental effect on larvae and pupae flies, helminth eggs and pathogenic and non-spore-forming microorganisms.

The microbiological process decomposition organic matter goes through two stages. First, with an increase in the number of microorganisms, the temperature of compost mass rises to 40°C. At this stage, mesophilic microorganisms multiply intensively in the compost (the optimum temperature for their development is 25 ... 30°C). Then the temperature rises above 40°C, which leads to the death mesophylls and the reproduction thermophiles. This is the most important stage composting, during which oxidation processes are most intense; then the temperature of the mass gradually decreases, and the process dies out.

Composting manure or litter with various water-intensive materials does not increase the fertilizing value the mixture components and compost. On the contrary, the content of nutrients in compost is reduced compared to that in manure and litter due to their low content in water-intensive materials.

Despite this, composting becomes necessary when manure or litter has unfavorable physical and mechanical properties, an unpleasant odor, is heavily contaminated with weed seeds, infected with eggs and helminth larvae and non-fast-forming pathogenic microorganisms. Secondly, the use manure as an organic fertilizer - compost, allows you to maintain soil fertility and obtain high yields agricultural crops [2, 5, 6].

To improve the technological properties and prevent the loss liquid excrement, semi-liquid manure, crossbreeds are mixed with water-intensive materials taken in such a ratio that the humidity composted mass is 70...75% and is optimal for biothermy. When working with high humidity, air access to the compost mass and the living conditions aerobic thermophilic microorganisms sharply deteriorate. Therefore, the temperature inside the pile rises to 56 ... 60 ° C, which does not contribute to the death eggs and larvae helminths and flies, as well as disinfection compost from some microorganisms, while the seeds many weeds remain viable. The full effect of disinfection does not occur even when the temperature inside the stack rises to 56 ... 60 ° C, since at its surface it is close to the ambient temperature. However, as a result biothermy, the contamination and infestation of the compost sharply decrease.

To obtain compost with optimal moisture, first of all, the amount of water-intensive material (peat, straw, sawdust, crushed bark and others) is determined per 1 kg of manure (droppings, feces, etc.) according to the formula:

$$K_T = \frac{W_H - W_K}{W_K - W_T},$$

where is W_H – is manure moisture, %; W_K – is compost moisture, %; W_T – is peat moisture, %.

The potential nutrient content is then determined to predict agroecological performance. With a manure humidity of 90% and a total nitrogen content of 0.6%, phosphorus - 0.4 and potassium - 0.16%, and in low-lying peat with a moisture

content of 60% and a total nitrogen content of 0.9%, phosphorus and potassium 0.04% peat mixture should contain, %:

$$N_{\text{общ}} = \frac{2r \cdot 0,9\% + 1r \cdot 0,6\%}{3r} = 0,8\%.$$

including 0.6% and 0.2% of hard-to-reach peat nitrogen and manure nitrogen, respectively

$$P_2O_5 = \frac{2r \cdot 0,04\% + 1r \cdot 0,4\%}{3r} = 0,16\%,$$

$$K_2O = \frac{2r \cdot 0,04\% + 1r \cdot 0,16\%}{3r} = 0,08\%.$$

As a result of the same average mass and nitrogen losses during composting in the amount 15%, the nitrogen content does not change in the finished peat-based compost:

$$N_{\text{общ}} = 0,8\% \cdot 0,85 : 0,85 = 0,8\%.$$

In the absence of loss phosphorus and potassium and loss of 15% of the mass during composting, the content phosphorus and potassium in the compost will increase:

$$P_2O_5 = 0,16\% : 0,85 = 0,19\%,$$

$$K_2O = 0,08\% : 0,85 = 0,09\%.$$

With such a content total phosphorus and nitrogen (including 0.25 nitrogen of litter), peat-throwing compost in combination with potash fertilizers is slightly inferior in effect on the yield to the equal norms of litter manure, and its mass increases by 3 times.

Conclusion

The most important indicator of a highly fertile soil is organic matter, which serves as a kind of reserve of nutrients necessary for plants, and has a beneficial effect on the optimal formation its agrophysical properties. Farmers are obliged to take constant care the growth the content organic matter in the soil, that is, it is necessary to apply manure to the fields in order to improve its fertility. The highly cultivated soil, rich in organic matter, with high humus content, smooths out fluctuations in the weather over time and thus creates optimal conditions for the formation of a good harvest. To meet the needs plants for potassium, potash fertilizers must be added to the soil. Adding them to compost is not recommended as they inhibit the vital activity of microorganisms and the composting process. All compostable litterless manure must be composted to preserve nutrients and use organic matter most effectively to increase yields and soil fertility.

References

1. Vasiliev V.A., Filippov N.V. Spravochnik po organicheskim udobreniyam [Handbook of organic fertilizers]. M.: Rosagropromizdat, 1988, 255 p. (Rus)

2. Kapustin V.P., Brusenkov A.V. Organicheskie udobreniya i urozhajnost' [Organic fertilizers and crop yield]. Equipment and technologies in animal husbandry, 2020, 2 (38), pp. 86-89. (Rus)

3. Zavrazhnov A.I., Mironov V.V. Matematicheskoe modelirovanie biotekhnologicheskoy sistemy proizvodstva organicheskikh udobrenij [Mathematical modeling of the biotechnological system for the production of organic fertilizers]. Michurinsk: MichGAU, 2012, 150 p. (Rus)

4. Veterinarno-sanitarno-gigienicheskie trebovaniya k ustrojstvu tekhnologicheskikh linij po udalenyu, obrabotke, dezinfekcii i utilizacii navoza, poluchennogo v zhivotnovodcheskikh hozyajstvah [Veterinary and sanitary and hygienic requirements for the installation of technological lines for the removal, treatment, disinfection and disposal of manure obtained at livestock farms]. M.: VNIIVS, 1979, 13 p. (Rus)

5. Koroleva M.N., Kapustin V.P. Sposoby pererabotki zhidkikh udobrenij [Methods for processing liquid manure]. Technics in agriculture, 1973, No. 9, pp.17-20. (Rus)

6. Semenov P.Ya. Besposadochnyj navoz i ego ispol'zovanie dlya udobrenij [Litter-free manure and its use for fertilization]. M.: Kolos, 1978, 271 p. (Rus)

ОРГАНИЧЕСКИЕ УДОБРЕНИЯ КАК ФАКТОР ПОВЫШЕНИЯ УРОЖАЙНОСТИ СЕЛЬСКОХОЗЯЙСТВЕННЫХ КУЛЬТУР

А. А. Андреев

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: fenex2014@gmail.com

Аннотация. Урожайность сельскохозяйственных культур и качество продукции зависят от культуры земледелия, погодных условий, уровня механизации и химизации и ряда других факторов. Решающим является повышение урожайности сельскохозяйственных культур за счет применения достаточного количества не только минеральных, но и в первую очередь органических удобрений, а также правильное их использование в сочетании с высокой культурой земледелия.

Ключевые слова: плодородие почв, органические удобрения, навоз, компост.

Direction of Improving the Design of Devices for Determining the Friction Coefficients of Bulk Materials

A. Yu. Glazkov*, I. A. Shemonaev, V. O. Prokhorova

Tambov State Technical University, Tambov, Russia

*e-mail: pav1981@bk.ru

Abstract

The design of devices for studying the coefficients of rest and motion, internal and external friction is considered. Their analysis, advantages and disadvantages are given. The direction of improving the design of devices for determining the coefficients of friction is revealed.

Keywords: bulk materials, coefficient of friction, device.

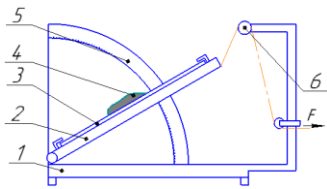
When designing new machines, introducing new materials in the structural elements of machines, specifying technological and energy parameters, it is necessary to know the physical and mechanical properties of bulk materials, in particular the coefficients of friction: internal, external and friction of movement. To study these parameters of bulk materials, various installations and methods of determination are developed and patented [1-4].

Devices for determining the coefficient of rest friction force, coefficients of rest friction with an inclined plane [1]. The device includes a platform pivotally fixed on the frame, a scale for fixing the lifting angle, a plate with the test surface on which the test bulk material is placed, and a platform lifting mechanism.

Devices of this type work as follows. Particles of the test bulk material are placed in the longitudinal grooves of the plate fixed on the platform previously lowered to the lower position. Then the traction device slowly lifts the platform with the fixed plate until the particles start sliding along the longitudinal grooves. In this case, the angles (α) of the beginning of the sliding of particles are recorded on a scale and the average value α is determined, which determines the coefficient of the rest friction force, as the tangent of the angle α .

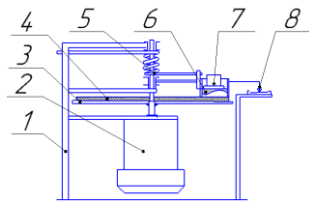
Devices for determining internal and external friction coefficients are also widely used [2, 3]. Devices based on a movable frame with a rotating surface under study allow to study the coefficients of friction of rest and movement on various surfaces [2].

Such devices are usually used to study the coefficients of friction at rest and the movement of materials on various surfaces [2]. A device for determining the coefficient of friction, contain a frame with a drive attached to it, on the shaft of which disks with replaceable test surfaces are installed, the drive allows you to smoothly adjust the rotation frequency of the rotating disk.



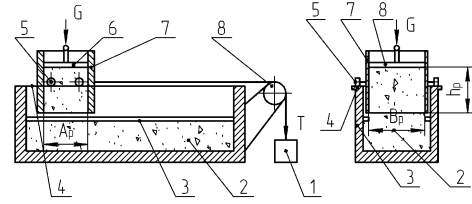
1-bed; 2-platform; 3-plate with the test material; 4-test material; 5-scale; 6-platform lifting mechanism

a) Device for determining the coefficient of friction at rest [1]



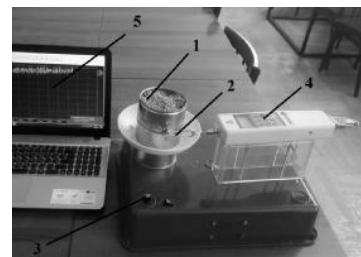
1 – frame, 2 – drive motor interchangeable plates, 3 base for fixing the removable disk, 4 – disk (made from the test material), the transmitting mechanism 5, 6 – truck with the study of the agricultural material 7 – the mechanism of loading 8 - the recorder

b) a Device for determining coefficients of friction with the rotation of the surface [2]



1-cargo Cup; 2-bulk material; 3-lower guides; 4-upper guides; 5-rollers; 6-plate; 7 frame; 8 block.

c) Device for determining the coefficients of friction (tribometer) [3]



1-friction device holder; 2-Cup; 3-Cup rotation speed controller; 4-dynamometer; 5 - Force gauge software v6. 0 program for visualizing the dynamometer reading in on-line mode measuring shear forces inside the bulk material

d) Device for determining the dynamic and static coefficient of friction [4]

Fig. 1. Diagrams of devices for studying friction coefficients

Devices of this type consist of a gutter and a frame [3]. The frame is supported by rollers on the upper rails and is connected to the cargo Cup by a cord thrown over the block. The test material in the frame is pressed against the gutter material by plates. When determining the coefficient of external friction of bulk feed on a solid surface, a plate made of solid material is installed on the lower guides.

Disadvantages are limited scope; the ability to study only the coefficients of friction at rest.

Currently, these devices are being adapted to the use of digital technologies. The main task that the upgraded devices provide is to ensure the accuracy of the results of studies of the friction characteristics of materials [4].

On the basis of the obtained data, taking into account the mass of portions of the shifted bulk product, the coefficients of friction of rest and motion for the bulk material are calculated [4].

A device for determining the friction characteristics of bulk materials has also been developed at present. It has advantages over known designs, since it allows

you to get more accurate information about the friction characteristics of one or different bulk materials under static and dynamic conditions, namely, the coefficients of external and internal friction.

Analyzing the devices and the principle of operation of most devices, devices and devices for determining the coefficients of friction, the friction forces of the structure are reduced to three main types:

- inclined plane [1];
- movable frame with replaceable rotating elements (surfaces) [2,4].
- movable frame with translational rectilinear motion [3]

This article provides an overview of existing designs for determining the coefficient of friction at rest, indicating the advantages and disadvantages of each of them.

Based on the analysis, we can conclude that further improvement of the device designs using digital technologies is necessary to study the physical and mechanical properties of bulk materials when interacting with various materials.

References

1. Berdyshev E.V., Teplyaev A.N., Ryadnov A.I., Shaprow M.N., Sharipov R.V., Dugin J.A., Teplyaev V.A. Teoreticheskoe i eksperimental'noe issledovanie tekhnologij i tekhnicheskikh sredstv obmolota sel'skohozyajstvennyh kul'tur: monografiya [Theoretical and experimental study of technologies and technical means for threshing crops: monograph]. Volgograd: Volgograd state agricultural university, 2012, 224 p. (Rus)

2. Vedishchev S.M., Brusenkov A.V., Prokhorov A.V., Gorgodze A.R., Balakhonova D.N. Ustrojstvo dlya opredeleniya koefficienta treniya podachi [Device for determining the coefficient of feed friction]. Patent 2644035 Russian Federation, IPC G01N, publ. 07.02.2018, Byul. No. 4. (Rus)

3. Prokhorov A.V. Usovershenstvovanie dozatora bunkernogo korma dlya svinej s regulirujemoj moshchnost'yu zahvata shnekovyh dozatorov: dis. ... kandidat tekhnicheskikh nauk: 05.20.01 [Improvement of the bunker feed dispenser for pigs with adjustable gripping capacity of screw dispensers: dis. ... candidate of technical Sciences: 05.20.01]. Michurinsk, 2007, 137 p. (Rus)

4. Kiradiev O.R., Paraviev A.S., Arzamastsev R.S., Tasbas A.Y. Opytnyj obrazec tribometra dlya issledovaniya staticheskikh i dinamicheskikh parametrov treniya sypuchih materialov [An experimental prototype of a tribometer for the study of static and dynamic friction parameters of bulk materials]. Notes of the scientist, 2019, 5 (39), pp. 15-19. (Rus)

НАПРАВЛЕНИЕ СОВЕРШЕНСТВОВАНИЯ КОНСТРУКЦИЙ УСТРОЙСТВ ДЛЯ ОПРЕДЕЛЕНИЯ КОЭФФИЦИЕНТОВ ТРЕНИЯ СЫПУЧИХ МАТЕРИАЛОВ

А. Ю. Глазков*, И. А. Шемонаев, В. О. Прохорова

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: pav1981@bk.ru

Аннотация. Рассмотрены конструкции приборов для исследования коэффициентов покоя и движения, внутреннего и внешнего трения. Дан их анализ, преимущества и недостатки. Выявлено направление совершенствования конструкции приборов для определения коэффициентов трения.

Ключевые слова: коэффициент трения, прибор, сыпучие материалы.

A Universal Root Crop Chopper for Cattle

A. S. Ivanov, N. V. Sheludyakov

Tambov State Technical University, Tambov, Russia
e-mail: ia.ivanov2012@yandex.ru, n.she.1997@mail.ru

Abstract

At present, the lack of technical means for obtaining high-quality products of feed production, as well as increasing the level of equipment of agricultural production with the most advanced, less energy-efficient and metal-intensive machines for preparing feed, and ways to solve this problem remain relevant. Therefore, we are faced with the task of improving the quality and efficiency of feed preparation by improving the technical means for chopping root crops into slices in accordance with zootechnical requirements.

Keywords: root crops, cattle, fodder and sugar beet, root crop chopper, quality of grinding.

Introduction

The availability of high-quality feed and their effective use when feeding cattle is one of the most important tasks in the successful development of animal husbandry [1, 2]. Cattle provide more than half of the total amount of meat and the main part of the valuable product that is irreplaceable for humans-milk, which contains all the nutrients necessary for the body in an easily digestible form. Fresh milk and fermented dairy products have bactericidal properties. Cattle meat has high nutritional and taste properties, it contains all the essential amino acids, fatty acids, and minerals. Compared to pork and lamb, beef has less cholesterol, which ensures its high nutritional value [2, 3]. By changing the level and mode of feeding, the set and ratio of feed in the diet, it is possible to influence the entire metabolism, to form the desired type of animal capable of high milk or meat productivity [3]. In accordance with science-based nutrition standards, the specific weight of beef and veal in the human diet should be 36 kg or about 40 ... 45% of the total meat consumption [3] and 405 kg of milk and dairy products.

Results and discussion

In feeding dairy cows, sugar and fodder beets are a valuable component of the diet. It has a beneficial effect on milk productivity, but it is the most expensive and labor-intensive feed in production, which is one of the main reasons that many farms use these root crops in limited quantities or do not use them at all. In addition, their contamination during harvesting by agricultural machines can reach 20% or more. It is known that the technological process of processing root crops is reduced to two main operations – washing and grinding.

According to zootechnical requirements, the residual contamination after washing should not exceed 3%. However, the physical and mechanical properties of root crops and soil are very diverse and depend on many factors, including natural and climatic conditions. When the soil humidity increases, the

contamination increases, it is mainly concentrated in its depressions, straw inclusions, stones and other impurities stick to the surface, which negatively affect the health of animals and disable the working organs of feed preparation machines. As practice shows, when root crops with increased contamination arrive from the field, water consumption increases, and the productivity of cleaning machines and grinding machines decreases as a result of breakdowns. Scientific studies conducted by scientists have shown that if the fattening of cattle, carried out for a relatively short period, washing root crops does not justify itself economically, then it is necessary for feeding dairy cows. It is known that systematic feeding of highly productive cows 20...30 kg of dirty root crops per day after 6...7 months leads to digestive disorders, loss of condition and a sharp decrease in milk productivity. Especially a lot of soil remains on the roots of kuuziku, sugar beet and carrots. Therefore, any root crops must be washed before delivery. In this regard, the constant scientific search for the most advanced and efficient technological lines that can perform these operations efficiently with the lowest energy costs, is an important task for the agricultural industry.

One of the main ways to increase the efficiency of using root crops is their grinding, which is carried out in order to speed up the processes of digestion in the stomach of animals, increase the digestibility of nutrients and increase the feed consumption by 1.5 times compared to using in unprocessed form. In the daily diet of dairy cows, beets are introduced to 15 ... 20% of the total nutritional value of the feed mass. Milk cows are given up to 15 kg per head per day, and a single feeding of beetroot with high sugar content should not exceed 5 ... 7 kg. With large amounts of such beets, the rumen receives a lot of sugar, which is fermented to lactic acid, and the latter, having accumulated in a significant amount, is absorbed into the blood and causes metabolic disorders. At the same time, the animals have increased thirst and temporary agony of the scar. The role of beetroot in the preparation of feed mixtures from low-edible feed components is particularly important. In accordance with zootechnical requirements, the thickness of cutting root crops for feeding cattle (in a mixture) is-10 ... 15 mm, calves - from 5 to 10 mm with a width of 10 ... 30 mm and a length equal to the length of the product; contamination is not more than 2...3%. When laying root crops as part of combined silos, the requirements for the quality of grinding and contamination are the same as when issuing cattle as part of a mixture with other feeds [3].

The analysis of technical characteristics and designs of machines for chopping root crops of cattle showed that the choppers produced by the industry are characterized by high energy and metal consumption, have low quality indicators of grinding, abundant release of juice from them, which do not always meet modern zootechnical requirements. The most widely used machines for grinding feed with knives are machines with disk and drum working bodies. Their advantages include simplicity of design, good quality of the resulting products (55 ... 60% of the finished (crushed) feed meets zootechnical requirements), as well as relatively low specific energy costs [3, 4].

In order to reduce energy consumption and improve the quality of root crop grinding, the Department of agricultural Engineering of the “Tambov State Technical University” developed and manufactured a single-stage grinding device with a vertical screw feeder and a fixed knife ring grid with flat plate knives installed in accordance with zootechnical requirements at a certain distance from each other (RF patent No. 2556720), shown in Fig. 1.

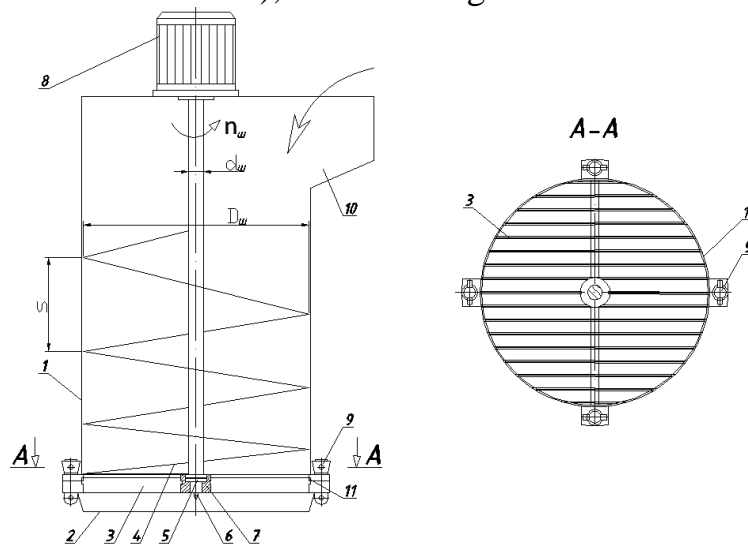


Fig. 1. Design and technological scheme of the device for chopping root crops

This chopping device contains a cylindrical body 1 with a replaceable block 2 of knives 3. Inside the body 1, a screw 4 is vertically located with a variable pitch that decreases in the direction of the feed product. With its lower end, the screw 4 rests on a thrust bearing 5, which is lubricated through the oil press 6 and is located in the lower support 7 of the knife block 2. The upper end of the screw also rests on a thrust bearing located in the upper support (not shown in the figure) and is lubricated through the oil press. The screw is driven by a gear motor 8. The replacement unit 2 is attached to the housing 1 using four hinged screw clips 9, which allow it to be quickly removed and installed. The knives are made of rectangular plates, all sharp edges of which have the same sharpening angles and are located in the grooves of the replaceable block at a certain distance from each other (for the purpose of grinding in accordance with zootechnical requirements) at an angle of 90° and are fixed from falling out using an annular spacer 11.

The device works as follows. Pre-cleaned root crops are loaded from above into the receiving hopper 10 of the cylindrical body. Further, under their own weight, they roll down the inclined wall of the body and captured by the winding of the rotating screw 4, move axially from top to bottom to the block 2 of the knives 3. The presence of the screw 4 of a variable step, decreasing in the direction of movement of the feed product, provides it with a seal when approaching the block of knives. Under the action of compression and constant support from the screw, root crops are pre-pressed into the knife grid, and then pushed through it and removed from the chopping device.

These technical solutions in the design of the root chopper exclude the accumulation of products between the knives of the replaceable block, provides quick removal and installation of the block itself for its replacement or cleaning, provides a stable chip width in accordance with zootechnical requirements, increases the reliability and durability of the entire device. As a result, all this leads to an increase in the quality of grinding, the efficiency of the device and reduces the energy consumption of the grinding process.

Conclusion

Root crops play an important role in feeding cattle. Therefore, special attention should be paid to improving the quality and reducing the loss of their nutritional value during harvesting, storage and preparation for feeding. All these operations require energy-efficient equipment that meets modern farming conditions. It is necessary to introduce root crops more widely in the diets for cattle on livestock farms, which will ultimately increase the productivity of animals, the growth of livestock, the genetic potential, and the efficiency of using feed mixtures. Further development of specialization and concentration of agricultural production will only contribute to a more efficient transfer of animal husbandry to a more modern level.

References

1. Brusenkov A.V. Tekhnologicheskaya liniya prigotovleniya korneklubneplodov [Technological line for the preparation of root tubers]. Voprosy sovremennoj nauki i praktiki. Universitet imeni V.I. Vernadskogo. Tambov: TSTU, 2019, 2 (72), pp. 152-157. (Rus)
2. Brusenkov A.V. Razrabotka tekhnologicheskogo processa i ustrojstva dlya izmel'cheniya korneklubneplodov s val'covym podporom [Development of a technological process and a device for grinding root and tuber crops with a roller support: dis. Cand. tech. Sciences: 05.20.01]. Dis. kand. tekhn. nauk: 05.20.01, Tambov, 2015, 222 p. (Rus)
3. Boyarskij L.G. Tekhnologiya kormov i polnocenno kormlenie sel'skohozyajstvennyh zhivotnyh [Feed technology and full-fledged feeding of farm animals]. Veterinariya i zhivotnovodstvo. Rostov-on-Don: Feniks, 2001, 416 p. (Rus)
4. Patent 2556720 RF, MPK V02S 18/00, A01F 29/00, A47J 43/00. Ustrojstvo dlya izmel'cheniya [Device for grinding]. Byul. №20, publ. 20.07.2015. (Rus)

УНИВЕРСАЛЬНЫЙ ИЗМЕЛЬЧИТЕЛЬ КОРНЕКЛУБНЕПЛОДОВ ДЛЯ КРУПНОГО РОГАТОГО СКОТА

А. С. Иванов, Н. В. Шелудяков

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ia.ivanov2012@yandex.ru, n.she.1997@mail.ru

Аннотация. В настоящее время остается актуальным вопрос отсутствия технических средств для получения высококачественной продукции кормопроизводства, а также повышения уровня оснащённости сельскохозяйственного производства наиболее совершенными, менее энергоэффективными и металлоёмкими машинами для приготовления кормов, и путей решения данной проблемы. Поэтому перед нами стоит задача повышения качества и эффективности приготовления кормов путем совершенствования технических средств для измельчения корнеклубнеплодов на ломтики в соответствии с зоотехническими требованиями.

Ключевые слова: корнеклубнеплоды, крупный рогатый скот, кормовая и сахарная свекла, измельчитель корнеклубнеплодов, качество измельчения.

An Overview of Existing Installations for Determining the Rest of Friction Coefficient

M. S. Petrov, I. A. Shemonaev*, A. A. Terekhov

Tambov State Technical University, Tambov, Russia

**e-mail ivanshemonaev.com@mail.ru*

Abstract

The design of devices for studying the coefficients of rest and movement, internal and external friction are considered. Their analysis of advantages and disadvantages is given.

Key words: coefficient of friction, device, bulk materials.

When designing new machines, introducing new materials in structural elements of machines, clarifying production parameters, it is necessary to know the physical and mechanical properties of bulk materials, in particular the coefficients of friction: internal, external and friction in the movement of material. To study these parameters of bulk materials, various installations and determination methods are being developed and patented. Friction is the most important form of harmful resistance. At the same time, a number of the most important technological processes and the operation of mechanisms are based on the action of friction forces: rolling, crushing, etc. There is external and internal friction. External friction is called this type of friction, in which forces arise at the points of contact of solids that impede the mutual movement of bodies and are directed tangentially to their surfaces.

Internal friction (viscosity) is the type of friction, which consists in the fact that with mutual displacement. Layers of liquid or gas between them, tangential forces arise that prevent such a movement.

External friction is classified as static friction and kinematic friction. Friction at rest occurs between immobile rigid bodies when any of them are trying to move. Kinematic friction exists between mutually contacting moving rigid bodies. Kinematic friction, in turn, is subdivided into sliding friction and rolling friction. But it is not the friction force that is more important, but the coefficient of friction.

The following is an overview of existing installations for determining the coefficient of static friction.

Device No. 1 (Patent No. 2343455) for implementing the method for determining the coefficient of friction includes a frame 1, in which two plates 3 are located on one hinge 2, on the inner sides of which the investigated surfaces are fixed 4. Moreover, the plates are pressed against each other using the same springs 5. In addition, a protractor 6 is fixed on the frame, concentrically to the hinge, in the plane of parallel movement of the plates. The test sample 7 is placed between the surfaces under study.

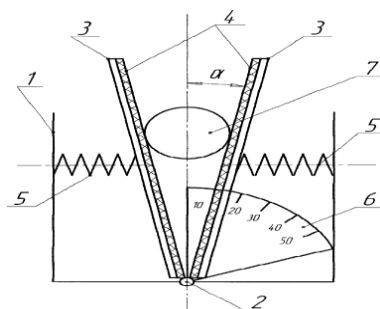


Fig. 1. Device for determining the coefficient of friction

The device works as follows:

To eliminate the effect of gravity, the device is positioned horizontally. Plates 3 are spread, overcoming the resistance of the springs 5. In the formed gap between the investigated surfaces 4, the test sample 7 is placed, and it is placed as close as possible to the hinge 2. After that, the plates 3 are compressed under the action of the springs 5, squeezing it out of the gap until the angle α does not become equal to the angle of friction of the investigated surfaces of the sample (the condition of replacement of bodies). Thus, after stopping the test sample using a protractor, I determine the angle of friction under study. The coefficient of friction is found as the tangent of a given angle. The disadvantage of this method is its high labor intensity. The advantage is the reduction in the time required to determine the coefficient of friction.

Device No. 2 (Patent No. 2408869) is a tool for determining the force and coefficient of friction at rest. It includes a force-measuring device with a stretching device 1, connected to one end of the tested element 2 of the article 3. The other end of the element is connected to the weight 5 by a thread 4, which is rolled through block 6.

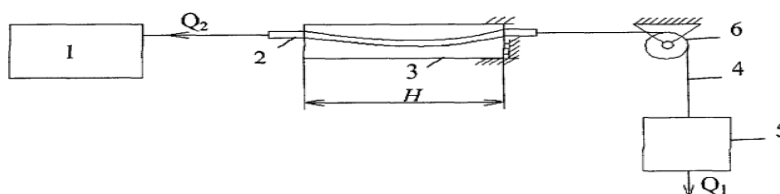


Fig. 2. Device for determining the coefficient of friction

The device works as follows:

Choose a twisted product and leave the ends free. One end of the element is installed in the movable grip of the stretching device; the other end is connected to the thread. From the side of the thread, other elements of the product are connected with a fixed grip. When a certain force is created, Q_2 of the product element will begin to move along with the load. This force is recorded using a force meter. The disadvantages of this method are low accuracy; small area of application. The advantage is that it can be used for determining the force and coefficient of friction of twisted products.

Device No. 3 (Patent No. 2488 094) is a device for determining the coefficient of static friction force.

The device includes a platform 1 pivotally mounted on a frame 2, a scale 3, a plate 4 with longitudinal grooves 5, in which particles 6 of the bulk material under study are placed, a traction device 7.

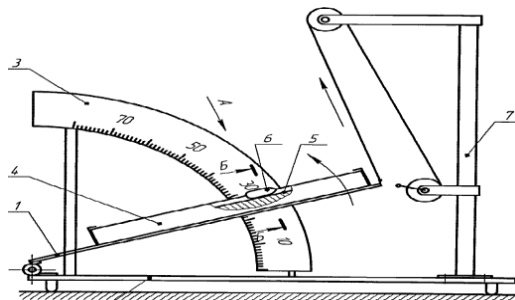


Fig. 3. Device for determining the coefficient of friction

The device works as follows: particles of bulk material under investigation are placed in the longitudinal grooves of the plate, fixed on the platform previously lowered to the lower position. Then the platform with the fixed plate is slowly raised by the traction device until the particles begin to slide along the longitudinal grooves. In this case, the angles (α) of the beginning of sliding of the particles are recorded on a scale and the average value α is determined, according to which the coefficient of the static friction force is determined as the tangent of the angle α .

The disadvantages include limited scope; it does not ensure the efficiency of measurements. The advantages are reduced labor intensity of measurements and improved determination of the friction coefficient of bulk materials.

This article presented an overview of existing designs of installations for determining the coefficient of friction at rest, indicating the advantages and disadvantages of each of them.

References

1. Lobachevsky P.Ya. RF Patent No. 2007133949/28, 10.11.2007. Metod opredeleniya koeffitsienta treniya [Method for determining the friction coefficient]. Patent of Russia No. 2343455, 2009, Bul. No. 1. (Rus)
2. Ismailov G.M. RF Patent No. 2009139603/28, 26.10.2009. Metod opredeleniya koeffitsienta treniya i sily treniya [Method for determining the coefficient of friction and friction force]. Patent of Russia No. 240869, 2009, Bul. No. 1. (Rus)
3. Tishaninov N.P. RF Patent No. 201210707/28, 20.02.2013. Ustrojstvo dlya opredeleniya koeffitsienta sily treniya pokoya [Device for determining the coefficient of static friction force]. Patent of Russia No. 2488094, 2012, Bul. No. 20. (Rus)

ОБЗОР СУЩЕСТВУЮЩИХ УСТАНОВОК ДЛЯ ОПРЕДЕЛЕНИЯ КОЭФФИЦИЕНТА ТРЕНИЯ ПОКОЯ

М. С. Петров, И. А. Шемонаев*, А. А. Терехов

Тамбовский государственный технический университет г. Тамбов, Россия
*e-mail ivanshemonaev.com@mail.ru

Аннотация. Рассмотрены конструкции приборов для исследования коэффициентов покоя и движения, внутреннего и внешнего трения. Дан их анализ, преимущества и недостатки.

Ключевые слова: коэффициент трения, прибор, сыпучие материалы.

Ways of Improving the Device Design and Method for Determining Elastic Properties of Plant Stems

A. A. Terekhov*, A. O. Nozdrina, A. I. Kadomtsev

Tambov state technical University, Tambov, Russia
*e-mail: terehoff5ash@yandex.ru

Abstract

The design of installations for determining the elastic properties of plant stems is considered. A brief analysis, advantages and disadvantages are given. The direction of improving the design of installations for determining the elastic properties of plant stems is considered.

Key words: elastic properties, stem, bending.

In modern agricultural engineering, the study of the properties of agricultural materials plays an important role in the design of machines and the optimization of their operation. Important properties are the elastic properties of agricultural plants, as they have a significant impact on the choice of materials for parts, their characteristics in the development of new machines and improvement of existing ones.

The device is designed to study the properties of plants. Installation for studying the elastic properties of plants [1]. This device works as follows (Fig. 1): the compression chamber 5 with its extreme left position and with the retracted bottom 6 of the side wall 7 and the removed light movable bar 17 is filled with a mass of stems, after which the side wall 7 is installed by connecting it to the spring 11, a movable bar 17 and a bottom 6. The bottom 6 is fixed in the closed position by a lock 9, which is held in this position by a spring 12. The stop 3 is set at the required distance, which allows the lock 9 to turn to the left when a predetermined degree of compression of the mass of the stems in the chamber 5, drive 4, which moves the compression chamber 5 kinematically connected to it to the right and compresses the investigated leaf-stem material between the piston 2 rigidly attached to the frame 1 and the bottom 6. The movable bar 17 registers the movement of the compression chamber 5 to the right. The movement of the compression in chamber 5 is to the right, and, consequently, the compression of the mass of the stems and the extension of the spring 10 is carried out until the lock 9 reaches the stop 3 fixed on the frame 1 at a given place.

After that, the lock 9 turns to the left and releases the bottom 6, which is the spring 10 swings to the left, while the pins rigidly fixed in the bottom 6 come out of the holes 14 and 15 of the hinged side wall 7 and the hollow cylinder 16 and thereby release the side wall 7, which swings towards the connection of the spring 11. Freed from the bottom 6 and the side, of the wall 7, the compressed mass of the stems without lateral expansion, and therefore without lateral friction forces, expands in the arcuate shelf 8, which is a continuation of the hollow cylinder 16

and moves the movable bar 17 to the left, registering the expansion of the stem mass free from lateral expansion.

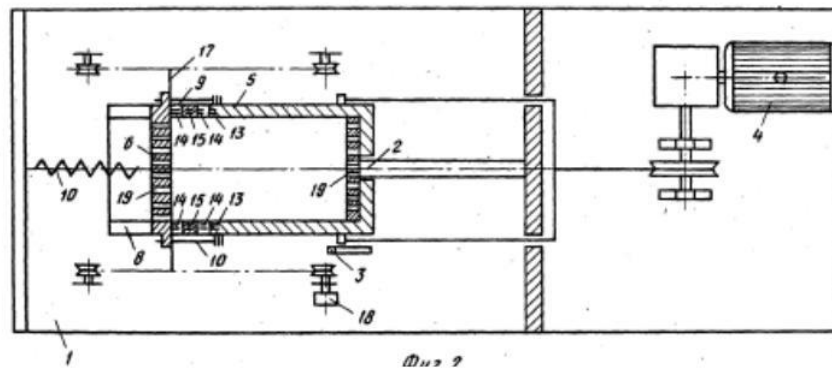


Fig. 1. Installation of research of elastic properties of plant stems:
 1 - frame; 2 - piston; 3 - emphasis; 4 - drive; 5 - compression chamber; 6 - bottom; 7 - walls; 8 - shelf; 9 - retainer; 10.11 - springs; 12 - spring; 13 - pins; 14, 15 - holes; 16 - cylinder; 17 - movable bar; 18 - sensor

The main disadvantage of this device is the study of already cut plants, while the time between the cut and the study should be minimal, otherwise the physical and mechanical properties of the plants change and the data obtained is distorted.

A device has also been developed for studying the physical and mechanical properties of potatoes [2]. The most generalized characteristic for stems can be their rigidity, taking into account the modulus of proportionality E and the moment of section of the stem J . To determine the stiffness of stems under static conditions, the stem bending method is used. Imagine the tested part of the stem in the form of a straight beam, clamped by one end of the beam (Fig. 2) with the same cross-section along the entire length.

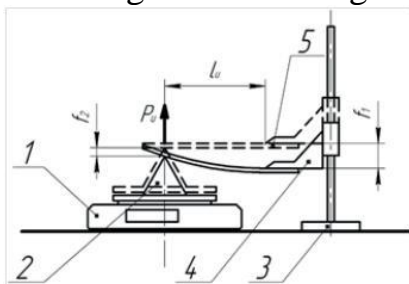
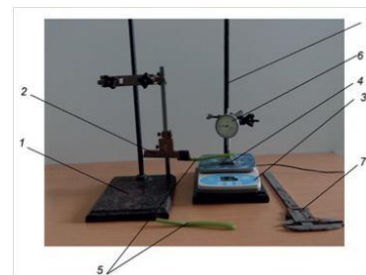


Fig. 2. Scheme and general view of the installation for testing stems



a) Installation diagram

1 - scales; 2 - prism; 3 - tripod; 4 - stem holder; 5 - test stem; f_1 and f_2 - the height of the stem holder and prism lowering, respectively; P_i - bending force; l_i - bending force shoulder

b) General view of the installation

1 - tripod; 2 - vernier depth gauge; 3 - scales; 4 - prism; 5 - samples of the tested stems; 6 - measuring head; calipers

To determine the bending force, an electric scale VSP-0.5 / 0.1-1 is used, and as a tripod with a ruler - a depth gauge SHG 200-0.05, to the base of which the test stem is attached. The magnitude of the displacements of the prism is determined

using a dial indicator (indicator head) ICh-10 with a reading accuracy of 0.01 mm. In order to eliminate stress concentration at the attachment point, the end of the stem is evenly and without tension wrapped with adhesive tape and the same end is fixed on the stem holder, the radius of the profile of the bending prism is 3 mm [2] (according to the recommendations for thick-stemmed crops). The experiments are carried out as follows. To the base of the depth gauge 2 (Fig. 2b), fixed in the stand 1, a sample of the stem 5 is attached with adhesive tape. When the base is lowered, the stem touches the top of the prism. This serves as a starting point.

In the logbook, the position of the base is recorded and the indicator head is set to zero, the micrometer feed frame of the depth gauge is fixed with a screw. Then, the nut of the micrometric feed of the depth gauge slowly rotates, the stem holder with the fixed stem is lowered down, at short intervals (1-5 mm) it is recorded at each fixed position of the stem holder installation height and the readings of the scales and indicator head. The bending test of each sample is carried out in two mutually perpendicular planes. This device is also characterized by the study of already cut plants, which leads to a distortion of the information received, but in some cases it is a necessary condition for the experiment (study of freshly cut plants, withered and dried).

An interesting approach in the study of the interaction of plants and organs of agricultural machines is the method of studying cutting the stems of agricultural crops [3]. In accordance with this method, to study cutting, the stalks 1 of agricultural crops are fixed with holders 2, which are rigidly mounted on the conveyor 3 in the form of an endless belt (Fig. 3). Holders 2 are arranged in parallel rows with a distance corresponding to the row spacing h of agricultural crops. Then carry out the movements of the conveyor 3 with the holders 2 with the stalks 1 to the cutting element 4 at a speed corresponding to the speed of movement of the machine intended for harvesting this crop. Next, the stems 1 are cut by the cutting element 4 in the form of a screw 5, which imitates the working body of the harvesting machine. The rotational speed of the screw 5 corresponds to the required frequency for cutting the crop under study. After that, the conveyor 3 with the remains of the stems in the holders 2 returns to its original position (Fig. 3c, d).

Then the cutting height of the stems is changed with the measuring tool 6. A visual assessment of the cut quality is carried out and a decision is made on the efficiency of the cutting element on the studied agricultural crop. The use of the method for studying cutting the stems of agricultural crops makes it possible to carry out studies of thick-stemmed agricultural crops with variable values of the screw rotation frequency depending on the studied agricultural crop and the thickness of its stem, the speed of the conveyor and the height of the auger above the conveyor, and the working speeds of the harvesting machines. The use of the proposed invention in comparison with known similar purposes allows you to expand the functionality.

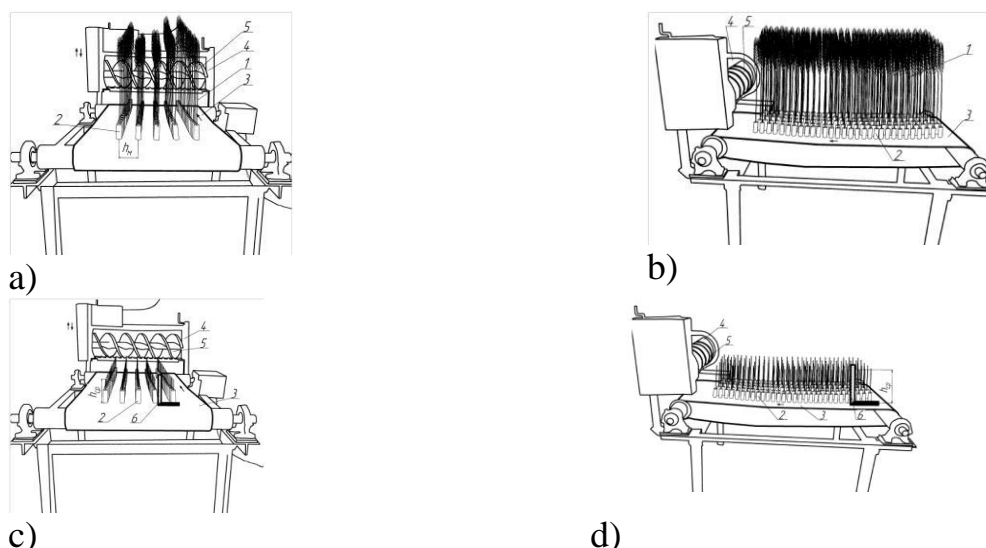


Fig. 3. A method for studying cutting the stems of agricultural crops:

1 - Stem; 2 - Holder; 3 - Transporter; 4 - Cutting element; 5 - auger; 6 - Measuring tool

The disadvantage of this method is also the limited time interval due to the fact that research is carried out on already cut plants.

This article provides an overview of existing devices and methods for determining the elastic properties of plant stems. Based on the analysis performed, it can be concluded that in order to increase the accuracy of measurements, the effect of machines on living plants, further improvement of devices and methods of testing is necessary.

References

1. Zagryadskiy R.G. Ustanovka dlya izucheniya uprugih svoystv rastenij [Installation for studying the elastic properties of plants]. Patent No. 3826513, No. 173013, appl. 12/13/84, publ. 05/07/87. Altai Scientific Research Institute of Agriculture and Breeding of Agricultural Crops. (Rus)

2. Oreshkina M.V., Krygina E.E., Krygin S.E. Issledovanie nekotoryh fiziko-mekhanicheskikh svoystv stebel' kartofelya [Investigation of some physical and mechanical properties of potato stems]. Bulletin of RGATU, 2020, No. 2, pp. 80-84. (Rus)

3. Kalimullin M.N., Markina N.O., Abdrakhmanov R.K. Stend dlya issledovaniya processa izmel'cheniya stebel' rastenij [Stand for research of the process of grinding plant stems]. Patent No. 87862, No. 2009118134, appl. 05/13/2009, publ. 10/27/2009, Kazan State Agrarian University. (Rus)

4. Truflyak E.V., Truflyak I.S., Razgonov I.V. Sposob issledovaniya stebel' srezki sel'skokozyajstvennykh kul'tur [A method for studying cutting the stems of agricultural crops]. Patent No. 2679728, No. 2017125871, appl. 18.70.2017, publ. 01/23/2019, Kuban State Agrarian University named after I.T. Trubilin. (Rus)

НАПРАВЛЕНИЯ СОВЕРШЕНСТВОВАНИЯ КОНСТРУКЦИЙ УСТРОЙСТВ И СПОСОБА ДЛЯ ОПРЕДЕЛЕНИЯ УПРУГИХ СВОЙСТВ СТЕБЛЕЙ РАСТЕНИЙ

А. А. Терехов*, А. О. Ноздрин, А. И. Кадомцев

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: terehoff5ash@yandex.ru

Аннотация. Рассмотрены конструкции установок для определения упругих свойств стеблей растений. Дан краткий анализ, преимущества и недостатки. Рассмотрено направление совершенствования конструкции установок для определения упругих свойств стеблей растений.

Ключевые слова: упругие свойства, стебель, изгиб.

A Theoretical Study of the Nipple Rubber Impact on the Nip during the Compression State

V. S. Zharikov*, V. I. Dorovskikh, S. M. Vedishev

Tambov State Technical University, Tambov, Russia

**e-mail: Vadim_688@bk.ru*

Abstract

The analysis of the quality ensuring problem of the milking process has shown the effect of the structural operating parameters of milking machines on the physiology of animals. A priori information on the methods and technical means of determining and evaluating the process of interaction between liner and teat during milking is considered. Based on the provisions of the combined theory of liner pressure on the nipple (American model) and the classical theory of shells, the dependence of the liner pressure on the nipple when closing on the thickness of its walls, the radius of the liner, the modulus of elasticity of the material and the working vacuum is obtained.

Keywords: apparatus, nipple rubber, pressure on the nipple, critical pressure, deformation

Introduction

The efficiency of the milking machine is determined mainly by the correspondence of its structural and operational parameters to the morphological and functional properties of the udder of animals.

Direct contact with the udder of the animal is carried out by the teat rubber installed in the sleeve of the milking cup. Compression of the nipple rubber with a certain frequency and duration of cycles determines the magnitude of the pulse of vacuum action on the nipple.

Another important characteristic of the quality of the milking machine is the pressure of the teat rubber on the animal's teat during the compression stroke.

Studies performed by a number of scientists have shown that the value of this pressure more than 12 kPa worsens the flow of arterial blood and leads to hyperkeratosis of the nipple end, at a pressure less than 8 kPa, the stimulation of breast delivery is worsened, which leads to a decrease in the intensity of milk production [1-3]. Thus, it is assumed that the optimal pressure range at the end of the nipple is 8 ... 12 kPa.

However, theoretical studies performed by domestic and foreign scientists (L.P. Kartashov, I.N. Krasnov, E.A. Kelpis, E.A. Matisan, N.N. Belyanchikov, I.V. Zhilov, Yu.S. Karavaev, A.S. Vepritsky, D. Reineman, M. Davis) do not provide a clear solution to the problem of determining and evaluating the interaction of teat rubber and teat during milking, and even contradict each other [1 - 2].

Materials and methods

The paper uses the provisions of the classical theory of shells, methods for studying functions, the provisions of the unified theory of pressure acting on the

teat from the side of the liner (American model).

Results and its discussion

According to the studies of Reineman, Mein, Williams, Douglas, Pobedinsky and other scientists, the amount of overpressure at the end of the teat depends on the following factors: thickness and stiffness of the teat liner, the amount of its tension in the teat cup, and the working vacuum [1, 2].

The results obtained in these studies (Figure 1) show that the overpressure (OR-SD) exerted by the teat rubber on the teats changes as follows:

- it increases, first of all, with an increase in the working vacuum due to the larger pressure difference acting across the walls liner rubber;
- increases with increasing tension when the liner is installed in the teat cup;
- initially increases with an increase in the depth of immersion of the teat into the liner, but then begins to decrease to almost zero when the end of the teat reaches the base of the cylindrical part of the liner;
- at first it gradually increases, but then begins to decrease with: 1) an increase in the wall thickness of the liner rubber, 2) an increase in the rigidity of the rubber, 3) an increasing resistance to compression.

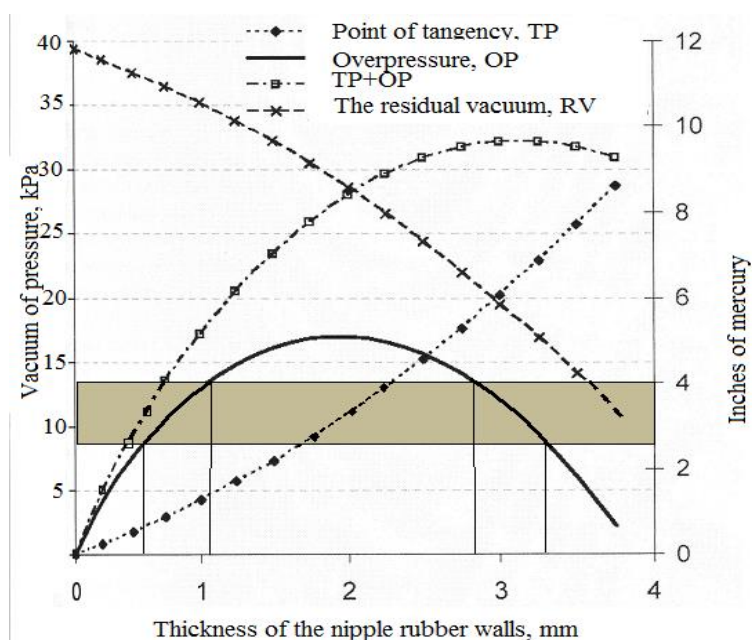


Fig. 1. Dependences of the interaction of the teat with 18 types of liners produced by companies in France, Germany, Sweden and the USA

Analysis of the dependence (Fig. 1), demonstrating the change in the pressure of the teat liner on the teat (P_{OP}) on the wall thickness of the liner (δ), showed that this dependence can be represented by a second-order equation of the type: $P_{OP} = a\delta^2 + b\delta + c$.

Three characteristic points can be distinguished on the graph: “A” in which $\delta = 0$ and $P_{OP} = 0$; “C” in which $\delta = \delta_K$ and $P_{OP} = 0$; “B” in which $\delta = \delta_K / 2$ and $P_{OP} = P_{MAX}$.

If the coordinates of 3 different points of its graph $(x_1; y_1)$, $(x_2; y_2)$, $(x_3; y_3)$ are known for a second-order equation, then its coefficients can be found as follows [5]:

$$a = \frac{y_3 - \frac{x_3(y_2 - y_1) + x_2y_1 - x_1y_2}{x_2 - x_1}}{x_3(x_3 - x_1 - x_2) + x_1x_2}, -b = \frac{y_2 - y_1}{x_2 - x_1} - a(x_1 + x_2), -c = \frac{x_2y_1 - x_1y_2}{x_2 - x_1} + ax_1x_2.$$

For the characteristic points we have selected, the coefficients of the equation will be:

$$a = \frac{-4P_{max}}{\delta_k^2}; b = \frac{4P_{max}}{\delta_k}; c = 0.$$

The equation will take the form:

$$P_{OP} = 4P_{max} \left(\frac{\delta}{\delta_k} - \frac{\delta^2}{\delta_k^2} \right) \quad (1)$$

The value of δ_k is equal to the wall thickness of the liner stocking, at which the critical pressure corresponding to the onset of deformation of the liner corresponds to the pressure difference between the interwall and suction chambers of the teat cup during the compression stroke.

The critical pressure at which the deformation of the liner stocking begins is determined from the expression [6]:

$$P_k = \frac{E\delta^3}{4(1-\mu^2)R^3} \quad (2)$$

where P_k is critical pressure; E is the modulus of elasticity of the material; M is Poisson's ratio; δ is wall thickness of the liner stocking; R is the radius of the liner stocking.

At point "C", the critical pressure is equal to the vacuum in the suction chamber during the compression stroke, which can be taken equal to the working vacuum (P_p). Then the wall thickness of the liner stocking corresponding to this condition will be equal to:

$$\delta_k = 1,44R \sqrt[3]{\frac{P_p}{E}} \quad (3)$$

The magnitude of the pressure of the liner rubber on the teat P_{max} at the point "B" can be determined by the critical pressure formula proposed by E.A. Kelpis. and E.A. Matisan [4]:

$$P_{max} = qE \frac{\delta^2}{R^2}$$

where q is a dimensionless critical load parameter obtained experimentally.

Taking into account the fact that at point "B" $\delta = \delta_k/2$ the formula will take the form:

$$P_{max} = qE \frac{\delta_k^2}{4R^2}$$

Or, taking into account expression (3), we get:

$$P_M = 0,5^3 \sqrt[3]{P_p^2 E q} \quad (4)$$

Then equation (1) taking into account expressions (3) and (4) will take the

form:

$$P_{OP} = q \left(\frac{1,38 \sqrt[3]{P_p E^2}}{R} \delta - \frac{E}{R^2} \delta^2 \right) \quad (5)$$

For liner with a stocking radius of 13 mm and a rubber modulus of 5 mPa, the wall thickness at which the pressure on the teat is zero when the pressure difference between the interwall and suction chambers during the compression stroke is 40 kPa, in accordance with expression (3) equal to 3,74 mm, which roughly corresponds to the data of American scientists (Figure 1).

Figure 2 shows the dependence of the change in the pressure of liner rubber on the teat when it is closed with a stocking radius of 13 mm on the thickness of the stocking made of rubber with a modulus of elasticity of 5 MPa for a working vacuum of 40, 44 and 48 kPa.

The graph shows that with an increase in the working vacuum from 40 to 48 kPa, the maximum of the function increases from 16.24 kPa to 18.0 kPa, the ordinate of the maximum value changes from 1.87 mm to 2.14 mm. The wall thickness of the liner stocking, at which the pressure on the teat becomes zero, increases from 3.74 mm to 4.28 mm with a change in the working vacuum.

The obtained mathematical model can be used to optimize the design parameters of liners in their design, as well as in the development of instrumental monitoring of the state of liners during their operation [7].

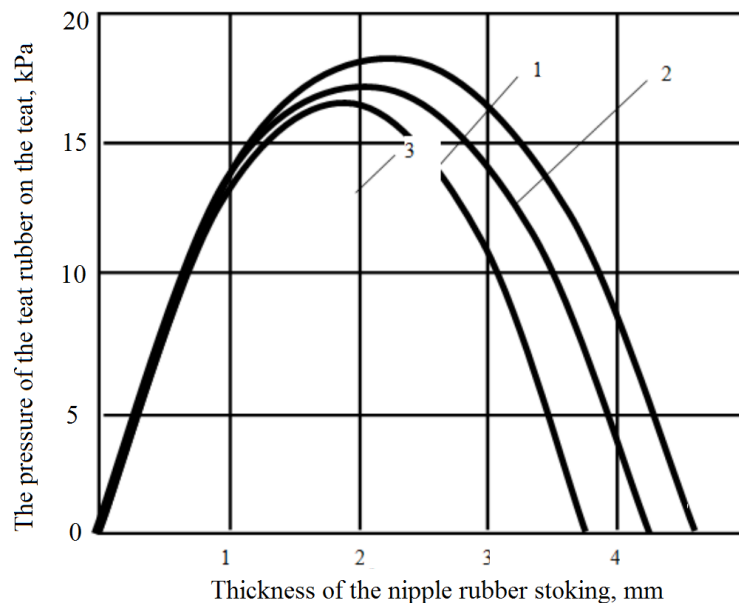


Fig. 2. Graphs of changes in liner pressure on the teat from the wall thickness at a working vacuum: 1 - 40 kPa; 1 - 44 kPa; 1 - 48 kPa

Conclusion

Based on the provisions of the combined theory of liner pressure on the teat (American model) and the classical theory of shells, the dependence of the liner pressure on the teat when closing on the thickness of its walls, the radius of the

liner stocking, the modulus of elasticity of the material and the working vacuum is obtained.

The nature of the dependence is a second-order equation; while the pressure of the liner rubber on the teat with increasing wall thickness first increases from zero to a maximum, and then decreases and reaches zero at the point where the critical pressure is equal to the working vacuum.

The resulting model makes it possible to predict the nature of the interaction between the liner and the teat at different values of the design parameters of the milking machine and the modes of the milking process. Thus, for liners with a stocking radius of 13 mm and a rubber modulus of 5 mPa, with an increase in the working vacuum from 40 to 48 kPa, the maximum of the function increases from 16,24 kPa to 18.0 kPa, the ordinate of the maximum value changes from 1.,87 mm to 2.14 mm.

References

1. Mein G.A., Williams D.M.D., Reinemann D.J. NMC effects of milking on teat-end hyperkeratosis: Mechanical forces applied by the teatcup liner and responses of the teat. 42nd Annual Meeting of the National Mastitis Council, Fort Worth Texas, USA, January 2003, pp. 26-29.
2. Davis M.A., Reinemann D.J., Mein G.A. Relationships between physical characteristics and milking characteristics of the aging milking liner. 2000 ASAE annual international meeting, Milwaukee, Wisconsin, July, pp. 10-13.
4. Kartashov L.P. Mashinnoe doenie korov [Machine milking of cows]. M.: Kolos, 1982, 104 p. (Rus)
4. Dorovskikh V.I., Dorovskikh D.V., Khokhlov I.N. Povichshenie kachestva doeniya regulirovaniem davleniya soskovoy rezin na sosok [Milking quality puffing by regulating the pressure of the nipple rubber on the nipple]. *Tekhnika v seljskom khozyaystve*, 2012, No. 6, pp. 12-13. (Rus)

ТЕОРЕТИЧЕСКОЕ ИССЛЕДОВАНИЕ ПРОЦЕССА ВОЗДЕЙСТВИЯ СОСКОВОЙ РЕЗИНЫ НА СОСОК ВО ВРЕМЯ ТАКТА СЖАТИЯ

В. С. Жариков*, В. И. Доровских, С. М. Ведищев

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: Vadim_688@bk.ru

Аннотация. Проведен анализ состояния проблемы обеспечения качества процесса доения; показано влияние конструктивно режимных параметров доильных аппаратов на физиологию животных. Рассмотрена априорная информация о методах и технических средствах определения и оценки процесса взаимодействия сосковой резины и соска при доении. На основе положений объединенной теории давления сосковой резины на сосок (американская модель) и классической теории оболочек получена зависимость давления сосковой резины на сосок при смыкании от толщины ее стенок, радиуса чулка сосковой резины, модуля упругости материала и рабочего вакуума.

Ключевые слова: аппарат, сосковая резина, давление на сосок, критическое давление, деформация.

The Analysis of Existing Methods and Means of Drying

O. A. Zorina, A. S. Zorin*

Tambov State Technical University, Tambov, Russia

*e-mail: zorin619@bk.ru

Abstract

The article analyses the drying process which is a thermophysical process aimed at removing moisture from a product. However, this type of treatment is at the same time a technological process, during which it is necessary not only to remove excess moisture, but also to preserve nutrients, vitamins, aroma and taste of the product. Today, there are many high temperature automated fruit dryers. However, their use is unprofitable with small volumes of processing of vegetable raw materials in the conditions of peasant and farm households, which is associated with large capital investments and high energy costs.

Keywords: drying, vegetable raw materials, dryer.

Introduction

Drying is a thermophysical process aimed at removing moisture from a product. The evaporation rate is proportional to the free surface area of the liquid and depends on the concentration of its vapors in the air. The processes of the transition of molecules from liquid to air and vice versa are balanced when the partial vapor pressure reaches equilibrium (saturation state). The kinetics of drying is mainly understood as the time dependence of the average moisture content and temperature of the dried mass, which can be used to calculate the amount of removed moisture and heat energy consumption.

Requirements for fruit drying technology are limited not only by humidity up to standard values, but also by the maximum preservation of nutrients, vitamins, aroma and taste, as well as the presentation of the dried product. These additional requirements impose certain restrictions for a warm o- and mass-transfer processes of drying, the parameters that determine the features of moisture due to the organic fruit material.

Discussion

In the general case, the connection of moisture with the material occurs by three mechanisms: physicommechanical, physicochemical and chemical.

Inside the cells of plant material, moisture is bound by osmotically semipermeable walls and (membranes), which freely pass solutes. Therefore, during their drying, energy is spent on overcoming the resistance of osmotic pressure when moisture is transferred to the outer surface of the cells. Subsequently, moisture, being only mechanically bound to the outer surface of the membrane, is removed by the usual evaporation mechanism. Acceleration of drying by additional heat input is limited by the danger of local overheating and destruction of organic tissues, which worsens the consumer quality of dried fruits. Consequently, bonding forces of different physical nature also require different mechanisms of moisture removal, the essence of which is determined by the corresponding driving forces.

The cells of plant materials have a complex structure. The main active part of the

cell is protoplasm, consisting of cytoplasm and nucleus. The protoplasm has a common outer cell membrane, and the nucleus and cytoplasm are surrounded by membranes. The outer cell membrane consists of two layers: primary and secondary, including fibrils (filaments) of cellulose (cellulose), cemented with calcium and magnesium pectates.

In fruits, the amount of free moisture is negligible. It is always associated with components, or is located in the compartments of the cell surrounded by membranes. During drying, the product is dehydrated and heated. Heating the product has a different effect on the organic matter content. In fruits, the most thermolabile components are ascorbic acid, pigments, and phenolic compounds. The maximum allowable temperature of the coolant is mainly determined by the thermal stability of these indicators of the chemical composition. Comparison of indicators of chemical composition with similar indicators of quality in dried products will make it possible to assess the degree of their transformation and the amount of losses during processing.

During the drying of plant materials, all release processes occur simultaneously, but at different rates. It is impossible to single out each component of dehydration separately, and the drying stages are studied with the so-called sorption isotherms - graphical dependences of the moisture content on its vapor concentration in the air at a constant temperature. The slope of the sorption isotherm determines the distribution coefficient of a substance between phases in a state of dynamic equilibrium. In practice the drying process is characterized by kinetic curves - temporal dependencies of the moisture content of the fruit at constant temperature and speeds of airflow.

When processing plant raw materials, natural and forced convective methods of drying agricultural products are used, this is due to the methods of heat transfer, the characteristics of materials, the types of connection between moisture and material and energy consumption.

Drying in natural conditions in the open air is the simplest and therefore the most common way of dehydrating plant materials. During dehydration of natural drying vegetable raw material occurs without intensifying effect on human factors (temperature and product and the heating medium - air, humidity surrounding of the medium, etc.).

In real conditions of natural drying in the open air, moisture on the surface is always blown by an air stream, which intensively scatters the molecules of saturated vapors of the near-surface layer of air, which is equivalent to the acceleration of diffusion processes due to the convective component of diffusion mass transfer. In this case, the surface temperature of the water is further reduced, and moisture release is accelerated. Therefore, low-temperature drying occurs even when the temperature of the air flow is equal to the ambient temperature. Convective dryers, in which the outside air serves as a drying agent, regardless of its temperature, are called atmospheric.

The disadvantages of the atmospheric drying plants are: pollution of fruits and the environment with toxic products of fuel combustion; fruit mass uneven heating and the high drying rate, which leads to transplanting, deformation and cracking of the material;

high energy costs. The use of natural drying of fruit outdoors in natural light requires significant labor costs and low productivity [1].

With the forced method of drying plant materials, it is necessary to choose the correct drying method and the design of the drying apparatus.

Depending on the method of supplying heat energy to vegetative raw materials used are drying techniques: Sublimation s minutes, convective, conductive, drying at a high frequency current heating, infrared.

The compulsory method of drying plant materials is carried out in special apparatuses (drying plants or chambers), which, according to their design, are: chamber, belt, conveyor, infrared drying plants, tray, roller, rack, and corridor.

The convective method of drying heat involves the transfer from the heat source to the surface of the material being dried by a heating medium. The air flow or a gas flow is used as a heat carrier. This method is the most common, but it has a number of disadvantages:

- large energy expenditure (for removal of one kilogram of water from the fruit raw material and converting it into steam must be expended from 1.6 to 2.5 kW · h of electricity);
- difficulties in controlling the drying process, and the liquefied gas layer, as the impossibility of sampling and visual inspection in drying;
- at the indicated temperature drying mode deviation in temperature leads to caramelization of the sugar in the fruit feedstock.

The conductive drying method is based on the transfer of heat of the material to be dried in contact with a heated surface. In case conductively minutes drying diffusion and thermal diffusion due to concentration difference moisture same direction that promotes intensification of the process shown in the first drying and the second drying period is reduced intensity due to temperature variations.

Roller chute and drying installations based on this drying method have conductive high electricity consumption (1.5 to 1.7 kW · h per 1 kg of removed moisture).

Drying with infrared rays is accompanied by strong heating of the material surface, as a result of which a significant temperature gradient is created, which prevents the movement of moisture from the inside of the material to the surface. It should here intermittent irradiation, in which the surface material is rapidly heated and dehydrated, and during the removal of moisture from the inner layers of the material moves to the outside.

The freeze-drying method is one of the most effective in the fruit drying process. It can be divided into two stages: in the first, with the help of a deep vacuum, moisture is frozen and comes out to the surface, in the second, due to the intensive supply of heat and moisture is evaporated (ice, bypassing the liquid state, turns into steam). A large spread of this technology has not received due to the complexity of the design of tunnel dryers, low productivity, high capital investment, the costs of production, electric energy consumption (from 3 to 3.9 kW · h per 1 kg of removed moisture).

The introduction of new methods and progressive technologies in the process of drying plant raw materials is the most important task of increasing the efficiency of

drying plants. It poses stringent requirements for quality in the dried fruit (preservation labile components, nutrients, vitamins, aroma and flavor, etc.).

Combination methods and means of the drying plant materials (convection and vacuum, convection and infrared radiation), provide a synergistic effect in the process while warm o- and mass transfer within the product. This effect results in a higher quality dried product, increased energy savings, and drying efficiency and a shorter drying time [3].

Conclusion

Thus, for individual farming and small subsidiary farms, the issue of developing energy-intensive and material-intensive dryers that would use available alternative sources of thermal energy, for example, solar, to maintain the quality of the product, remains relevant.

The analysis of the existing means and methods for drying fruits has shown that chamber-type dryers with convective heat supply are most widely used in personal peasant and private farms.

References

1. Baydakov E.M., Kupreeenko A.I., Isaev H.M., Chenin A.N. Development of a drum solar dryer for grain and substantiation of its design and technological parameters. Journal: Technology of wheeled and tracked vehicles. Moscow, 2014, 103 p.

2. Genin S.A. Technology of drying potatoes, vegetables and fruits. M.: Food prom-st, 1971, 291 p.

3. Zorin A.S. Sovershenstvovanie tekhnologii i tekhnicheskikh sredstv kombinirovannoj vakuumnoj sushki rastitel'nogo syr'ya dlya proizvodstva chipsov [Improvement of technology and technical means of combined vacuum drying of vegetable raw materials for the production of chips]. Dis. ... Cand. tech. Sciences: 05.20.01. Tambov, 2019, 156 p. (Rus)

АНАЛИЗ СУЩЕСТВУЮЩИХ МЕТОДОВ И СРЕДСТВ СУШКИ

О. А. Зорина, А. С. Зорин*

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: zorin619@bk.ru

Аннотация. Сушка – процесс, направленный на удаление влаги из продукта. Однако данный процесс сушки материалов является одновременно и технологическим процессом, во время которого необходимо не только удалить лишнюю влагу, но и сохранить питательные вещества, витамины, ароматические и вкусовые качества продукта. Сегодня существует много высокотемпературных автоматизированных аппаратов для сушки фруктов. Однако их применение является нерентабельным при небольших объемах переработки растительного сырья в условиях крестьянских и фермерских хозяйств, что связано с большими капитальными вложениями и высокими энергозатратами.

Ключевые слова: сушка, растительное сырье, сушилка.

The Study of Reflected and Least Scattered Photons in Optical Coherent Tomography

V. O. Chereshnev*, I. V. Kuleshov, I. V. Romanenko

Tambov State Technical University, Tambov, Russia
*e-mail: vitaliy-cha1999@yandex.ru

Abstract

This paper describes the results of a study of structural images of human skin and blood vessels *in vivo* obtained with an optical coherence tomography (OCT) system based on a Michelson interferometer. The obtained data were subjected to computer processing, with the help of which the variances matrix between adjacent A-scans was calculated. The structural OCT image is compared with the image of the variance matrix. To minimize speckle noise and determine the areas corresponding to reflected and backscattered photons, we use averaging of the initial data over the corresponding pixels. A significant decrease in the intensity corresponding to the area of air and surface layers of the skin is determined in the variance matrix of the corresponding parts of the structural image. With decrease of the anisotropy parameter and increase of the scattering coefficient of the medium we register increase of speckle noise and decrease of the coherence probing depth (CPD). The area of the blood vessel has high variance values, which is reflected in the results of constructing the matrix in the form of low intensity indicators.

Keywords: variance matrix, optical coherence tomography (OCT), image processing, speckle structure, coherence probing depth (CPD).

Multiple scattering of optical radiation, the presence of speckle noise, as well as the characteristics of the radiation source used and the type of scanning in the shoulder of the sample, significantly complicate the biomedical visualization of biological object structures using OCT. The study of the fundamental principles of OCT, in particular, the study of the role of reflected and low-scattered photons on the process of constructing structural images, will further improve the technical diagnostic tools in ophthalmology and dermatology [1].

Biological tissues have a complex spatial structure, which leads to deviations in the trajectory of photons, in particular to an increase in the scattering multiplicity, which can be observed by constructing a variation matrix.

The purpose of this paper is to differentiate reflected and slightly scattered photons by constructing a variation matrix of a structural OCT image.

The main object of the study is structural OCT images of human skin *in vivo*, obtained using a non-standard optical system based on a Michelson interferometer, which uses small-angle raster scanning in the shoulder of the sample, which makes it possible to increase the CPD by ~ 30%, and, therefore, to visualize the subcutaneous blood vessels.

Indicators of anisotropy and scattering coefficients of tissue and blood vessels are very different, and, therefore, they correspond to a different number of acts of

interaction, which is expressed by the difference between adjacent A-scans of the image [2, 3]. To test this hypothesis, the variances of the intensity of the corresponding image pixels were calculated.

The variance was calculated using the standard formula:

$$\sigma^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}$$

Initially, n was taken equal to 5. The A-scan of the original image and the variance for five adjacent scans is shown in the Fig. 1.

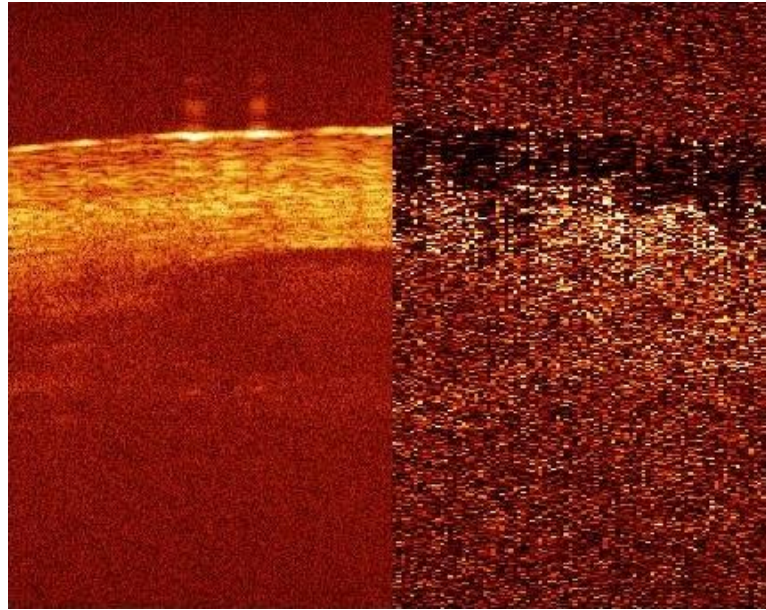


Fig.1. Structural OCT image of human skin, vessel and blood in vivo (left) and image of variances matrix (right); image size 2 × 2 mm

This paper describes the results of a study in which, using digital processing, structural OCT images of the layers of the skin and a human blood vessel in vivo were constructed. Also, dispersion matrices reflecting the processes of backscattering and reflection of coherent photons were obtained. It was revealed that at low values of the signal-to-noise ratio, the calculation of the difference between the pixels of five consecutive images reflects artifacts of the tomographic image construction, such as speckle noise, reflection and scattering. At large values of the signal-to-noise ratio, the effect of noise components is minimal, and the calculation of the variance allows one to detect changes in the heterogeneity of the medium, for example, the layers of the skin and a blood vessel.

Using the results of the above calculations, further research will be carried on 2D and 3D OCT image processing, as well as with the dedicated software package development based on. The development of this algorithm together with the differentiation of the structures of the skin, blood vessels and blood by analyzing the distribution of the histogram of pixel intensities. Therefore, it will possible to create anatomical maps of the subcutaneous blood vessels of humans and animals *in vivo*.

References

1. Chereshev V.O., Abdulkarim S.N., Proskurin S.G. Investigation of reflected and low-frequency scattered photons by means of constructing a dispersion matrix of OCT images. Modern high technology, 2019, No. 12-1, pp. 118-122.
2. Chereshev V.O., Romanenko I.M., Kuleshov I.V., Proskurin S.G. Differentiation of skin, blood vessels and blood structures by means of constructing a variation matrix of OCT images. Modern high technology, 2019, No. 10 (part 2), pp. 319-323.
3. Chereshev V.O., Frolov S.V., Potlov A.Yu., Proskurin S.G. Construction of OCT images of biological tissues based on the analysis of pixel intensity. Models, systems, networks in economics, technology, nature and society, 2019, No. 3 (31), pp. 104–112.

ИССЛЕДОВАНИЕ ОТРАЖЕННЫХ И МАЛОКРАТНО РАССЕЯННЫХ ФОТОНОВ В ОПТИЧЕСКОЙ КОГЕРЕНТНОЙ ТОМОГРАФИИ

В. О. Черешнев*, И. В. Кулешов, И. М. Романенко

Тамбовский государственный технический университет, Тамбов

*e-mail: vitaliy-cha1999@yandex.ru

Аннотация. Представлены результаты исследования структурных изображений кожи и кровеносных сосудов человека *in vivo*, полученные оптическим когерентным томографом (ОКТ) на базе интерферометра Майкельсона. Полученные данные подвергнуты компьютерной обработке, при помощи которой рассчитана матрица дисперсий между соседними А-сканами. Структурное ОКТ изображение сравнивается с изображением матрицы дисперсий. Для минимизации шумов и определения областей, соответствующих отражённым и рассеянным назад фотонам использовано усреднение исходных данных по соответствующим пикселям. На полученной матрице дисперсии соответствующего структурного изображения определяется значительное уменьшение интенсивности, соответствующей области воздуха и поверхностных слоёв кожи. При увеличении глубины когерентного зондирования (ГКЗ) определяется уменьшение показателя анизотропии и увеличение коэффициента рассеивания среды и спекл-шума. Область кровеносного сосуда обладает высокими показателями рассеивания, что отражается на результатах построения матрицы дисперсии в виде низких показателей интенсивности

Ключевые слова: матрица дисперсий, оптическая когерентная томография (ОКТ), обработка изображений, спекл структуры, глубина когерентного зондирования (ГКЗ).

Structuring of Tissues in Optical Coherence Tomography Using Pixel Intensity Analysis

V. O. Chereshnev*, I. V. Kuleshov, I. V. Romanenko

Tambov State Technical University, Tambov, Russia

*e-mail: vitaliy-cha1999@yandex.ru

Abstract

The results of the study of structural images of human skin and subcutaneous blood vessels *in vivo* obtained using the OCT system, based on the Michelson interferometer, are presented. The obtained data were subjected to computer processing, with the help of which histograms of the intensity of the pixels of the structural image were constructed. The histograms of pixel intensities for the skin and vessel areas showed differences in the probability distributions and mean values of α/β of the corresponding fits of the Gamma distribution using the least squares method at a determination coefficient of $R^2 \sim 0.95$, which indicates an adequate quantitative description of the data. The tissues with the lowest anisotropy parameter, g , and the highest scattering coefficients, μ_s , are distinguished by the highest intensities of the variance matrix, which corresponds to backscattered photons and the region of blood flow. At the same time, tissues with high values of the anisotropy parameter, in which a relatively small part of the photons is reflected or scattered back, show relatively low intensity in the variance image, which corresponds to the skin area

Keywords: optical coherence tomography (OCT), image processing, variance matrix, Gamma distribution, speckle structure.

Introduction

Visualization of biological tissue structures, which is crucial for early diagnosis of diseases and pathologies, in particular dermatology, is one of the most significant directions in the development of optical coherence tomography (OCT) as a method of biomedical diagnostics. The resolution of modern OCT allows the construction of structural images down to the micron scale, however, studies of the subcellular level are still inaccessible. Nevertheless, there is some evidence that the analysis of images of OCT speckle structures can extract additional information about tissue cells *in vivo* [1].

Analysis of pixel intensity in OCT images

The aim of this work is to identify regular relationships between structural OCT images by analyzing changes in the pixel intensity of individual parts of the images.

The main object of the study is structural OCT images of human skin *in vivo*, obtained using a non-standard optical system based on a Michelson interferometer, which uses small-angle raster scanning in the shoulder of the sample, which makes it possible to increase the CPD by $\sim 30\%$, and, therefore, to visualize the subcutaneous blood vessels.

The optical characteristics of the structures of biological objects have significant differences, as a result of which each structure corresponds to a different intensity of the pixels of the structural OCT image. To quantitatively express the effect of tissue heterogeneity, a histogram of pixel intensities corresponding to areas of skin, blood vessels, blood and areas without biological tissue was constructed [2].

To identify patterns in histograms, the results were approximated by the least squares method by the gamma distribution function:

$$f(x, \alpha, \beta) = x^{\alpha-1} \frac{1}{\Gamma(\alpha)} \beta^\alpha e^{-\beta x},$$

where Γ is Euler's gamma function: $\Gamma(\alpha) = \int_0^\infty x^{\alpha-1} e^{-x} dx$, α is the number of degrees of freedom, β is the scale factor.

The obtained distributions are presented for the area of the skin and the vessel reflect clear differences in the distribution of pixel intensities and the average value α/β of the corresponding graphs of the gamma distribution, which was, $\alpha/\beta = 2.7 \cdot 10^{-4}$ for the blood area and $\alpha/\beta = 7.0 \cdot 10^{-4}$ for skin, $\alpha/\beta = 8.0 \cdot 10^{-4}$ for an area without biological tissue. The tightness of fit corresponds to $R^2 \sim 0.95$, demonstrating good quantitative agreement of the processed data [2, 3].

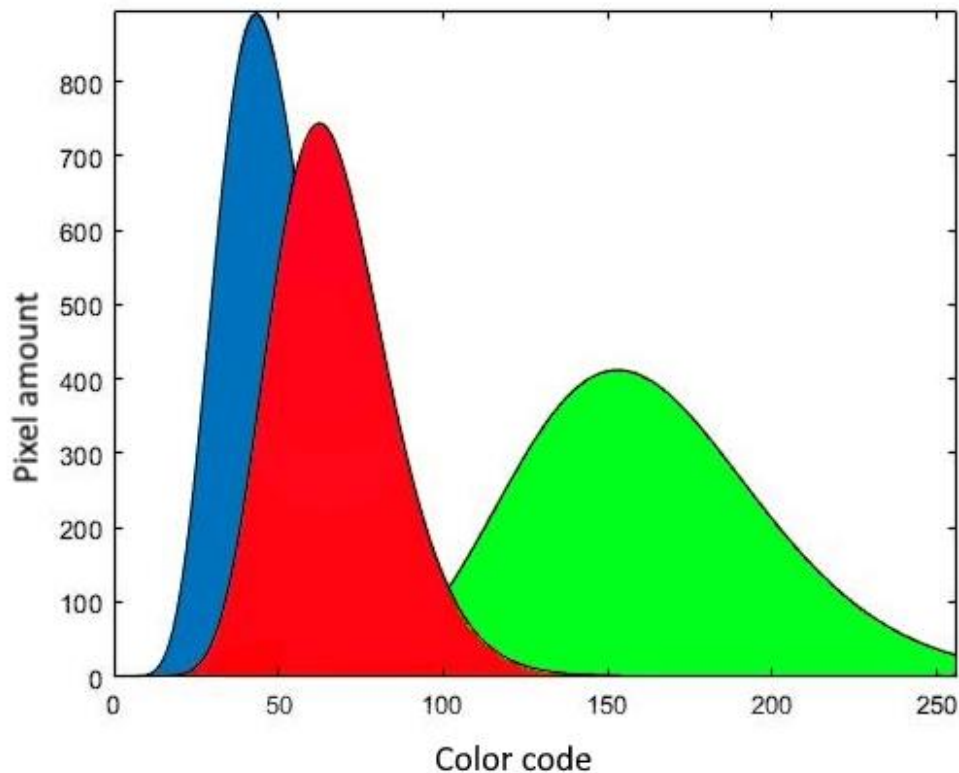


Fig.1. Gamma distributions corresponding to histograms of pixel intensity for air (blue), blood (red), and skin (green)

Conclusion

Thus, the construction of a histogram of the pixel intensity for various structures of OCT images with subsequent fitting of gamma distributions demonstrates the possibility of tissues differentiating. The described method has the potential to detect changes in the structure of biological tissues caused by diseases (skin cancer) or due to functional changes (pulsations of the blood flow). It is also possible to detect the boundaries of heterogeneous structures with subsequent visualization of a 3D object.

References

1. Chereshev V.O., Abdulkarim S.N., Proskurin S.G. Issledovaniye otrazhennykh i malokratno rasseyannykh fotonov posredstvom postroyeniya matritsy dispersiy OCT izobrazheniy [Investigation of reflected and low-frequency scattered photons by means of constructing a dispersion matrix of OCT images]. Modern high technology, 2019, 12-1, pp. 118-122.
2. Chereshev V.O., Romanenko I.M., Kuleshov I.V., Proskurin S.G. Differentsiatsiya struktur kozhi, krovenosnykh sosudov i krovi posredstvom postroyeniya variatsionnoy matritsy OKT-izobrazheniy [Differentiation of skin, blood vessels and blood structures by means of constructing a variation matrix of OCT images]. Modern high technology, 2019, 10 (part 2), pp. 319-323.
3. Chereshev V.O., Frolov S.V., Potlov A.Yu., Proskurin S.G. Postroyeniye izobrazheniy opticheskoy kogerentnoy tomografii biologicheskikh tkaney na osnove analiza intensivnosti pikseley [Construction of OCT images of biological tissues based on the analysis of pixel intensity]. Models, systems, networks in economics, technology, nature and society, 2019, 3(31), pp. 104–112.

СТРУКТУРИРОВАНИЕ ТКАНЕЙ В ОПТИЧЕСКОЙ КОГЕРЕНТНОЙ ТОМОГРАФИИ ПОСРЕДСТВОМ АНАЛИЗА ИНТЕНСИВНОСТИ ПИКСЕЛЕЙ

В. О. Черешнев*, И. В. Кулешов, И. М. Романенко

Тамбовский государственный технический университет

**e-mail: vitaliy-cha1999@yandex.ru*

Аннотация. Представлены результаты исследования структурных изображений кожи и подкожных кровеносных сосудов человека *in vivo*, полученные при помощи ОКТ системы, на базе интерферометра Майкельсона. Полученные данные подвергнуты компьютерной обработке, при помощи которой были построены гистограммы интенсивности пикселей структурного изображения. Гистограммы интенсивностей пикселей для области кожи и сосуда демонстрировали различия в распределениях вероятностей и среднего значения α / β соответствующих подгонок гамма распределения с использованием метода наименьших квадратов при значении коэффициента детерминации, $R^2 \sim 0.95$, что свидетельствовало об адекватном количественном описании данных. Ткани, обладающие наименьшими коэффициентами анизотропии g и наибольшими коэффициентами рассеяния μ_s , отличаются наибольшими интенсивностями матрицы дисперсий, что соответствует рассеянному назад фотонам и области течения крови. В то же время, ткани с высокими значениями коэффициента анизотропии, в которых сравнительно небольшая часть фотонов отражается или рассеивается назад, показывают относительно небольшую интенсивность на изображении матрицы дисперсий, что соответствует области кожи.

Ключевые слова: оптическая когерентная томография (ОКТ), обработка изображений, матрица дисперсий, гамма распределение, спекл структуры.

Analytical and Procedural Models of the Decision Support System of a Neurologist When Choosing Parameters and Controls for Detecting Paroxysmal Conditions

G. O. Chilikin*, Y. Y. Gromov

Tambov State Technical University, Tambov, Russia

*e-mail: george87320@gmail.com

Abstract

The paper presents the results of studies of such a decision support system that can influence decision-making processes in various areas of human activity by collecting and analyzing information. In health care the following software products are referred to as the specified term system to support medical decision-making

Keywords: epileptic and nonepileptic paroxysms, epileptiform changes Electroencephalogram (EEG); epilepsy; epileptic seizures.

Introduction

The word 'Epilepsy' is derived from the ancient Greek word 'Epilepsia'. The condition was first registered in the East in a Babylonian treatise that was discovered in southern Turkey. In ancient times, epilepsy was considered to be sacred as people believed that it was a form of attack by demons and curse by the gods. This misconception resulted in the discrimination of epileptic patients forcing them to stay in darkness. Hippocrates once remarked that the day epilepsy is understood, it would cease to be considered divine. Today, with the discovery of EEG (Electroencephalography – recording of bioelectrical activity in the brain) and advancements in neuroscience, epilepsy is better understood as a neurological disorder characterized by epileptic seizures that result from abnormal neuronal activity in the brain. Epilepsy is one of the most common neurological disorders that affect a significant percentage of the world's population. Approximately one in every 100 persons experiences an epilepsy-related event (epileptic seizure) at some time in their life. Epileptic seizures are often violent disturbances of the normal brain functionality. These seizures are due to the sudden development of highly synchronous abnormal paroxysmal cerebral electrical activity in the brain and can be fairly recurrent in chronic epilepsy. The clinical manifestations of an epileptic seizure include behavioral changes, involuntary motor functions like flexing of arms and legs, eyes rolling towards the back of the head, teeth clenching, facial

Instruments and materials

The electroencephalogram (EEG) signal contains information about the electrical activity of the brain and is recorded either from the surface of the head (scalp EEG) or directly from the brain (intracranial EEG). EEG is to date universally accepted as the most reliable clinical tool for understanding epilepsy. Billions of neurons are electrically charged pump ions across their membranes, and

create a potential difference that EEG measures over time. EEG measures these voltage fluctuations as differences in voltage between any two recording sites in the brain. It is important for an electroencephalographic to understand that the EEG signal from neuronal population in the brain is greatly modified by the time it reaches a recording electrode. Every electrode will record an average of electrical activity around it along with voltage fluctuations from distant parts of the brain.

Scalp EEG, being a non-invasive recording technique, is plagued by recording and movement artifacts. These artifacts are the potentials generated by sources other than the brain. Physiological artifacts arise from body activities which include head movement, eye blinking, tongue movement, while environmental artifacts originate from power line interferences, electrode movement etc. Because of such noise, and the fact that deeper brain activity cannot be recorded accurately by scalp EEG, an invasive technique where signals are recorded directly from the human cortex using subdural grids or electrodes placed directly on the surface of the cortex is preferred. This recording arrangement is known as Electrocorticography (ECoG). Other specific areas in the brain can be effectively targeted (Intracranial EEG (iEEG)) by using this approach, thereby improving the information content of the signal.

Results and discussion

This is the most common type of seizures in children and the electrographic changes are limited to one hemisphere of brain. They are further classified as Simple Partial Seizures if there is no impairment in the consciousness of the patient and if they are electrographically limited to a small region of one hemisphere or, as Complex Partial Seizures if the patients lose consciousness. Fig. 1 and Fig. 2 show two typical examples of a complex partial clinical seizure and a simple partial sub-clinical seizure respectively. The subclinical seizure is comparatively of lesser duration and spatial extent.

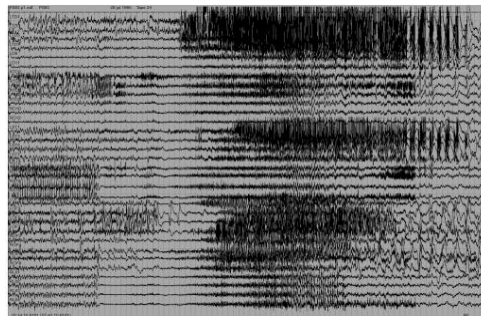


Fig. 1. 90 sec of intracranial EEG with a secondarily generalized complex partial seizure clinical seizure. Seizure onset is the right hippocampus

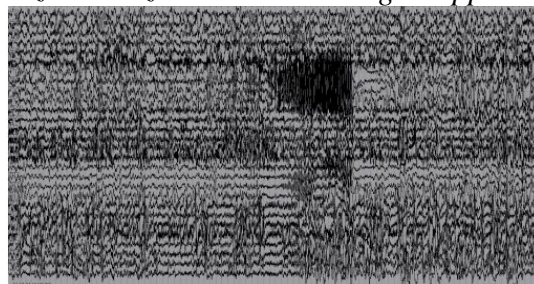


Fig. 2. 90 sec of EEG with a simple partial sub-clinical seizure

These seizures typically affect both hemispheres of the brain (large areas of the cortex or subcortical structures). Such seizures do not have a recognizable focus at onset and usually cause loss of consciousness

Conclusion

The motivation for the development of an automated seizure detection algorithm in this MS research was to assist physicians in the laborious, time consuming and expensive task of seizure detection from long-term EEG recordings. Within this framework, we developed and tested a new seizure detection algorithm based on measures from linear and nonlinear dynamics, i.e., the adaptive short-term maximum Lyapunov exponent (ASTLmax) and the adaptive Teager energy (ATE). The algorithm was tested on long-term (0.5-11.7 days) continuous EEG recordings from five patients (3 with intracranial and 2 with scalp EEG) and a total of 56 seizures, producing a mean sensitivity of 93% across all seizures and mean specificity of 0.048 false positives per hour. The developed seizure detection algorithm is data-adaptive, training-free and patient-independent. It is expected that this algorithm leads to faster and more accurate diagnosis, better evaluation of treatment, and possibly to better treatments if it is incorporated online and real-time with advanced neuromodulation therapies for epilepsy.

References

1. Adeli H., Ghosh-Dastidar S., Dadmehr N. A wavelet-chaos methodology for analysis of EEGs and EEG subbands to detect seizure and epilepsy. *Biomedical Engineering, IEEE Transactions*, 2007, 54(2), pp. 205-211.
2. Baker G.A., Jacoby A., Buck, D., Stalgis C., Monnet D. Quality of life of people with epilepsy: A European study. *Epilepsia*, 2007, 38(3), pp. 353-362.
3. Iasemidis L.D., Olson L.D., Savit R.S., Sackellares J.C. Time dependencies in the occurrences of epileptic seizures. *Epilepsy Research*, 2015, 17(1), pp. 81-94.
4. Roux J.C., Simoyi R.H., Swinney H.L. Observation of a strange attractor. *Physica D: Nonlinear Phenomena*, 2008, 8(1-2), pp. 257-266.

АНАЛИТИЧЕСКИЕ И ПРОЦЕДУРНЫЕ МОДЕЛИ СИСТЕМЫ ПОДДЕРЖКИ ПРИНЯТИЙ РЕШЕНИЙ ВРАЧА-НЕВРОЛОГА ПРИ ВЫБОРЕ ПАРАМЕТРОВ И СРЕДСТВ КОНТРОЛЯ ДЛЯ ВЫЯВЛЕНИЯ ПАРОКСИЗМАЛЬНЫХ СОСТОЯНИЙ

Г. О. Чиликин*, Ю. Ю. Громов

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: george87320@gmail.com*

Аннотация. Представлены результаты исследования системы поддержки принятия решений, которая позволяет сбор и анализ информации влиять на процессы принятия решений в различных областях человеческой деятельности. Отрасль здравоохранения должна следовать программным продуктам с системами поддержки принятия медицинских решений.

Ключевые слова: эпилептические и неэпилептические пароксизмы; эпилептиформные изменения; электроэнцефалограмма (ЭЭГ); эпилепсия; эпилептические припадки.

The Application of Strip Wavelet Filters to Study the Brain Visual Core Potentials

B.E. Sudakov

Tambov State Technical University, Russia, Tambov
e-mail: sudakov.dima1702@yandex.ru

Abstract

Method of biomedical engineering control system creation is discussed. It is pointed out that neurons sending visual signals from the eyes are directly connected to the visual cortex. By analyzing the potentials, it is possible to obtain information that can be successfully used to create control systems for biomedical technology or diagnose diseases of the eyeball. In other words, it is proposed to develop a method that can be effectively used to study visual information on an electroencephalogram.

Keywords: electroencephalograph, visual cortex, wavelet analysis.

Introduction

Neurons that send visual signals from the eyes are directly connected to the visual area of the cerebral cortex. By analyzing the potentials, it is possible to obtain information that can be successfully used to create control systems for biomedical techniques or to diagnose diseases of the eyeball. In other words, it is planned to develop a method that can be effectively used for the study of visual information on the electroencephalogram.

All wavelet filtering algorithms have a characteristic feature - the “filtered” expansion coefficients are obtained by multiplying the “noisy” coefficients by a filtering factor that takes a value in the interval $[0, 1]$. To calculate this factor, the noise-to-signal ratio or an estimate of this ratio is used [1].

Application of band wide wavelet filters

The EEG signal was removed from the visual core, which is a part of the cerebral cortex, responsible for processing visual information. Basically, it is concentrated in the occipital lobe of each of the hemispheres of the brain.

Wavelet filtering was used to filter the EEG signal. The signal is fed to the input of two conjugated quadrature mirror filters. As a result, the original signal will be represented as two new sequences of coefficients L and H. The L and H sequences are half the length of the original signal.

The L level is selected from the condition under which the signal-to-noise ratio is the highest. Thus, the frequency is selected, at which the interference will be suppressed, while maintaining the useful signal.

Figure 1 shows the EEG signal at different levels of filtration - 2^0 , 2^1 , 2^2 , respectively.

With a filtering level of 2^2 , a part of the useful signal is lost, so we select level 2^1 as the optimal filtering level for the signal.

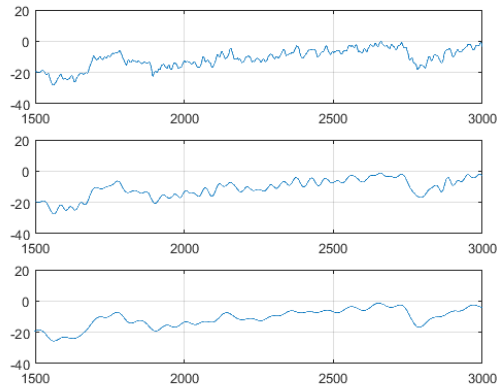


Fig. 1. EEG signal at different filtration levels

After analyzing the signal at different frequencies, the frequency was chosen at which the signal has the most information, with the lowest noise level (Fig. 2).

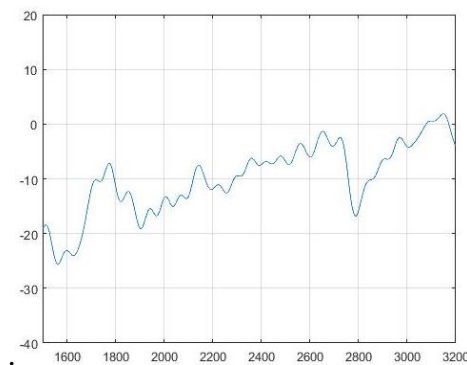


Fig. 2. Optimal signal frequency after processing

After filtering the signal, we find the amplitude-frequency characteristic (AFC) - $A(\omega)$ and the phase-frequency characteristic (PFC) - $\varphi(\omega)$ (Fig. 3).

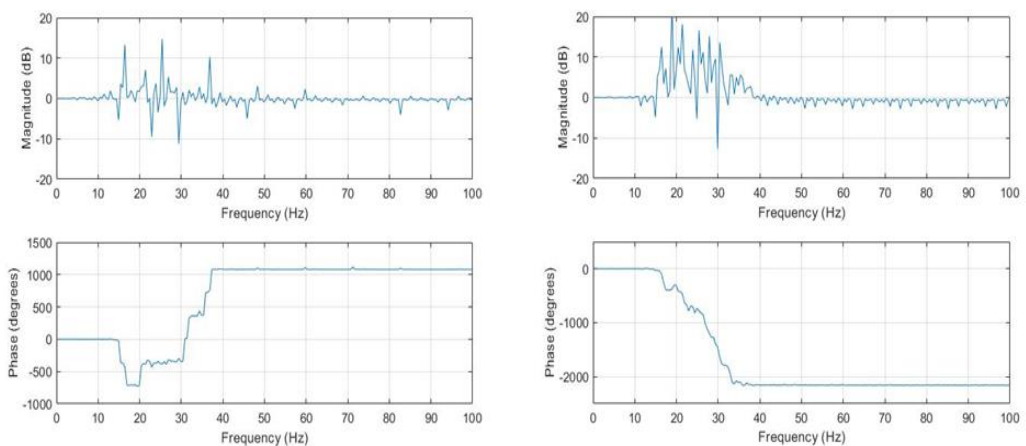


Fig. 3. Frequency response and phase response with eye movement up and down

Comparing the obtained frequency characteristics, we see the inversion of the phase response when the eyeballs move in directly opposite directions. The frequency response shape also changes, but its changes are not so significant.

Phase-frequency characteristic carries a greater amount of useful information, so this characteristic will be the main function in further research.

Conclusion

Thus, when using the optimal wavelet filtering algorithm, you can minimize the root mean square error. However, this requires knowledge of the decomposition coefficients of a non-noisy signal, which must be selected experimentally

References

1. Phinyomark A. Optimal Wavelet Functions in Wavelet Denoising for Multifunction Myoelectric Control. ECTI Transactions on Electrical Eng., Electronics, and Communications. ECTI, 2010, 8(1), pp. 43-52.
2. Mallat Stephane. A wavelet tour of signal processing, 1998, pp. 250-252.
3. Sudakov D.E. Model' ehlektronnogo glaza cheloveka s ispol'zovaniem iskusstvennoj nejronnoj seti [Model of the human electronic eye using an artificial neural network] Energy saving and efficiency in technical systems, 2016, pp. 521-522. (Rus)

ПРИМЕНЕНИЕ ПОЛОСОВЫХ ВЕЙВЛЕТ-ФИЛЬТРОВ ДЛЯ ИССЛЕДОВАНИЯ ПОТЕНЦИАЛОВ ЗРИТЕЛЬНОЙ КОРЫ ГОЛОВНОГО МОЗГА

Д. Е. Судаков

Тамбовский государственный технический университет, Тамбов
e-mail: sudakov.dima1702@yandex.ru

Аннотация. Нейроны, посылающие зрительные сигналы от глаз непосредственно соединены со зрительной зоной коры большого мозга. Анализируя потенциалы возможно получить информацию, которая с успехом может использоваться для создания систем управления биомедицинской техникой или диагностики заболеваний глазного яблока. Другими словами, предполагается разработать метод который можно будет эффективно использовать для исследования зрительной информации на электроэнцефалограмме.

Ключевые слова: Вейвлет-анализ, зрительная кора, электроэнцефалограф.

УДК 62-1/-9
ББК 473

Transportation of Petroleum Products

I. A. Chernyshov*, Y. A. Kazhaeva, A. V. Gridchina

Tambov State Technical University, Tambov, Russia

* e-mail: ilyxa1998rus68@gmail.com

Abstract

The purpose of this study is to analyze rolling stock intended for the transportation of petroleum products. The study will consider the types of vehicles and types of oil products. The relevance of the study lies in the fact that transportation has many features and dangers. As a result, it is necessary to develop a set of measures to ensure safety during the transportation of petroleum products through the use of innovative technologies and modern vehicles.

Keywords: modern vehicles; oil products; transportation of petroleum products.

Russia possesses the richest reserves of black gold, which led to the prevalence of cargo transportation of products of the distillation of crude oil. The most popular option for such transportation is the use of road transport. But it should be borne in mind that the transportation of this product is associated with risk.

This type of material belongs to the category of flammable liquids, the main hazard during transportation of which is the high risk of fire / explosion. Approximately the same level of danger comes from vapors of petroleum products, which can also be flammable, and in addition, toxic to humans and other highly organized representatives of the animal world. Another danger inherent in the transportation of oil products is the likelihood of a spill, which threatens to cause serious damage to the environment, which is equivalent to a local environmental disaster.

There are several generally accepted criteria for classifying petroleum products. In particular, according to the state of aggregation of a substance in natural conditions (pressure / temperature), they are divided into the following categories: gaseous oil products in a liquid state, solid.

Only the last two categories can be transported by road. According to the totality of physical and chemical properties, oil products can be divided into the following large groups: fuel (diesel, jet, gasoline, aviation kerosene); oils (industrial, for internal combustion engines and electric motors, transmission, ship, transformer, for insulating products, hydraulic, etc.); technological viscous lubricants, substances for the preservation of equipment; solid petroleum products (bitumen, paraffin); special substances.

Most of the varieties of petroleum products are delivered to their destination using the bulk method, which involves the use of specialized rolling stock. ATP classification: fuel trucks, tankers, bitumen trucks, gas carriers equipped with pumping equipment for pumping LH into stationary tanks, asphalt distributors, gas carriers specializing in the transportation of household cylinders with liquefied gas.

Transportation of liquid petroleum products by general-purpose vehicles in bulk volumes is carried out using flexitanks - elastic multilayer bags designed for placement in containers. The volume of such containers varies between 10,000 and 25,000 liters. But most often, tankers are used to transport petroleum products, ensuring compliance with all safety requirements and rules for the transport of dangerous goods. With a fully sealed oval-shaped body (optimal in terms of aerodynamics), they are equipped with: a wedge-shaped gate valve for convenient discharge of transported products, a special nozzle designed for pouring oily liquids into a container, a rod-type liquid level indicator, a breathing valve that ensures reliable sealing of the tank, pumping equipment with a pump and a hose system, removable wave cutters designed to minimize the shock wave arising during acceleration / deceleration while the vehicle is moving.

Delivery of fuel oil and other light / dark oil products by road should be carried out along the route agreed with the representatives of the traffic police. Transportation in the dark is unacceptable. A vehicle that meets all of the above requirements is admitted in accordance with the ADR rules for a specific type of oil refined products.

The oil industry is rapidly becoming an extremely high-tech industry. The growth rates of consumption volumes, the discovery of new oil fields directly lead to the improvement of existing and the creation of new types of transport.

To ensure safety, it is necessary to change the vehicle fleet in a timely manner, observe safety precautions and transportation rules, and apply innovative technological solutions.

References

1. Konnova G.V. Oborudovaniye transporta i khraneniye nefti i gaza. Uchebnoye posobiye dlya VUZov [Oil and gas transportation and storage equipment. Textbook for the university]. Rostov-na-Donu: Feniks, 2006. (Rus)

2. Korshak A.A., Shammazov A.M. Osnovy neftegazovogo dela. Uchebnik dlya VUZov [Basics of oil and gas business. Textbook for the university]. Ufa: DizaynPoligrafServis, 2002. (Rus)

3. Rybakov K.V., Savin D.V., Mityagin V.A. Avtomobil'nyye tsisterny dlya transportirovki nefteproduktov [Tank trucks for transportation of petroleum products]. M.: Transport, 1979. (Rus)

ТРАНСПОРТИРОВКА НЕФТЕПРОДУКТОВ

И. А. Чернышов*, Ю. А. Кажяева, А.В. Гридчина

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: ilyxa1998rus68@gmail.com

Аннотация. Целью данного исследования является анализ подвижного состава, предназначенного для перевозки нефтепродуктов. В исследовании будут рассмотрены типы транспортных средств и виды нефтепродуктов. Актуальность исследования заключается в том, что транспорт имеет множество особенностей и опасностей. В связи с этим необходимо разработать комплекс мер по обеспечению безопасности при транспортировке нефтепродуктов за счет использования инновационных технологий и современных транспортных средств.

Ключевые слова: Нефтепродукты, современные технологии, транспортировка нефтепродуктов.

To the Problem of Modeling the Periodic Process of *Chlorella Vulgaris* Cultivation

M. A. Eskova*, Y. V. Ustinskaya, A. K. Bryankina

Tambov State Technical University, Tambov, Russia

*e-mail: mashaeskova@yandex.ru

Abstract

A mathematical model of the *Chlorella vulgaris* Beijer C-2 microalgaecultivation process has been developed. The model allows to calculate changes in the microalgaecell mass, the concentration of a nitrogen-containing substrate in the culture fluid and the intracellular lipids concentration.

Keywords: *Chlorella vulgaris*, mathematical modeling, microalgae cell mass, renewable energy sources.

Chlorella microalgae are a promising raw material for food, medical products and renewable energy sources. These microorganisms have a high growth rate, have flexible metabolism, significantly change their chemical composition depending on the conditions of cultivation and may contain an increased number of various valuable components (carotenoids, chlorophyll, ω -3 fatty acids, protein, lipids for biofuel production). According to [1-2], the chemical composition of microalgae cells can vary in a wide range depending on the strain: when grown on conventional mineral media, dry biomass contains 40–55% protein, 25–45% carbohydrates, 5–30% lipids and up to 10% minerals. According to current research [3-4], microalgae of the genus *Chlorella* are well adapted to changing environmental conditions, showing high rates of substrate conversion, speed of biomass accumulation and use of photosynthetic energy. In the process of cultivation, microalgae cells are in different conditions due to uneven distribution of biomass and nutrients (including gaseous ones) in the volume of the bioreactor, parietal cell growth and limited light permeability, which leads to an increase in the cost of the final product (increased time of cell biomass accumulation, energy costs (illumination, temperature regime)). To increase the efficiency of microalgae cultivation (i.e. to reduce costs), mathematical modelling and optimization methods, which make it possible to determine the most effective technological regimes for the process, should be used.

The microalgae cultivation process can be represented in the form of a structural diagram, shown in Fig. 1.

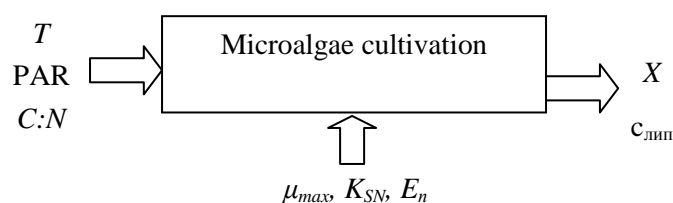


Fig. 1. Structural diagram of the microalgae cultivation process

The input variables of the model are: cultivation temperature T , ($^{\circ}\text{C}$), the photosynthetically active radiation level PAR, ($\text{mmol photons/m}^2 \text{ s}$), the ratio of carbon to nitrogen C : N. Output variables are: cell concentration X , (mln cells/ml), the amount of intracellular lipids slip, ($\%$ (mass)). The following are considered as internal parameters: maximum specific growth rate μ_{max} , (day^{-1}); half-saturation constant K_{SN} , (g/l); population capacity E_p , (mln cells/ml).

When choosing the equations of the microalgae cultivation mathematical model, it is necessary to take into account intracellular processes. Nitrates are used for the amino acids and proteins biosynthesis, and as a result for the biomass accumulation. High nitrogen concentrations in the nutrient medium have an inhibitory effect on the microalgae growth rate. Also, the efficiency of cell transport systems and the enzyme systems activity affect the growth rate. The specific growth rate is proportional to the absorption rate of the limiting nutrient under optimal cultivation conditions. It is also necessary to take into account that in conditions of limited food resources, there is a maximum concentration of biomass that a population can reach. At low nitrogen concentrations, biosynthesis and lipid accumulation are enhanced, accompanied by a decrease in protein content and growth rate. At the same time, the formed lipids amount is proportional to the accumulated microalgae biomass concentration.

Thus, the microalgae cultivation process can be described by a model consisting of three equations connecting: biomass accumulation, substrate consumption (nitrates), and product biosynthesis (lipids).

When mathematical model was developed, the following assumptions were made: 1) all microalgae cells are identical in structure and have the same metabolism; 2) laboratory setup ensures uniform distribution of nutrients between cells; 3) temperature, PAR and pH during cultivation had fixed values; 4) microalgae absorb substances regardless of their ionic form; 5) cell growth is limited only by the concentration of nitrates.

The mathematical model coefficients were calculated using experimental data by solving the inverse problem. The experiment was carried out under the following conditions: 1) microalgae cultivation was carried out on the Tamiya nutrient medium for ten days, 2) initial concentration of biomass is 0.2 million cells/ml, 3) different levels of PAR and temperature (No. 1 - 105 $\text{mmol photons/m}^2 \cdot \text{s}$, 20 $^{\circ}\text{C}$, No. 2 - 315 $\text{mmol photons/m}^2 \cdot \text{s}$, 20 $^{\circ}\text{C}$, No. 3 - 105 $\text{mmol photons/m}^2 \cdot \text{s}$, 30 $^{\circ}\text{C}$, No. 4 - 315 $\text{mmol photons/m}^2 \cdot \text{s}$, 30 $^{\circ}\text{C}$ [2]). The number of microalgae cells was determined by hemocytometry. Lipids were extracted using a Soxhlet apparatus. The system of equations for microalgae cultivation process kinetics had the form:

$$\begin{cases} \frac{dX}{dt} = \mu_{\text{max}} \frac{S_N}{K_S + S_N + S_N^2/K_{\text{ing}}} \cdot X \cdot \left(1 - \frac{X}{E_p}\right), \\ \frac{dS_N}{dt} = -\frac{1}{Y_{XS_N}} \frac{dX}{dt}, \\ \frac{dc_{\text{лип}}}{dt} = \frac{q_P}{S^r} \cdot X \cdot \left(1 - \frac{c_{\text{лип}}}{c_{\text{лип}}^{\text{max}}}\right). \end{cases} \quad (1)$$

with initial conditions: 1) $X(0) = 0.24$ m kl/ml, $S_N(0) = 3.5$ g/l, $c_{lip}(0) = 7.5$ %.

The processing of experimental data made it possible to calculate the coefficients of the equations for the strain *C. vulgaris* Beijer C-2 (Table 1).

Table 1 – Coefficients of mathematical model

Coefficient	Coefficient finding method	1	2	3	4
E_n , mln cells/ml	From experimental data plots	1.5	1.62	1.32	1.48
C_{lip}^{max} , %		35.6	41.25	35	44.2
μ_{max} , days ⁻¹	Haynes method	1.01	1.15	0.87	1.08
K_S , g/l		4.7	4.7	4.7	4.7
K_{ing} , g/l		16.39	16.39	16.39	16.39
q_p , days ⁻¹		37.1	73.7	40.2	38.5
Y_{XS} , (mln cells/ l)/(ml/g)	Least square method	0.82	0.88	0.8	0.82
r		0.003	0.003	0.003	0.003

The comparison of the experimental data and those obtained as a result of calculations using a mathematical model showed that the maximum mismatch was 13%. The resulting mathematical model can be used to calculate the material balances of the process of cultivation of microalgae.

References

1. Schneider R., de Moura Lima M., Hoeltz M. Life cycle assessment of microalgae production in a raceway pond with alternative culture media. *Algal Res*, 2018, vol. 32, pp. 280–292.
2. Khan M.I., J. Shin H., Kim J.D. The promising future of microalgae: current status, challenges, and optimization of a sustainable and renewable industry for biofuels, feed, and another products. *Microb Cell Fact*, 2018, vol. 5, pp. 17-36.
3. Koyande A.K., Chew K.W., Rambabu K. Microalgae: A potential alternative to health supplementation for humans. *Food Science and Human Wellness*, 2019, vol. 8, pp. 16-24.
4. Dvoretzky D., Dvoretzky S., Temnov M. Research into the influence of cultivation conditions on the fatty acid composition of lipids of *Chlorella vulgaris* microalgae. *Chemical engineering transactions*, 2020, vol. 79.

К ВОПРОСУ МОДЕЛИРОВАНИЯ ПРОЦЕССА ПЕРИОДИЧЕСКОГО КУЛЬТИВИРОВАНИЯ МИКРОВОДОРОСЛИ *CHLORELLA VULGARIS*

М. А. Еськова*, Я. В. Устинская, А. К. Брянкина

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: mashaeskova@yandex.ru

Аннотация. Разработана математическая модель процесса культивирования микроводоросли *Chlorella vulgaris* Beijer C-2, позволяющая рассчитывать изменение массы клеток микроводорослей, концентрацию азотсодержащего субстрата в культуральной жидкости и концентрацию внутриклеточных липидов.

Ключевые слова: *Chlorella vulgaris*, математическое моделирование, биомасса микроводорослей, возобновляемые источники энергии.

Technologies for Producing the Catalyst for Synthesis of Carbon Nanotubes

N. E. Fomin*, I. V. Burakova

Tambov State Technical University, Tambov, Russia
*e-mail: nickita.fomi2012@mail.ru

Abstract

This work considers the preparation of carbon nanotubes. A literature review was carried out, which reflects the main methods of obtaining catalysts for the synthesis of carbon nanotubes. As a result, a technology for obtaining a catalyst was selected for further experimental research.

Keywords: carbon nanotubes, sol-gel technology, catalyst, catalytic pyrolysis of hydrocarbons.

Introduction

Carbon nanotubes (CNTs) have unique properties, which include high mechanical strength, high thermal and electrical conductivity, and chemical resistance [1]. In turn, they have a relatively low cost, which makes them one of the most promising materials in developing nanotechnology.

The field of application of carbon nanomaterials - nanotubes, nano-fibers, is expanding every year, and accordingly there is a need for them at enterprises of various industries. Carbon nanotubes are used in materials science, in the development of new functional materials, and can also be used in medicine and pharmacology for the production of biomaterials and the manufacture of biosensors [2]. The main methods for producing CNTs are magnetic deposition using graphite with metal catalysts Y, Ni, gas-phase chemical deposition or chemical vapor deposition (CVD) using a catalyst of magnesium oxide, cobalt and iron, etc. For each of these methods, it is necessary the presence of a precursor of carbon and a catalyst in the synthesis process.

Experimental results and their discussion

The aim of this work was to provide a literature review of methods for the synthesis of CNT growth catalysts. Methods for preparing catalysts for the synthesis of CNTs are diverse: thermal decomposition, coprecipitation, Pechini's method, spraying, spray drying, etc. For example, one of the methods for obtaining catalysts is the method of electrospark alloying based on nickel. The process was carried out on an electrospark alloying installation using a modern element base. As starting materials, we used polished plates of sheet nickel of 99.8% purity and 1 mm thickness and aluminum rods of 99.9% purity. This results in more evenly coated surfaces with a low roughness. At higher voltages, in addition to the process of plasma deposition of aluminum on the nickel surface, a parallel flow of the phenomenon of electrical spark erosion occurs with the sputtering of contact micro-areas of the materials of both electrodes with the formation of a highly developed surface. The increase in the specific surface of the obtained samples in comparison with the initial one varies within wide limits depending on the modes

of electric spark processing and the number of passes of the processed electrode over the surface – from 5 to 30 times [3].

One of the promising technologies for catalyst production is the sol-gel method, which can be attributed to a fundamentally new method that allows the synthesis of products without going through the cooking stage.

According to the sol-gel method, the initial sol was obtained by mixing metal nitrates, according to the required catalyst composition, with water. With continuous stirring, ethylene glycol was added in double excess. Citric acid was added to the solution and stirred until complete dissolution. The resulting solution was heated in a vacuum oven to 80 ° C and kept at this temperature for 3 hours. Then it was heated to 140 ° C, the solution was kept at this temperature for 1 hour. They were fired at 500-550 ° C.

The final product synthesized by the sol-gel method was a nanodispersed powder of catalyst oxides (Ni, Co, Fe), support (Mg), and promoter (Y, Mo). The obtained catalyst powders were crushed and dispersed into fractions: 100; 80; 71; 64; 56; 40 microns. Then the catalyst was used for the synthesis of MCNTs by pyrolysis of hydrocarbons in a batch reactor. The process temperature was 650 ° C, the time was 35 min [4].

Conclusion

Thus, the main technologies for obtaining a catalyst for the synthesis of carbon nanotubes were considered. The sol-gel method was chosen as a method for preparing the catalyst, as an approach that allows one to obtain nanosized catalyst particles.

References

1. Hong S., Myung S. Nanotube electronics: a flexible approach to mobility. Nat. Nanotechnol, 2007, vol. 2, pp. 208.
2. Smart S.K., Cassady A.I., Lu G.Q., Martin D.J. The biocompatibility of carbon nanotubes. Carbon, 2006, vol. 44, pp. 1034.
3. Dil'dayev N.S., Makhmadov A.A., Karabekova A.K. Polucheniye katalizatorov na osnove nikelya metodom elektroiskrovogo legirovaniya [Dildaev N.S., Makhmadov A.A., Karabekova A.K. Preparation of nickel-based catalysts by electric spark alloying]. Bulletin of the kyrgyz state university of construction, transport and architecture N. Isanova, 2013, No. 3, pp. 147-149. (Rus)
4. Melezhik A.V., Dyachkova T.P., Bychkov O.N., Shlykova A.A., Romantsova I.V., Tkachev A.G., Golovin Yu.I. Effect of the Matrix Composition on the Activity of Metal Oxide Catalysts in CVD Synthesis of Carbon Nanotubes. Russian Journal of Applied Chemistry, 2012, vol. 85, No. 5, pp. 782-788.

ТЕХНОЛОГИИ ПОЛУЧЕНИЯ КАТАЛИЗАТОРА ДЛЯ СИНТЕЗА УГЛЕРОДНЫХ НАНОТРУБОК

Н. Е. Фомин*, И. В. Буракова

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: nickita.fomi2012@mail.ru

Аннотация. В данной работе было рассмотрено получение углеродных нанотрубок. Был проведен обзор литературы, в котором отражены основные методы получения катализаторов синтеза углеродных нанотрубок. В результате выбрана технология получения катализатора для дальнейших экспериментальных исследований.

Ключевые слова: углеродные нанотрубки, золь-гель технология, катализатор, каталитический пиролиз углеводородов.

Studying the Effect of Modifiers on the Properties of Phenol-Formaldehyde Resin

N. D. Gabibov^{1*}, E. S. Bakunin¹, A. E. Isaev²

¹Tambov State Technical University, Tambov, Russia

²Gagarin Saratov State Technical University, Saratov, Russia

*e-mail: gabibov.nihad@yandex.ru

Abstract

Adhesive based on phenol-formaldehyde resin is one of the most promising polymeric materials. Studying the effect of modifiers on the properties of phenol-formaldehyde resins is an urgent task in the wood-processing industry. The search is underway for new modifiers to improve the performance characteristics of the adhesive composition based on phenol-formaldehyde resins. The article examines several additives to improve the shear strength of plywood.

Keywords: phenol-formaldehyde resin, modifiers, adhesive composition, plywood.

Introduction

Currently, phenol-formaldehyde resins are used in various industries: as binders in glue for plywood, in paints and varnishes, etc. Since the consumption of wood products is growing, the demand for high-quality phenol-formaldehyde resins is also growing. The advantages of these resins are considered their high mechanical, chemical and thermal strength, increased adhesion to the veneer, and sufficient water resistance. However, the glue based on phenol-formaldehyde resin also has an important drawback - toxicity due to the presence of free phenol in the resin.

An adhesive composition based on phenol-formaldehyde resin is used with various fillers, hardeners and additives. There are several types of plywood glue: one-component (pure resin), two-component (contains a filler or solvent in addition to resin), and multicomponent (contains resin, filler, solvent, hardener and additives). Usually, rye, soybean, wood flour, and lignin are used as fillers. The solvent is water. Hardeners are substances that promote the curing of synthetic resins, that is, their transition from a liquid to a solid state. Hardeners are mineral or organic acids or salts of strong acids. Modifiers are used to improve the technological and operational properties of the adhesive system. They are introduced either directly into the synthesis of phenol-formaldehyde resin, or into an adhesive composition.

By adjusting the introduction of modifiers, it is possible to obtain an adhesive system that meets certain requirements for plywood and wood-based panels. To improve the environmental friendliness of the product, modifiers are used that reduce the amount of free phenol and formaldehyde in the resin. The introduction of modifiers to increase the water resistance and mechanical strength of plywood is considered interesting. Basically, such additives are classified as surfactants.

In this paper, 5 modifying additives were tested to increase the shear strength of plywood. Modifiers were introduced into standard SFJ-3014 phenol-formaldehyde resin, which is a binder in plywood glue. All modifiers were added at various concentrations to the resin to determine the optimal additive amount.

The composition of the used adhesive system: SFJ-3014 phenol-formaldehyde resin, rye flour and chalk serve as fillers, as well as a solvent in the form of water to maintain the desired viscosity of the adhesive. The target for shear strength is > 2 MPa.

Modifier 1 is a sulfoderivative of lignin. It was introduced into the resin composition directly during its synthesis in an amount of 2 ... 5% of the technical weight of the resin. Sodium lignosulfonate was chosen for the experiment. The best result achieved was obtained with the introduction of 4% of the additive. The ultimate strength was 2.23 MPa.

Modifier 2 is a mixture of carboxylic acids, introduced during the synthesis of the resin in an amount of 1, 2 and 3% of the technical weight of the resin. With the introduction of 2% of the modifier, the shear strength was 2.15 MPa. No further increase in the additive is required, as no increase in the plywood strength index was observed.

The influence of modifier 3 –acrylamide – on the properties of the SFJ-3014 resin was investigated. The additive was introduced in the amount of 1, 2 and 3% of the technical weight of the resin. With the introduction of 2% modifier No. 3, the ultimate shear strength of 2.4 MPa was obtained.

Table 1. Influence of modifiers on the physical and mechanical properties of plywood

Modifiers	Number, %	Plywood shearing strength, MPa
Nomodifier	-	1,6
Modifier 1	2	2,18
	3	2,2
	4	2,23
	5	2,22
Modifier 2J	1	1,9
	2	2,15
	3	2,15
Modifier 3	1	2,22
	2	2,4
	3	2,3
Modifier 4	2	1,82
	3	2,2
	4	2,18
	5	2,2
Modifier 5	1	2,0
	2	2,23
	3	2,3

Modifier 4 - carbonic salt of alkaline earth metals - was introduced into the adhesive system in an amount of 2-5%. An increase in the tensile strength of

plywood was observed with the addition of more than 3%. No further increase in the modifier is required. The ultimate strength was 2.2 MPa.

Modifier 5 is molasses feed, a by-product of sugar production. The additive was introduced in an amount of 1-3%. The maximum tensile strength of plywood of 2.3 MPa was obtained with the introduction of this modifier in an amount of 3%.

Thus, the given modifiers had a positive effect on the strength characteristics of plywood based on SFJ-3014 phenol-formaldehyde resin. The best result of 2.4 MPa was obtained with the introduction of 3% acrylamide additive.

References

1. Malikova G. Jurnalprofessionalov LPK: Rossiyskiy rinok – rost potrebleniya i proizvodstva. LesPromInform. 2013. No 6. 3 p. (Rus)
2. Shchegolev V.P. Visokomolekulyarnie soedineniya, primenyaemie v derevoobrabativaushey promishlennosti. Leningrad, 1974. 123 p. (Rus)
3. Volkov A.V., Kondrat'ev V.P. Spravochnik fanershika. St. Petersburg, 2010. 486 p. (Rus)
4. Kondratyev V.P., Kondrashchenko V.I., Schroeder V.E. Sinteticheskie smoli v derevoobrabotke. St. Petersburg: Publishing house of the Polytechnic University, 2013. 412 p. (Rus)

ИССЛЕДОВАНИЕ ВЛИЯНИЯ МОДИФИКАТОРОВ НА СВОЙСТВА ФЕНОЛФОРМАЛЬДЕГИДНОЙ СМОЛЫ

Н. Д. Габибов^{1*}, Е. С. Бакунин¹, А. Е. Исаев²

¹Тамбовский государственный технический университет, Тамбов, Россия

²Саратовский государственный технический университет имени Гагарина Ю.А., Саратов, Россия

*e-mail: gabibov.nihad@yandex.ru

Аннотация. Клей на основе фенолформальдегидной смолы – один из самых перспективных полимерных материалов. Изучение влияния модификаторов на свойства фенолформальдегидных смол является актуальной задачей в деревоперерабатывающей промышленности. Ведется поиск новых модификаторов, позволяющих улучшить эксплуатационные характеристики клеевой композиции на основе фенолформальдегидных смол. В работе приведены исследования нескольких добавок для улучшения показателя предела прочности при скалывании фанеры

Ключевые слова: фенолформальдегидная смола, модификаторы, клеевая композиция, фанера.

Entwicklung messtechnischer Tests von Produkten aus der Legierung 79 NM

M. W. Kabargina

Tambov State Technical University, Tambow, Russia

e-mail: kabargin@yandex.ru

Abstrakt

Ziel dieser Studie ist die Entwicklung von Messtests für Produkte aus der Legierung 79 NM. Im Verlauf der Studie wird die messtechnische Unterstützung für die Prüfung der 79-NM-Legierung berücksichtigt. Die Relevanz der Studie liegt in der Tatsache, dass Permalloy Legierungen sind die, die gegenüber den geringsten elastischen Spannungen empfindlich sind, ganz zu schweigen vom Auftreten einer Kaltverfestigung in den Oberflächenschichten und der Bildung eines Spannungszustands des Kristallgitters.

Keywords: Legierung 79 Nm, Permollooy.

Weichmagnetische Legierungen auf der Basis von Nickel (Ni) und Eisen (Fe) mit einem Nickelgehalt von bis zu 85% werden derzeit in großem Umfang im Instrumentenbau, im Maschinenbau, in der Robotik, in Spezialgeräten und in anderen Branchen eingesetzt, die wiederum die Anforderungen an ihre Chemikalien und physikalische Eigenschaften vorschreiben. Diese Legierungen umfassen unlegierte und mit Kupfer (Cu), Molybdän (Mo), Chrom (Cr), Vanadium (V) und Wolfram (W) hochnickelpermallierte Legierung legierte Legierungen. Ihr Hauptunterschied liegt in der maximal möglichen Übereinstimmung der chemischen Zusammensetzung mit den Anforderungen von Normen, die das Niveau der magnetischen Eigenschaften, die Reinheit der Legierungen, den Strukturzustand und die hohe Genauigkeit des Herstellungsprozesses bestimmen, die zusammen die Werte der Konstanten der magnetischen Anisotropie und Magnetostriktion bestimmen. Darüber hinaus hat der endgültige Wärmebehandlungsmodus einen signifikanten Einfluss auf die magnetischen Parameter von Teilen von Montageeinheiten, die aus diesen Legierungen hergestellt sind, gemäß deren Ergebnissen die endgültige metallografische Struktur der Legierungen gebildet wird, und infolgedessen der Wert und das Vorzeichen der magnetischen Anisotropiekonstante.

Das Hauptanwendungsgebiet der legierten Permalloy mit hohem Nickelgehalt ist die Herstellung von Kernen für kleine Impulstransformatoren, Rotoren von Motoren mit hohem Drehmoment, Niederfrequenzdrosseln und berührungslosen Relais, magnetischen Abschirmungen für verschiedene Geräte und Kabel und vielen anderen Geräten, die in schwachen statischen und dynamischen Magnetfeldern arbeiten. Derzeit bietet die Industrie Legierungen 79HM GOST 10160-75, 80HXC GOST 10160-75 und andere hochnickelpermalloy in Form von kaltgewalzten Bändern mit einem breiten Dickenbereich von 0,005 bis 2,5 mm, kaltgewalzte und warmgewalzte Bleche mit einer Dicke von bis zu 22 mm sowie

warmgewalzte und kalibrierte Bleche an Stangen mit Durchmessern von 8 bis 100 mm.

Gegenwärtig wurde eine ausreichende Anzahl von Experimenten durchgeführt, auf deren Grundlage ein Diagramm des Zustands der Fe-Ni-Legierung entwickelt ist, die chemischen Zusammensetzungen und technologischen Modi der Herstellung von Bändern, Platten und Stäben verfeinert und normalisiert wurden, um die spezifizierten magnetischen Parameter von Eisen-Nickel-Legierungen zu erhalten. Es wurde festgestellt, dass Legierungen mit einem Nickelgehalt von 70 bis 85% Mindestwerte der Konstanten der kristallographischen magnetischen Anisotropie aufweisen, die negativ sind und deren Magnetostraktion gegen Null tendiert, und infolgedessen eine hohe magnetische Permeabilität aufweisen. Das Legieren mit Chrom, Mangan, Silizium-Chrom-Permalloy 80HXC und Molybdän-Molybdän-Permalloy 79HM ermöglicht eine signifikante Erhöhung des spezifischen elektrischen Widerstands, wodurch präzise weichmagnetische Legierungen in dynamischen Magnetfeldern verwendet werden können, während 80HXC in Bezug auf 79HM in elektromagnetischen Feldern höherer Frequenz verwendet werden können aufgrund des höheren spezifischen Widerstands. Zusätzlich ist bei der Menge an Verunreinigungen, die die magnetischen Parameter nicht beeinflussen, der Gehalt an Silizium und Mangan für 79 ° C und Kupfer und Titan für 80 ° C zulässig. Der hohe Nickelgehalt in der Permalloy 79NM und 80NKhS hat auch einen signifikanten Einfluss auf ihre technologischen Eigenschaften, indem sie Legierungen eine unbedeutende Korrosionsbeständigkeit verleiht und gleichzeitig eine hohe Duktilität beibehält, was es wiederum ermöglicht, Streifen bis zu 0,5 µm leicht zu rollen, zu bearbeiten, zu stanzen und zu wickeln. Darüber hinaus erhöht der hohe Nickelgehalt ihre Kosten erheblich. Die Einführung von Kupfer in einer Menge von bis zu 14% - Fe-72Ni-14Cu-3Mo-Permalloy ermöglicht es, hohe Werte der anfänglichen magnetischen Permeabilität zu erreichen.

Entsprechend dem Gehalt an Legierungselementen werden die folgenden Legierungen unter Permalloy mit hohem Nickelgehalt unterschieden: Supermallierung Fe-79,7Ni-5,1Mo-0,7 Mn, mumetales Fe-77Ni-4,7Cu-1,7Cr, Mo-Cu-Cr-V-Permalloy Fe-78,7Ni-1,4Mo-2,4Cu-1Cr-1,2 V und Wolframpermalloy Fe-75 8Ni-9,1W.

Der Gehalt an schädlichen Verunreinigungen in Fe-Ni-Legierungen sollte minimal sein, da durch Erhöhung ihrer Reinheit und Homogenität ein hohes Maß an magnetischen Eigenschaften erreicht wird. Wärmebehandlung von 79NM- und 80NKhS-Präzisions-Weichmagnetlegierungen: Tempern im Hochvakuum.

Die Wärmebehandlung ist ein obligatorischer technologischer Vorgang bei der Eingangskontrolle der Präzisions-Weichmagnetlegierungen 79HM und 80HXC und der letzte in der Kette des technologischen Prozesses zur Herstellung von Teilen von Montageeinheiten. Anforderungen an die Wärmebehandlung - Hochtemperaturglühen von Permalloy 79NM und 80NKhS im Vakuum oder in Wasserstoff zur Wiederherstellung der magnetischen Eigenschaften und die

Relevanz der Optimierung ihrer Parameter werden auf der Grundlage des Folgenden ermittelt. Die Herstellung von Montageeinheiten sowie Zeugenproben zur Bestätigung ihrer wichtigsten magnetischen Parameter aus Streifen, Blechen und Stäben der Legierungen 79HM und 80HXC kann derzeit durch Kaltblechprägen, Wasserstrahlschneiden, Laserschneiden, Funkenerosion, Wickeln und Drehen erfolgen. Die Wahl dieser oder jener Produktionsmethode hängt im Wesentlichen von der Serienproduktion, der Produktpalette und den Anforderungen an die Genauigkeit der geometrischen Abmessungen sowie der Verfügbarkeit der Ausrüstung ab. Permalloy sind Legierungen, die gegenüber den geringsten elastischen Spannungen empfindlich sind, ganz zu schweigen vom Auftreten einer Kaltverfestigung in den Oberflächenschichten und der Bildung eines Spannungszustands des Kristallgitters. Diese Prozesse führen zu einer Verschiebung der Domänengrenzen, einer Fragmentierung und Umlagerung der Domänenstruktur, was zu einer signifikanten Abnahme der magnetischen Eigenschaften in Folge zur Nichtkonformität von Produkten mit der erforderlichen Qualität beiträgt. Außerdem leistet die Wärmebehandlung einen erheblichen Beitrag zu den Kosten der Produkte aus Permalloy 79HM und 80HXC.

In dieser Arbeit wird die messtechnische Unterstützung von 79 NM-Legierungen berücksichtigt. Gemäß der obigen Methodik ist die optimalste Methode zur Eingangskontrolle in einem Unternehmen der Luftfahrtindustrie die Methode der Wärmebehandlung, gefolgt von der Kontrolle der magnetischen Eigenschaften durchgeführt. Es hilft die Qualität des Materials bestimmen. Der allgemeine Komplex von Arbeiten zur messtechnischen Unterstützung bei der Vorbereitung der Produktion umfasst folgende Arbeiten: messtechnische Untersuchung des Entwurfs und der technologischen Dokumentation; Entwicklung von Messverfahren für einzelne Indikatoren für die geometrische Genauigkeit; Prüfung auf Typgenehmigung von Messgeräten; Entwicklung von Messsystemen für bestimmte Branchen. Die messtechnische Unterstützung der Produktion sollte während ihrer Vorbereitung vollständig umgesetzt werden. Daher wird im Prozess der direkten Produktion die Arbeit an der messtechnischen Unterstützung auf die Verwendung von normativen und methodischen Materialien reduziert, die bei der Vorbereitung der Produktion entwickelt wurden, und gekaufte oder neu hergestellte Messinstrumente. Wenn alle Arbeiten zur messtechnischen Unterstützung darauf abzielen, die Einheitlichkeit der Messungen sicherzustellen, dann besteht im Produktionsprozess, d.h. bei der Verwendung von Messgeräten und anderen normativen Materialien der Zweck der messtechnischen Unterstützung darin, die Einheit von Maßnahmen und Messinstrumenten sicherzustellen. Der Hauptinhalt dieser Arbeiten ist die Überprüfung von Messgeräten oder deren Kalibrierung sowie die messtechnische Kontrolle und Überwachung, um die Einhaltung der messtechnischen Regeln und Normen zu überprüfen.

Referenzliste

1. GOST 10160-75 Legierungen Präzise weichmagnetische technische Bedingungen. M.: Verlag der Normen, 2004, 47 p.
2. GOST 8.377-80 Methoden zur Durchführung von Messungen zur Bestimmung statistischer magnetischer Eigenschaften. M.: Verlag der Normen, 1980, 26 p.

РАЗРАБОТКА ИЗМЕРИТЕЛЬНЫХ ИСПЫТАНИЙ ИЗДЕЛИЙ ИЗ СПЛАВА 79 НМ

М. В. Кабаргина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: kabargin@yandex.ru

Аннотация. Целью исследования является разработка измерительных испытаний изделий из сплава 79 НМ. В ходе исследования учтено метрологическое обеспечение испытаний сплава 79 НМ. Актуальность исследования заключается в том, что пермаллой - это сплавы, чувствительные к малейшим упругим напряжениям, не говоря уже о возникновении наклепа в поверхностных слоях и формировании напряженного состояния кристаллической решетки.

Ключевые слова: сплав 79 Нм, пермаллой.

The Study of the Carbon Nanostructure Influence on the Electric Conductivity of Elastomers with Temperature-Dependent Electric Resistance

A. V. Khrobak*, T. P. Dyachkova, A. V. Shchegolkov

Tambov State Technical University, Tambov, Russia

*e-mail: nastiarx@yandex.ru

Abstract

The purpose of this study is to analyze the effect of carbon nanostructures as additives in polymer elastomers on the electrical conductive properties. In the carried research, multi-walled carbon nanotubes (MWCNTs) of various bulk densities were used for the modification; epoxy resin and silicone were chosen as a polymer binder.

Keywords: composite material; multi-walled carbon nanotubes; specific electrical conductivity; epoxy polymer.

Introduction

Today, there is a large number of studies devoted to the study of the mechanisms of electrical conductivity of carbon nanotubes (CNTs) in various polymer systems. Varying the type of CNT, the synthesis method, functional processing of the nanomaterial, the type of polymer, and the dispersion method directly affect the mechanisms of electrical conduction.

Currently, carbon nanotubes (CNTs) are effective nanofillers that improve the electrical conductivity of polymers. In [1], the authors investigated a filler based on nanocomposites reinforced with crushed carbon fibers (HC) - (CNT). The change in electrical conductivity as a function of the tunneling distance, aspect ratios of CNTs and SWs, and intrinsic electrical conductivity for different volume fractions of CNTs is considered. The nanocomposite exhibits a percolation threshold when the CNT content is less than 0.2 vol. %.

In the study [2], nanocomposites of silicone elastomer were obtained, consisting of 2-6 wt.% Multi-walled nanotubes (MWCNTs). The thermogram shows that the temperature at 10%, 20%, 30% and 50% weight loss for silicon elastomer (SiR) / MWCNTs is higher than compared to pure SiR due to the greater polymer-filler interaction. The addition of MWCNTs significantly improved the thermal stability of the silicon elastomer.

In work [3], the authors created an elastic rubber-based composite modified with CNTs and carbon black with high mechanical and electrical properties. The resulting composite with a concentration of 5.76 vol.% Of the hybrid filler CNT and carbon black has a high tensile strength (4.5 MPa) and elongation at break (211%), while the minimum conductive percolation threshold and maximum

electrical conductivity of the composite is 0.24 vol. % and 248.8 S / m, respectively.

The purpose of this work is to study the effect of carbon nanotubes on the heat release of elastomers with temperature-dependent electrical resistance.

Instruments and materials

In order to determine the required amount of CNM in the filler required for the stable operation of the heater, samples were prepared into which various concentrations of carbon nanotubes (CNM) were introduced depending on the total mass of the sample. Manufacturing took place by extrusion of polymers and the gradual addition of CNM to it.

The obtained samples were connected to an electric current and thermograms were taken.

Results and discussion

Studies have shown that the composite material has self-regulating properties, since the thermal power changes when the ambient temperature changes. There is a uniform distribution of heat heating throughout the entire area of the material (Fig. 1). For products, the base power density is $800 \pm 10\%$ W / m² at an ambient temperature of + 10 ° C. When the ambient temperature drops to minus 40°C, the specific heating power is $1600 \pm 20\%$ W / m².

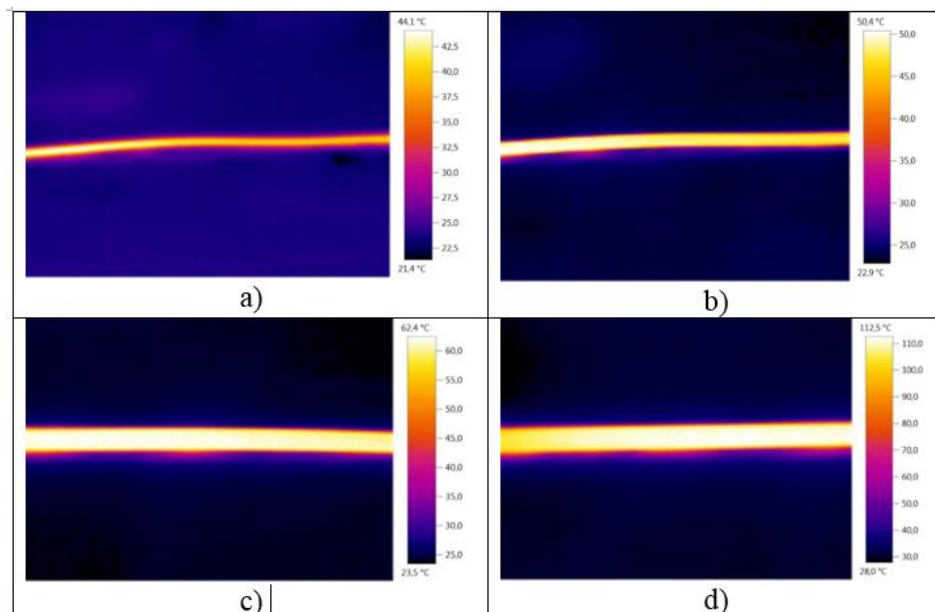


Fig. 1. Thermograms of thermal power:
a) $T = 44.1$ °C; b) $T = 50.4$ °C; c) $T = 62.4$ °C; d) $T = 112.5$ °C

Studies have shown that the technology of manufacturing elastomers, as well as the electrophysical properties of the functional material - the base of the heater, provide the ability to change the level of self-regulating properties (the degree of power increase with decreasing temperature), as well as the specific power during manufacture.

The change in specific power is associated with:

mode with specific power at 10 °C - 800 W / m², at minus 40 °C 1600 W / m² - thickness 1 mm;

mode with specific power at 10 °C - 1100 W / m², at minus 40 °C 1950 W / m² - thickness 2 mm;

mode with specific power at 10 °C - 1400 W / m², at minus 40 °C 2300 W / m² - thickness 3 mm;

Conclusion

A heater with the effect of self-regulation of temperature based on CNTs has been developed. The heater can have various power parameters and high-energy efficiency.

Acknowledgements

This work was supported by the Fund for the Promotion of Innovations within the framework of a scientific project under contract No. 13124GU / 2018 dated 23.05.2018.

References

1. Vodolazskaya I.V., Eserkepov A.V., Akhunzhanov R.K., Tarasevich Y.Y. Effect of tunneling on the electrical conductivity of nanowire-based films: computer simulation within a core-shell model. (Dated: 7 November 2019). URL: <https://www.researchgate.net/publication/337074749>.

2. Saji J. Thermal Studies of Multiwalled Carbon Nanotube Reinforced with Silicone Elastomer Nanocomposites. *Materials Today: Proc.*, 2019, 11, pp. 935–943, doi:10.1016/j.matpr.2018.12.022.

3. Song P.; Song, J.; Zhang, Y. Stretchable conductor based on carbon nanotube/carbon black silicone rubber nanocomposites with highly mechanical, electrical properties and strain sensitivity. *Composites Part B: Engineering*, 2020, 191, pp. 107979, doi:10.1016/j.compositesb.2020.107979.

ИССЛЕДОВАНИЕ ВЛИЯНИЯ УГЛЕРОДНЫХ НАНОСТРУКТУР НА ЭЛЕКТРОПРОВОДНОСТЬ ЭЛАСТОМЕРОВ С ТЕМПЕРАТУРОЗАВИСИМЫМ ЭЛЕКТРИЧЕСКИМ СОПРОТИВЛЕНИЕМ

А. В. Хробак*, Т. П. Дьячкова, А. В. Щегольков

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: nastiarx@yandex.ru

Аннотация. Целью данного исследования является анализ влияния углеродных наноструктур в качестве добавок в полимерных эластомерах на электропроводящие свойства. В проводимых исследованиях для модификации использовались многослойные углеродные нанотрубки (МУНТ) различной насыпной плотностью, в качестве полимерного связующего были выбраны эпоксидная смола и силикон.

Ключевые слова: композитный материал; многостенные углеродные нанотрубки; удельная электропроводность; эпоксидный полимер.

Mechanoactivation of Carbon Nanomaterials

K. O. Korobov

Tambov State Technical University, Tambov, Russia
e-mail: kirillkorobov98@mail.ru

Abstract

The purpose of the paper is to study issues related to the improvement of the properties of carbon nanotubes by mechanoactivation. Various types of equipment and methods of mechanical activation are considered. The possibility of using a ball mill, a rotary apparatus, and a vortex layer apparatus for mechanical activation of carbon nanotubes is considered.

Key words: carbon nanotubes, mechanical activation, vortex layer apparatus.

Introduction

Single-wall carbon nanotubes are of great interest due to their highly unusual and potentially useful properties. For example, they can exhibit the characteristics of both metals and semiconductors, depending on the diameter. However, nanotubes produced by conventional methods are often combined into entangled beams due to van der Waals interactions. So far, this is one of the main obstacles to the practical use of carbon nanotubes.

Carbon nanotubes are cylindrical molecules made from rolled sheets of graphene. These are the toughest and most durable materials that have been synthesized. They have unique electrical and thermal properties. The main problem of widespread practical application of this class of nanomaterials is the complexity and high cost of methods for their production, as well as the limitation of the size of tubes (tubes of centimeter length are still unique today).

Ball mill

The grinding of solid materials takes place inside the drum due to the movement of the balls.

The productivity of mills is also not the same. The latter parameter depends on the shape of the grinding bodies, the degree of filling the drum with them and the revolutions of its rotation. During the operation of the mill, two forces can act on rocks: impact and abrasion. The crushing process itself is a rather lengthy procedure. It can continue with the use of equipment such as a ball mill, from a couple of hours to several days. [1].

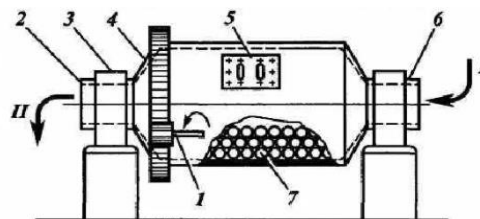


Fig. 1. Ball mill: 1-gear drive; 2- hollow discharge trunnion; 3- bearing; 4- drum; 5-hatch; 6-loading hollow trunnion; 7-crushing bodies; I-source material; II-crushed material [1].

Rotary mixer

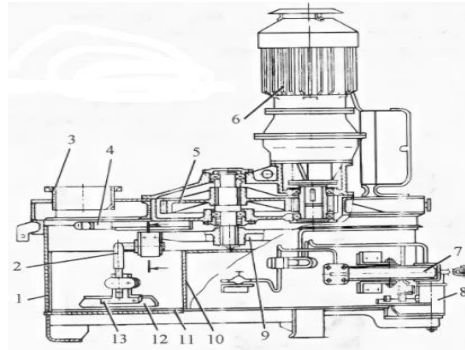


Fig. 2 Rotary mixer: 1-outer shell; 2- brackets; 3-loading branch pipe; 4-perforated water pipe; 5-reducer; 6-electric motor; 7-pneumatic cylinder; 8-sector shutter; 9-traverse; 10-inner glass; 11 replaceable wear plates; 12-blades [2].

Vortex layer apparatus

The operation of the device "vortex layer apparatus" is based on the principle of converting the energy of the electromagnetic field into other types of energy. The vortex layer apparatus is a working chamber (pipeline) with a diameter of 90–136 mm, which is located in the inductor of a rotating electromagnetic field. In the working area of the pipeline, there are cylindrical ferromagnetic elements with a diameter of 0.5–5 mm and a length of 5–60 mm in quantities from several tens to several hundred pieces (0.05–5 kg), depending on the volume of the working area of the apparatus [3].

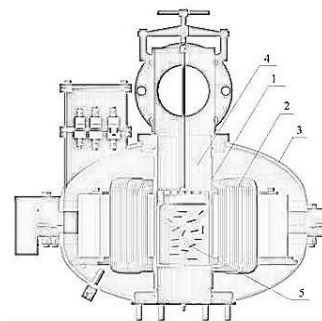


Fig: 3. Diagram of an electromagnetic device with a vortex layer: 1 - protective sleeve; 2 - inductor of a rotating electromagnetic field; 3 - inductor body; 4 - working chamber made of non-magnetic material; 5 - ferromagnetic elements [3].

The vortex layer apparatus can be effectively used in various industries: in construction, engineering, chemical, agricultural, food, mining, as well as in medicine (pharmacology) [3]. And it can be used for: obtaining multicomponent suspensions and emulsions; accelerating the processes of obtaining fine mixtures, activating substances both in a dry state and in the form of aqueous dispersions, which leads to an improvement in the physical and mechanical properties of rubber and a reduction in the vulcanization time; for complete purification of industrial waste water from: phenol, formaldehyde, heavy metals, arsenic, cyanide compounds, acceleration of heat treatment processes, obtaining protein substances from yeast cells; increasing the microbiological stability of food products and activating yeast in bakery production; improving the quality of semi-finished

products and finished products from meat and fish; intensification of extraction processes, including in the preparation of broths, production of berry drinks (juices), pectin, etc.; for the production of suspensions and emulsions with increased microbiological safety in the food industry without the use of stabilizers, as well as for increasing the yield of finished products.

A method of separation of metal and semiconductor single-wall carbon nanotubes

The purification and separation method begins with the dissolution of nanotubes in the ammonia / sodium system. Sodium dissolved in ammonia loses electrons, which are solvated by ammonia. The solvated electrons promote the unraveling of the nanotube coils, and the formation of sodium nanotube carbides.

The next stage of separation consists in removing ammonium and obtaining a dry powder of “nanotube” sodium carbides, after which this powder is treated with dimethylformamide (DMF). Also, depending on the amount of sodium with which the mixture of nanotubes was processed, it is possible to achieve that only sodium derivatives of metal nanotubes dissolve in DMF.

Mechanoactivation

Mechanoactivation is the process of formation of a more chemically active substance by preliminary mechanical treatment. It is carried out with the aim of accumulating energy in the form of defects and other changes in a solid, which make it possible to reduce the activation energy of its subsequent chemical transformation or to improve the conditions for the course of chemical processes.

Conclusion

As a result of the research with the help of mechanoactivation on these installations, the nanoactivity of carbon nanotubes should increase.

References

1. Olevskiy V.A. Shlifoval'noye oborudovaniye dlya obogatitel'nykh fabrik. M.: Gosudarstvennoye nauchno-tekhnicheskoye izdatel'stvo literatury po gornomu delu, 1963, 447 p. (Rus)
2. Zavgorodnev V.K. Oborudovaniye dlya pererabotki plastmass. Spravochnoye rukovodstvo. M.: Mashinostroyeniye, 1976, 407 p. (Rus)
3. Suslov A.D., Ivanov S.V., Murashkin A., Chizhikov Yu.V. Vikhrevyye ustroystva. M.: Mashinostroyeniye, 1985, 252 p. (Rus)

К ВОПРОСУ МЕХАНОАКТИВАЦИИ УГЛЕРОДНЫХ НАНОМАТЕРИАЛОВ

К. О. Коробов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: kirillkorobov98@mail.ru

Аннотация. Целью работы данной темы является изучение вопросов связанных с улучшением свойств углеродных нанотрубок путем их механоативации. Рассматриваются различные типы оборудования и способов механоактивации. Рассмотрена возможность применения шаровой мельницы, роторного аппарата и аппарат вихревого слоя для механоактивации углеродных нанотрубок.

Ключевые слова: углеродные нанотрубки, механоактивация, аппарат вихревого слоя.

Methods for Moisture Control in Pre-Insulated Pipes

D. V. Korpusov

Tambov State Technical University, Tambov, Russia
email: awesome009@yandex.ru

Abstract

The article discusses methods for controlling moisture in pre-insulated pipes. It is emphasized that in the conditions of service life there is an increase in the heating networks pipelines and an increase in the number of emergencies. The development of modern methods of continuous monitoring of the moisture content of a heat-insulating layer of polyurethane foam becomes especially urgent. The aim of this article is to review the well-known methods for controlling the moisture content of PUF insulation in pre-insulated pipes. The main objectives of the article are to identify the main advantages and disadvantages of previously known control methods.

Keywords: moisture control, pre-insulated pipes, polyurethane foam, thermal insulation layer, moisture sensor.

The relevance of using the moisture control methods is to quickly identify possible damage to pipelines of heat networks and also preventing the occurrence of an accident. Timely elimination of heat leakage also reduces energy losses in heat networks. In this regard it is proposed to consider the most common previously known methods for controlling the moisture content of the insulation of pre-insulated pipes.

Today, the most common method for monitoring the moisture content of polyurethane foam insulation of heat networks pipelines is a method based on measuring the electrical resistance between a signal copper wire and a metal pipe [1]. The resistance of dry polyurethane foam is approaching infinity. In the place of moistening between the copper cable and the pipe the insulation resistance (R_{ins}) decreases. This value is compared with the reference value of electrical resistance (R_{ref}). The insulation resistance in a signal line covering 1 km of pipes must not be lower than 200 kOhm. In the case when $R_{ref} > R_{ins}$ it is concluded that moisture has entered the heat insulator layer. A pulse reflectometer is used to locate the moistening place [2].

The main advantages of this method of moisture control are simplicity and reliability of equipment operation. Among the disadvantages of the method is the need for additional devices to improve the accuracy of locating sections of thermal insulation of pipelines with high moisture.

Instead of portable devices for monitoring the moisture content of polyurethane foam insulation of pipes for routine inspection of the heat networks it is proposed to install wireless communication modules based on ZigBee technology for continuous monitoring [3]. Such methods will significantly reduce the cost and time of repair work and quickly and accurately determine the places of possible leakage and prevent significant losses of resources before the start of the repair.

A new method for monitoring the moisture content in pre-insulated pipes is a method using a detector of the system of the operational remote state of the

insulation of pre-insulated pipes of heat networks [4]. This method is also based on determining the change in the electrical resistance of the thermal insulation material between the loop of the signal conductors and the metal pipe. The detector consists of a vandal-proof housing which contains: an electronic unit for diagnostics and transmission of the insulation state and signal wires made on a printed circuit board including a device for measuring the electrical resistance of thermal insulation; controller; single pulse generator; GSM modem and internal GSM antenna and secondary power supply. The connection of this technical device with the control room is initialized in the form of a single alarm signal in case of the insulation wetting or the wire contact with a metal pipe ($R_{ins} < 5 \text{ kOhm}$).

The use of this method for moisture control allows reducing operating costs for monitoring the condition of pre-insulated pipes by reducing the payment for GSM communication services, reducing the requirements for the configuration characteristics of the control room computer and removing restrictions on installing devices in public places (streets, basements, etc.).

The main disadvantage of the method for monitoring the moisture content of polyurethane foam insulation with a detector is the low accuracy in locating the place where the insulation of pre-insulated pipes gets wet and the inability to register the degree of moisture in the heat-insulating layer.

The use of digital moisture sensors is one of the modern methods of moisture control in pre-insulated pipes [5]. It is based on measuring the moisture content of polyurethane foam insulation with semiconductor digital moisture and temperature sensors which are located at a distance of 0.3...0.5 meters from each other directly in the polyurethane foam layer of pipe insulation. The moisture probes are soldered to a ribbon-like flexible printed circuit board. Each sensor has its own unique address which depends on its location on the track. The signals from the sensors are sent to the controller which interrogates them and transmits a signal about the place where the polyurethane foam insulation gets wet to the central control center.

The method for controlling moisture content with digital sensors is an improved analog of the method based on measuring the electrical resistance between a signal copper cable and a metal pipe [6]. In addition, the use of digital components to control the moisture content of the thermal insulation layer of pipelines provides the following advantages:

- registration of the fact and degree of moisture in the heat-insulating layer;
- the ability to bind the digital code of each sensor to the pipeline diagram which will allow detecting the damage location with the accuracy of the sensors installation without using an additional locator;
- temperature control allows for temperature correction of humidity readings;
- high noise immunity;
- convenience of presenting information and the ability to store it.

The disadvantages of the method of controlling moisture content with digital sensors there are high costs for electronic components capable of operating under conditions of elevated temperatures arising during the chemical reaction of

polyurethane foam components and during operation of the heat network. It is also worth noting that in the proposed system of the method for monitoring moisture in pipeline insulation the accuracy of determining the location of damage depends on the distance between the sensors.

Thus, this article provides an overview of well-known methods for controlling the moisture content of polyurethane foam insulation in pre-insulated pipes of heat networks and identifies the main advantages and disadvantages of each method. In the future, it is planned to develop a completely new method for controlling the moisture content of polyurethane foam insulation of pipes of heat networks taking into account all the disadvantages and limitations of previously existing control systems.

References

1. GOST 30732-2006. Truby i fasonnye chasti stal'nye s teploizolyaciej iz penopoliuretana v polietilenoj obolochke [Steel pipes and fittings with polyurethane foam thermal insulation in a polyethylene sheath]. M.: IPK Publishing house of standards, 2007. (Rus)
2. Finogeyev A.G., Finogeyev A.A. Sistemy operativnogo distantsionnogo kontrolya [Systems of operational remote control]. Nadezhnost' i kachestvo: sb. trudov Mezhdunarodnogo simpoziuma. Penza, PGU Publ., 2009, vol. 2, pp. 124 – 126. (Rus)
3. Finogeyev A.G., Dil'man V.B., Maslov V.A., Finogeyev A.A. Sistema besprovodnogo operativnogo distantsionnogo monitoringa i upravleniya setyami gorodskogo teplosnabzheniya na osnove sensornykh setey [System for wireless operational remote monitoring and control of urban heat supply networks based on sensor networks]. URL: <http://inno-terra.ru/sites/default/files/98-107.doc>. (Accessed 10.11.2020). (Rus)
4. Gorinov Yu.A., Chemodanov A.S., Yakubovich S.Ya., Safin R.G. Patent 132895. Russian Federation, IPC G01N 27/10. Detector of the system of on-line remote monitoring of the insulation condition of pre-insulated pipelines for the heat energy transportation: No. 04/25/2013: publ. 09/27/2013, 6 p.
5. Bolotov S.V. O vozmozhnosti ispol'zovaniya datchikov vlazhnosti dlya kontrolya sostoyaniya truboprovodov teplovykh setey [On the possibility of using moisture sensors for monitoring the state of pipelines of heat networks]. Materialy, oborudovaniye i resursosberegayushchiye tekhnologii: tez. dokl. mezhdunar. nauch.-tekhn. konf. Mogilev: Belorus.-Ros. un-t, 2015, p. 281. (Rus)
6. Bolotov S.V. Sistema operativnogo distantsionnogo kontrolya sostoyaniya penopoliuretanovoy izolyatsii truboprovodov teplovykh setey s tsifrovymi datchikami vlazhnosti [System for online remote monitoring of the state of polyurethane foam insulation of heating network pipelines with digital humidity sensors]. Vestnik Belorussko-Rossiyskogo universiteta, 2016, 2 (51), pp. 139 – 147. (Rus)

МЕТОДЫ ДЛЯ КОНТРОЛЯ ВЛАЖНОСТИ В ПРЕДВАРИТЕЛЬНО ИЗОЛИРОВАННЫХ ТРУБАХ

Д. В. Корпусов

Тамбовский государственный технический университет, Тамбов, Россия
email: awesome009@yandex.ru

Аннотация. В статье рассматриваются методы контроля влажности в предварительно изолированных трубах. Подчеркивается, что в условиях увеличения сроков эксплуатации трубопроводов тепловых сетей и роста числа аварийных ситуаций, особую актуальность приобретает разработка и освоение современных методов непрерывного контроля влажности теплоизоляционного слоя из пенополиуретана (ППУ). Целью данной статьи является обзор хорошо известных методов контроля влажности пенополиуретана в предварительно изолированных трубах. Основная задача статьи – выявить основные преимущества и недостатки известных ранее методов контроля.

Ключевые слова: контроль влажности, предварительно изолированные трубы, пенополиуретан, ППУ, теплоизоляционный слой, датчик влажности.

The Effect of Ultrasonic Dispersion on Dispersion Characteristics of Carbon Nanomaterials

G. V. Kuksov*, M. S. Kuznetsov, E. D. Tatarintsev

Tambov State Technical University, Tambov, Russia

*e-mail: egor.cuksov@yandex.ru

Abstract

At present, the search for optimal methods for dispersing CNF is underway. After a comparative analysis of various dispersing methods, it was suggested that ultrasonic grinding of carbon nanomaterials in a liquid medium is considered the most promising. It was found that the effectiveness of the destructive action of ultrasound on solid particles in an aqueous medium depends significantly on a number of factors: the properties of the liquid in which the treatment is carried out, the temperature of the medium, the intensity and frequency of ultrasound, and other factors. Further, it was concluded that the finest fraction of the material and in a larger amount is formed when it is dispersed for 10 minutes.

Keywords: carbon nanotubes, dispersion, ultrasound, experiments.

A complicating factor in achieving close to theoretical values of strength, elastic modulus, and other characteristics is the aggregation of carbon nanomaterials into granules of macroscopic size (1-500 microns) during their preparation. The process of granule formation is due to the presence of van der Waals bonding forces that act between individual carbon nanofibers (CNFs). When they are introduced into the composites in their initial state, an uneven distribution of the binder (cement, concrete, etc.) occurs in the matrix and there is not an improvement, but deterioration in physical and mechanical properties (since carbon nanogranules are stress concentrators). At present, the search is underway for optimal methods for dispersing CNF.

Having carried out a comparative analysis of various dispersing methods, it was suggested that ultrasonic grinding of carbon nanomaterials (CNMs) in a liquid medium is considered the most promising. Since the effect of ultrasound makes it possible to obtain highly dispersed (average particle size - microns and fractions of microns), homogeneous and chemically pure mixtures in a dispersion medium. The dispersion of suspensions is carried out by the action of ultrasound on the aggregates of CNMs, interconnected by the forces of adhesion, sintering or cleavage.

With ultrasonic dispersion of such suspensions, the dispersion of the product increases by several orders of magnitude in comparison with traditional mechanical grinding. Dispersion is mainly due to cavitation erosion. Cavitation is the process of formation of cavities in a liquid (cavitation bubbles, or caverns) filled with gas, steam or their mixture. On the surface of CNMs aggregates there are microcracks, surface irregularities, which are highlighted by an increased concentration of stresses, in which the nucleation of cavitation bubbles occurs. Under the action of intense microflows, the liquid penetrates into pores and cracks,

where, when the cavitation bubbles collapse, a powerful shock wave appears, which destroys the unit.

The effectiveness of the destructive action of ultrasound on solid particles in an aqueous medium substantially depends on a number of factors: the properties of the liquid in which the treatment is carried out, the temperature of the medium, the intensity and frequency of ultrasound, the duration of treatment, on the hardness, homogeneity and porosity of the particles to be ground, their chemical resistance, etc. This explains the selectivity of the destructive action of ultrasound as applied to individual materials in the ultrasonic treatment of suspensions.

Dispersion experiments were carried out on an IL100-6 / 4 ultrasonic unit. The installation consists of an ultrasonic generator, a magnetostrictive ultrasonic transducer (vibration amplitude at a frequency of 22 kHz), fixed on a tripod. A set of three waveguide-emitters allows obtaining different amplitudes of ultrasonic vibrations in a liquid. Waveguides are made as acoustic transformers of vibration amplitude with transformation ratio 1: 0.5, 1: 1 and 1: 2.

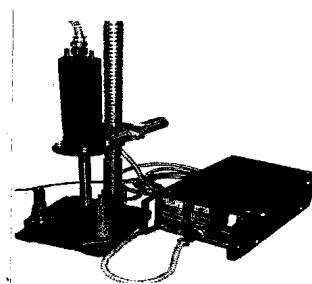


Fig. 1. Ultrasonic unit IL100-6 / 4

All experiments were carried out with a cylindrical waveguide-emitter, the transformation ratio of which is 1: 0.5. The dispersion was determined by the method of sieve analysis and the initial dispersion of CNM was 200 μm . Dispersion of CNM was carried out in distilled water, after which the suspensions were allowed to settle for some time at room temperature. The final fineness of CNM was determined using microscopic analysis on an MBS-9 microscope. Based on the experiments carried out, it can be concluded that for effective dispersion of CNM by ultrasound, the weighed amount of the material should be 0.2 g per 100 ml of the dispersion medium.

Because the suspension settling time is long enough, then it is enough to introduce the suspension with CNM into the matrix. Based on the results of these experiments, it can be concluded that the finest fraction of the material and in a larger amount is formed when it is dispersed for 10 minutes.

In order to improve the dispersion of CNM and increase the settling time of the resulting suspensions, it was proposed to use surfactants (surfactants) in its dispersion. It is known that surfactants stabilize suspensions, that is, make them more stable. DMF (dimethylformamide ($\text{HNC}(\text{O}(\text{CH}_3)_2)$)) was used as a surfactant. Experiments with surfactants indicate that the minimum fraction of

CNM in the presence of 5% concentration of DMF in the suspension is formed when it is dispersed for 1 min.

All these technologies are very important in the development of engineering and technology. There are many nanomaterials at the moment. The main challenge now is finding new structures or carbon or creating them. Scientists are focused on obtaining new materials, which will allow technology to develop faster and develop new technologies.

References

1. Anishchik V.M., Borisenko V.Ye., Zhdanok S.A., Tolochko N.K., Fedosyuk V.M. Nanomaterialy i nanotekhnologii [Nanomaterials and nanotechnology]. Minsk. Izdatel'skiy tsentr BGU, 2008. (Rus)
2. Anashina O.D., Andryushechkin S.Ye., Anevskiy S.L., Bulygin F.V., Krutikov V.N. Metrologicheskoye obespecheniye nanotekhnologiy i produktsii nanoindustrii [Metrological support of nanotechnology and nanoindustry products]. M.: Logos, 2020. (Rus)

ВЛИЯНИЕ УЛЬТРАЗВУКОВОЙ ДИСПЕРСИИ НА ДИСПЕРСИОННЫЕ ХАРАКТЕРИСТИКИ УГЛЕРОДНЫХ НАНОМАТЕРИАЛОВ

Г. В. Куксов*, М. С. Кузнецов, Е. Д. Татаринцев

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: egor.cuksov@yandex.ru

Аннотация. В настоящее время ведутся поиски оптимальных методов диспергирования УНВ. Проведя сравнительный анализ различных методов диспергирования, было высказано предположение, что наиболее перспективным считается ультразвуковое измельчение УНМ в жидкой среде. Было установлено, что эффективность разрушающего действия ультразвука на твердые частицы в водной среде существенно зависит от ряда факторов: свойств жидкости, в которой проводится обработка, температуры среды, интенсивности и частоты ультразвука и прочих факторов. Далее были сделаны выводы, что самая тонкая фракция материала и в большем количестве образуется при его диспергировании в течение 10 минут.

Ключевые слова: Углеродные нанотрубки, дисперсия, ультразвук, эксперименты.

Some Issues of Low Carbon Steel Hydrophobization

N. A. Kuryato^{1,2*}, L. G. Knyazeva²

¹Tambov State Technical University, Tambov, Russia

²All-Russian Research Institute for Use of Machinery and Petroleum Products in
Agriculture, Tambov, Russia

*e-mail: *cska-sparta@yandex.ru*

Abstract

The electrochemical behavior of steel St3 with superhydrophobic coatings of two types in 0,5 M NaCl is described. To obtain the type I coating, the metal surface was textured by an IR laser radiation of nanosecond duration followed by chemisorption of fluorobutylsilane out of a solution in n-decane. To obtain a coating of type II, a nanoscale composite layer consisting of aggregates of aerosil nanoparticles was applied additionally to the outcome of type I method. The influence of medium corrosive impact duration on protective effect of the superhydrophobic coating is considered. It is noted that during the first day of exposure, the anodic and cathodic processes on superhydrophobic electrodes of types I and II are inhibited, compared to the unprotected electrode, but the cathodic process suppression is significantly higher, and their corrosion potential decreases to -480 V.

Keywords: electrochemical measurements, steel, superhydrophobic surface.

According to the experts, economic losses from corrosion worldwide amount to about \$ 4 trillion [1]. The most common type of corrosion is atmospheric corrosion. All metal structures used in the open air are exposed to this type of corrosion, resulting in the need to protect metals. A promising direction is the method of hydrophobization of the surface, in which a phase water film cannot be formed on the surface or almost no H₂O molecules can be adsorbed-direct reagents of corrosion processes. In the Russian Federation these issues are actively studied at A.N. Frumkin Institute of physical chemistry and electrochemistry, RAS and in the Institute of Chemistry, Far Eastern Branch of the Russian Academy of Sciences. Hydrophobic materials and coatings are those whose wetting angle with water and aqueous solutions is > 90°, and superhydrophobic materials are > 150° [2]. In [3-4], the results of studies of the corrosion and electrochemical behavior of carbon steel St3 in 0.5 M NaCl and in a NACE medium containing 25 and 400 mg/l H₂S are presented.

The aim of this work is to study the behavior of steel with a hydrophobic surface of 0.5 M NaCl with an exposure time of 0.25 h and 24 h by polarizing measurements. Samples of three types reinforced in a frame made of cured ED-5 epoxy resin were studied: steel without superhydrophobic coating, steel with superhydrophobic coating of type I and type II.

To obtain the type I coating, the metal surface was textured by an IR laser radiation of nanosecond duration followed by chemisorption of fluorobutylsilane out of a solution in n-decane. In this treatment, the thickness of the superhydrophobic coating, which includes a textured metal layer and an adsorbed monolayer of a hydrophobic agent, was ≈ 100 μm. To obtain a type II coating, an additional nanocomposite layer consisting of aggregates of aerosil nanoparticles

coated with the same hydrophobic agent was applied to the type I coating. After chemisorption of the hydrophobizer, the samples were kept for at least 336 hours at room temperature for cross-linking in a layer of hydrophobic agent.

After 0.25 h of exposure in the test solution, a sample of hydrophobized steel (type I) has a corrosion potential close to -0.140 V.

On the cathode polarization curve, a section of the limiting current is clearly observed (Fig. 1, curve 2), which apparently passes into the section of the water electric discharge (dotted line).

At the initial stage, the speed of hydrophobized steel is reduced compared to unprotected steel. The braking coefficient $\gamma \sim 60$, γ is determined by the formula:

$$\gamma = \frac{K_0}{K_\Gamma},$$

where K_0 and K_Γ are the corrosion rates of non-hydrophobized and hydrophobized steel.

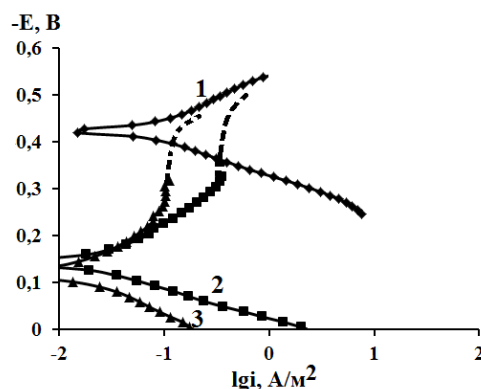


Fig. 1. The polarization curves after exposure to NaCl solution for 0.25 h. Hydrophobic surface: 1 – none; 2 – I type; 3 – II type.

Fig. 1 shows that on the hydrophobized surface of steel (type II) the rate of the anodic reaction is strongly inhibited compared to the uncoated sample, while the rate of the cathodic process is noticeably increased. The density of the limiting cathodic diffusion current is close to 0.44 A/m^2 in terms of the visible surface of the electrode. Moreover, the corrosion potential of samples of hydrophobized steel (type II) is equal to -0.120 V.

At the same time, the rate of the anodic reaction decreases slightly and the cathodic reaction practically does not change (Fig. 1, curve 3). The corrosion current also decreases somewhat, but within the limits of the experimental error.

After holding the hydrophobized electrodes for a day in a corrosive environment (0.5 M NaCl), the picture changes significantly. The corrosion potential of such steel (regardless of the type of surface) is sharply reduced, amounting to $\sim -0.480 \text{ V}$. At the same time, the corrosion potential of non-hydrophobized steel practically does not change ($E_{\text{cor}} \sim -0.400 \text{ V}$, Fig. 2, curve 1).

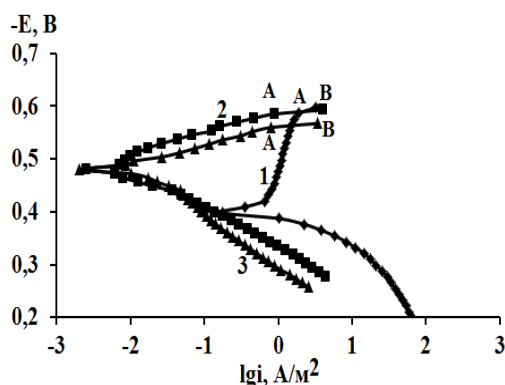
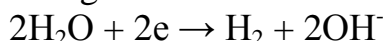


Fig. 2. The polarization curves after exposure to NaCl solution for 24 h.
 1 - steel electrode without coating, 2 - with superhydrophobic coating (type I), 3 - with superhydrophobic coating (type II)

Note that on its cathodic polarization curve, a section AB appears, apparently corresponding to the electric discharge of water:



in which, as can be clearly seen from Fig. 2, the section of the limiting cathodic current with $i_{\text{gi}} \sim 10^{0,1} \text{ A/m}^2$ (or $\sim 120 \mu\text{A/cm}^2$) passes.

On the cathode polarization curves of non-hydrophobized steel, there are no sections of the limiting current, but the AB area appears, as in the case of curve 1 figure 2. Apparently, in this region, starting from the potential E_A , the total cathode reactions (1) and (2) proceed in parallel, that is, in addition to oxygen depolarization, “water” depolarization also appears. The value of the cathode Tafel slope suddenly drops sharply to 0.04 V (Fig. 2, curves 2 and 3). Apparently, in this area, starting from the potential E_a , the total cathode reactions (1) and (2) proceed in parallel, that is, in addition to oxygen depolarization, “water” depolarization also appears. The value of the cathode Tafel slope suddenly drops sharply to 0.04 V (Fig. 2, curves 2 and 3).

On a hydrophobized type 2 steel electrode, the picture remains the same (Fig.2, curves 2 and 3), and the values of b_a and E_{cor} ($\sim 0.480 \text{ V}$) do not change. The density of the corrosion current within the experimental error on both series of hydrophobized electrodes is the same and is $\sim 0.01 \text{ A/m}^2$ (based on the visible surface). The value of γ is equal to 120. Such a high value of γ is achieved by inhibiting both the cathode and anode reactions, but the suppression of the cathode process is significantly higher.

After 0.25 h of exposure in the test solution, a sample of hydrophobized steel (type I) has $E_{\text{cor}} \sim -0.140 \text{ V}$, and the corrosion potential of samples of hydrophobized steel (type II electrodes) is -0.120 V . Braking coefficient (γ) ~ 60 . On hydrophobized samples, the rate of the anodic reaction is strongly inhibited, compared to the uncoated sample, while the rate of the cathodic process is noticeably increased. But after 24h, the E_{cor} of hydrophobized samples (type I and II) decreases sharply, amounting to $\sim -0.480 \text{ V}$. The value of γ is 120, which is achieved by inhibiting both the cathode and anode reactions, but the suppression of the cathode process is significantly higher.

References

1. Li X., Zhang D., Liu Z., Li Z., Du C., Dong C. Materials science: Share corrosion data. Nature, 2015, vol. 527, pp. 441-442.
2. Boinovich L.B., Emelyanenko A.M. Gidrofobnye materialy i pokrytiya: principy sozdaniya, svoystva i primeneniye [Hydrophobic materials and coatings: principles of creation, properties and application]. Uspehi Khimii, 2008, No. 7, pp. 619-638. (Rus)
3. Vigdorovich V.I., Tsygankova L.E., Uryadnikov A.A., Shel N.V., Knyazeva L.G., Tanygina E.D. Vliyanie nanokompozitnogo supergidrofobnogo pokrytiya na korroziyu i kinetiku elektrodnykh processov na stali v 0,5 M rastvore NaCl [Influence of a nanocomposite superhydrophobic coating on corrosion and kinetics of electrode processes on steel in a 0.5 M NaCl solution]. Korroziya: materialy, zashchita, 2016, No. 7, pp. 12-17. (Rus)
4. Vigdorovich V.I., Tsygankova L.E., Uryadnikova M.N., Shel N.V., Alshika N. Zashchita uglirodostoj stali supergidrofobnym pokrytiem v model'noj plastovoj vode, sodержashchej serovodorod [Protection of carbon steel with superhydrophobic coating in model stratal water containing hydrogen sulfide]. Vse materialy. Enciklopedicheskij spravochnik, 2020, No. 7, pp. 41-47. (Rus)

НЕКОТОРЫЕ АСПЕКТЫ ГИДРОФОБИЗАЦИИ НИЗКОУГЛЕРОДИСТОЙ СТАЛИ

Н. А. Курьято ^{1,2*}, Л. Г. Князева ²

¹Тамбовский государственный технический университет, Тамбов, Россия

²Всероссийский научно-исследовательский институт использования техники и нефтепродуктов в сельском хозяйстве, Тамбов, Россия

*e-mail: cska-sparta@yandex.ru

Аннотация. Электрохимическое поведение стали Ст3 с супергидрофобными покрытиями двух типов в 0,5 М NaCl. Для получения покрытия типа I, поверхность металла текстурировалась инфракрасным лазерным излучением наносекундной длительности с последующей хемосорбцией фторбутилсилана из раствора в н-декане. Для получения покрытия типа II дополнительно к результату метода типа I наносился наноразмерный композитный слой, состоящий из агрегатов наночастиц аэросила. Рассмотрено влияние продолжительности коррозионного воздействия среды на защитный эффект супергидрофобного покрытия. Отмечено, что в течение первого дня экспонирования анодный и катодный процессы на супергидрофобных электродах I и II типов тормозятся, по сравнению с незащищенным электродом, но подавление катодного процесса существенно выше, а их потенциал коррозии снижается до -480 В.

Ключевые слова. электрохимические измерения, сталь, супергидрофобное покрытие.

The Current State of Optimal Control in Electroplating

A. S. Lazeev

Tambov State Technical University, Tambov, Russia
e-mail: boncrasher96@gmail.com

Abstract

The issue of optimal control of the electroplating process in a bath with multisection anodes is considered. The investigation of modern control methods of galvanic processes in baths with multi-section anodes was carried out. The analysis of modern control methods of galvanic processes in baths with multi-section anodes proved its effectiveness, as they increase the efficiency and simplify the process of implementing this system.

Keywords: galvanic coating, multisection anodes, optimal control.

Introduction

Electrolytic plating processes (electroplating) are used to protect products from corrosion; protective-decorative finishes; restoration of the shape of worn parts; increasing resistance to mechanical wear; messages antifriction properties, reflectivity; raising surface hardness; reducing the transient electrical resistance and other purposes.

More than 80% of all metal structures, machines, devices and other equipment made of metal is operated in the atmosphere and subject to atmospheric corrosion, i.e. destruction (oxidation) of metals as a result of chemical or electrochemical effects of the external environment.

Thus, the development and analysis of a new hardware design galvanic processes and their automation, increasing equipment performance and improving quality indicators electroplating is an urgent scientific and practical problem.

The most widespread in all branches of industry are auto-operator mechanized and automated galvanic lines due to their wide functional properties. The galvanic line is a set of baths in which one of the following processes is carried out: preparatory (degreasing, etching, activation, polishing, rinsing); actual coating; final (neutralization, passivation, clarification, chromating, washing). A drying chamber is used to remove moisture from the surface of the treated parts.

Baths can be arranged in one or two rows, oval or ring, depending on the requirements of the enterprise. The movement of workpieces from one technological position (which means loading and unloading devices, baths and drying chamber) to another is carried out by an auto-operator (manipulator) or a transport robot.

The line is also completed with a ventilation system, rectifier units for powering electrochemical baths, a maintenance platform, a command device (or other control system), auxiliary equipment (containers for preparation and dosing of electrolyte components, filter equipment, pumps, etc.).

Since the preparatory and final operations have a significantly shorter duration than the coating time, several electrochemical baths are installed to increase the line productivity.

One of the main tasks of controlling the electroplating process is to achieve uniform distribution of the deposition thickness of the coating over the entire surface of the workpiece. The uniformity of the galvanic coating depends on their various factors, the most significant of which are the geometric shapes of the anodes, and the relative position in the electroplating bath, composition, properties and temperature of the electrolyte, current density and electrolyte mixing.

A modern trend in the process of creating a mechanism for improving the uniformity of the distribution of the thickness of the coating is a system that is a system of anode sections, consisting of separate metal plates of the same square shape. For a kind of devices, several methods of control have been proposed:

- in the arrangement of rows of anode sections in order to approximately repeat the configuration of the cathode;
- in the control of the current in each separate section, depending on the distance of the cathode surface;
- in the control of the duration of the current supply to each separate section;
- in the cyclic switching on of the anode sections according to special programs;

The main part of the proposed methods for controlling the production of the process of creating a galvanic coating in a bath with multisection anodes of the flow to each individual anode section, taking into account the composition of the electrolyte, its properties, shapes and sizes of electrodes. An important influence on the voltage distribution in the bath, and accordingly on the uniformity of the coating thickness distribution, is provided by a high-quality coating of the electrolyte thickness distribution.

To solve the problem of optimal control of the process of using galvanic coating in a bath with multi-section anodes, genetic algorithms can be applied. They belong to the class of evolutionary algorithms and provide probabilistic optimization methods. Their distinctive feature is that the search for a solution begins with a certain random set of solutions - a population, an element of which is called a chromosome.

A genetic algorithm is a combination of two types of operations:

1. Genetic operations: crossing and mutation.
2. Evolutionary operation: selection.

Genetic algorithms have the following advantages: they do not require a priori information about the behavior of a function (for example, differentiation and continuity); relatively resistant to getting into local optima; easy to implement.

The use of multi-section anodes can significantly improve the main indicators of the quality of the galvanic coating by the detailed adjustment of each individual section. And modern methods of optimal control, such as genetic algorithms,

increase the efficiency and simplify the process of implementing this system, which in due time reduces production costs.

References

4. Solovjev D.S., Litovka Y.V. Mathematical modeling and optimal control deposition process galvanic coverings in a multianode bath taking into account change concentrations of electrolyte components. *Computer Research and Modeling*, 2013, vol. 5, no. 2, pp. 193-203.

5. Soloviev D.S. Optimal'noe upravlenie gal'vanicheskimi processami s ciklicheski vkljuchaemyimi anodnymi sekcijami. Dis. kand. tekhn. nauk [Optimal Control of Electroplating Processes to Cycle on the Anode Sections. Cand. sci. diss.]. Tambov, TSTU, 2014, 166 p.

6. Konkina V.V., Soloviev D.S., Litovka Y.V. [Mathematical Modeling and Optimal Control of Reverse Plating Regime in Bath with Multi-Section Anodes]. *Vestnik ASTU. Ser.: Management, Computer Science and Informatics*, 2015, No. 2, pp. 7–15. (Rus)

ТЕКУЩЕЕ СОСТОЯНИЕ ОПТИМАЛЬНОГО УПРАВЛЕНИЯ В ГАЛЬВАНИКЕ

А. С. Лазеев

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: boncrasher96@gmail.com

Аннотация. Рассмотрен вопрос оптимального управления процессом гальваники в ванне с многосекционными анодами. Анализ современных методов управления гальваническими процессами в ваннах с многосекционными анодами. Рассмотрен вопрос оптимального управления процессом гальваники в ванне с многосекционными анодами. Анализ современных методов управления гальваническими процессами в ваннах с многосекционными анодами.

Ключевые слова: гальваническое покрытие, многосекционные аноды, оптимальное управление.

Einfluss der Mikrowellenverarbeitung auf Struktur und Eigenschaften der nanomodifizierten Polymer-Kohlenstoff- Materialien basierend auf Fluoroplast

T. A. Lutovinova, M. A. Funbayu

Tambov State Technical University, Tambow, Russland
e-mail: tanyalutovinova8991@yandex.ru, mariafubau@gmail.com

Anmerkung

Polymere, die durch Kohlenstoff-Nanomaterialien modifiziert sind, haben eine erhöhte elektrophysikalische Leitfähigkeit. Der qualitativ in der Polymermatrix verteilte Modifikator absorbiert aktiv Mikrowellen-Wellen häufig auch bei extrem geringem Volumen (bis zu 1,5 Massen). Die durch die Rasterelektronenmikroskopie erhaltenen Fotos zeigen die gleichmäßige Verteilung der Kohlenstoff-Nanoröhrchen in der Fluoroplast-Matrix 4. Die Mikrowellen-Verarbeitung der erhaltenen Verbundstoffe zeigte einen signifikanten Anstieg der Temperatur der Proben bei einer Aufheizzeit von bis zu 100 Sekunden, selbst bei minimalen Volumina des eingegebenen Modifikators.

Stichwort: Fluoroplast 4, Kohlenstoff-Nanoröhrchen, Polymer-Verbundwerkstoff, Mikrowellen-Verarbeitung.

Moderne Polymermaterialien sind komplexe Verbundwerkstoffe, die zusammen mit einer Polymermatrix eine Reihe von Komponenten enthalten, deren Wahl durch die Betriebsbedingungen der fertigen Produkte bestimmt wird. Insbesondere um die Festigkeitseigenschaften von Fertigprodukten zu verbessern, wurden kürzlich Polymerzusätzen kleine (bis zu 1-2%) Zusätze von Nanomaterialien zugesetzt [1, 2]. Diese Materialien und Produkte werden verwendet, um die Lebensdauer von Maschinenteilen, Mechanismen und technologischen Geräten zu erhöhen, die bei hohen Temperaturen unter Bedingungen intensiver Reibung in einer aggressiven und feuchten Umgebung betrieben werden.

Als Forschungsgegenstand ist fluoroplastische Qualität F-4 (GOST 10007-80) gewählt. Kohlenstoffnanoröhrchen (CNTs) „Taunit“ (hergestellt von LLC „Nanotechcenter“, Russland, Tambow) wurden als modifizierende Substanzen verwendet - eindimensionale nanoskalige Filamentformationen aus polykristallinem Graphit in Form eines frei fließenden Pulvers mit einer Partikelgröße von 40-100 nm Verfahren zur Herstellung von CNTs: Gasphasen-chemische Abscheidung (katalytische Pyrolyse - CVD) von Kohlenwasserstoffen (CH₄, C_x Well) auf Katalysatoren (Ni / Mg) bei Atmosphärendruck und einer Temperatur von 580-650 ° C. Die Bearbeitungszeit beträgt 10-80 Minuten. [3].

Das Mischen von modifizierenden Substanzen CNTs mit fluoroplastischem Pulver wurde vorläufig für 60 Sekunden in der Planetenmühle Activator 2 SL durchgeführt, zum Feinmahlen von Feststoffen entwickelt und zur Durchführung mechanochemischer Reaktionen vorbereitet. Die Trommeldrehfrequenz betrug 1490 U / min. Als Schleifelemente wurden Kugeln mit einem Durchmesser von 5 mm in der Menge von 50 Stück verwendet. Die Masse einer Probe des

verarbeiteten Materials betrug 200 g. Modifizierende Substanzen wurden vor ab 1 Stunde in einem Vakuumtrockner bei einer Temperatur von 100 ° C getrocknet. Die resultierende Mischung wurde erneut zwei Stunden bei einer Temperatur von 100 ° C unter Vakuum getrocknet und experimentelle Proben wurden durch Sintern in einer Form hergestellt.

Eine der vielversprechenden Methoden zur physikalischen Modifizierung von Materialien ist die Bestrahlung von Materialien (einschließlich Polymeren) mit elektromagnetischen Mikrowellenwellen. In der klassischen Form ist die Mikrowellenbehandlung eine der Methoden der Wärmebehandlung (Erwärmung). In einer Reihe von Arbeiten [4-10] ist gezeigt, dass die Zeit der Mikrowellenverarbeitung auf 10-100 Sekunden reduziert wird. Man beobachtet nichtthermische Effekte der Mikrowellenmodifikation von Materialien. Diese Methode der elektrophysikalischen Modifikation ist auf Polymere anwendbar. Es sollte jedoch berücksichtigt werden, dass die Effizienz der Mikrowellenmodifikation von Polymeren direkt von ihrer Leitfähigkeit und Polarität abhängt. Um die Effizienz der Mikrowellenverarbeitung zu erhöhen, ist es ratsam, die Polymermatrix mit elektrisch leitenden Partikeln zu modifizieren. Eine der Optionen ist die Verwendung verschiedener Formen von Kohlenstoff (Ruß oder seine orientierten Formen: Nanoröhren, Nanodrähte usw.).

Die Mikrowellenverarbeitung wurde in einer Kammer mit einer Magnetronstrahlungsfrequenz von 2450 MHz und einer Ausgangsleistung von 700 W durchgeführt. Die Probe wurde in einem Abstand von 5 cm vom Wellenleiter platziert und stand unter der direkten Wirkung des Mikrowellenstrahlungsflusses. Als Ballastladung wurde Wasser mit einem Volumen von 200 ml verwendet.

Die Hauptaufgabe bei der Bildung von Verbundwerkstoffen ist die qualitative Verteilung modifizierender Materialien in der Polymermatrix. Die mechanische Aktivierung bei extremen Rotationsgeschwindigkeiten von Trommeln in einer Planetenmühle ermöglicht es, eine homogene Struktur von modifizierten Polymeren zu erhalten, selbst wenn nur minimale Mengen an Modifikator eingeführt werden. Um die Verteilung des modifizierenden Kohlenstoffnanomaterials zu bestimmen, wurden Fotografien unter Verwendung eines Rasterelektronenmikroskops erhalten. Die Fotografien zeigen deutlich Einschlüsse von Kohlenstoffpartikeln, die gleichmäßig in der Polymermatrix verteilt sind.

Um die Änderungen der elektrischen Leitfähigkeit der erhaltenen nanomodifizierten Materialien während der Mikrowellenverarbeitung zu bestimmen, haben wir die Temperatur der Proben während der Mikrowellenerwärmung im Bereich von 0 bis 100 Sekunden gemessen. Die erhaltenen Daten ermöglichen es, die Grenzen der thermischen und nicht-thermischen Modifikation für Proben mit unterschiedlichem CNM-Gehalt zu bestimmen. Somit erwärmt sich das Ausgangsmaterial F-4 während der Mikrowellenverarbeitung praktisch nicht: In 100 Sekunden der Verarbeitung wurde ein leichter Anstieg seiner Temperatur um 10 Grad aufgezeichnet. In

дiesem Fall erhöht sogar eine unbedeutende Menge des eingeführten Kohlenstoffmodifikators in einem Volumen von 0,2 Massenteilen die Absorption von Mikrowellenwellen und die Erwärmung des Materials um fast 50 Grad. Es ist zu beachten, dass der Schmelzpunkt von Fluoroplast 4 etwa 327 ° C ist und der Betriebstemperaturbereich bis 260° C reicht, was es ermöglicht, die Modi der nicht-thermischen Modifikation auf einen Temperaturbereich von Umgebungstemperatur bis 80° C zu beschränken.

Die erhaltenen Ergebnisse zeigen die Möglichkeit, ein modifiziertes Polymermaterial mit erhöhten elektrischen Leitfähigkeitseigenschaften zu erhalten. Signifikante Änderungen werden auch durch die Zugabe von ultrakleinen Zusätzen hochleitfähiger Materialien erreicht. Dieser Effekt kann sowohl im Maschinenbau zur Entwicklung neuer Methoden zur Verarbeitung von Polymermaterialien zur Verkürzung des Technologiezyklus als auch im Geräte- und Instrumententechnik zur Gewinnung absorbierender Schutzbeschichtungen und leitfähiger Elemente aus Polymerverbundwerkstoffen genutzt werden.

Referenzliste

1. Panin S.V., Panin V.E., Ovechkin B.B., et al. Wissenschaftliche Grundlagen zur Bildung hochfester und verschleißfester Polymerbeschichtungen mit nanostrukturierten Füllstoffen. *Physical Mesomechanics*, 2006, No. 9, pp. 141-144.
2. Tkachev A.G., Zolotukhin I.V. Geräte und Verfahren zur Synthese von Festkörper-Nanostrukturen: Monographie. M.: Verlag Mashinostroenie-1, 2007, 316 p.
3. Baronin G.S., Zavrazhin D.O., Popov A.G., Tolstykh M.S. Einfluss der Mikrowellenstrahlung auf die Bildung struktureller und mechanischer Eigenschaften modifizierter Polymer-Kohlenstoff-Materialien während der Festphasenextrusion. *Wissenschaftliche Aussagen der Belgorod State University. Reihe: Mathematik. Physik*, 2011, vol. 23, No. 11, pp. 123-128.
4. Galygin V.E., Baronin G.S., Tarov V.P., Zavrazhin D.O. Moderne Technologien zur Herstellung und Verarbeitung von Polymeren und Verbundwerkstoffen. Elektronische Bildungsausgabe auf CD. Tambow, 2013.

ВЛИЯНИЕ СВЧ-ОБРАБОТКИ НА СТРУКТУРУ И СВОЙСТВА НАНОМОДИФИЦИРОВАННОГО ПОЛИМЕР-УГЛЕРОДНОГО МАТЕРИАЛА НА ОСНОВЕ ФТОРОПЛАСТА

Т. А. Лутовинова, М. А. Фунбаю

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: tanyalutovinova8991@yandex.ru, mariafubau@gmail.com*

Аннотация. Полимеры, модифицированные углеродными наноматериалами, обладают повышенной электрофизической проводимостью. Качественно распределенный в полимерной матрице модификатор активно поглощает СВЧ-волны даже при сверхмалом внесенном объеме (до 1,5 масс. част.). Фотографии, полученные методом сканирующей электронной микроскопии, свидетельствуют о равномерном распределении углеродных нанотрубок в матрице фторопласта 4. СВЧ-обработка полученных композитов показала значительное повышение температуры образцов при времени нагрева до 100 сек. даже при минимальных объемах вносимого модификатора.

Ключевые слова: фторопласт 4, углеродные нанотрубки, полимерный композит, СВЧ-обработка.

A Physical-Mathematical Model of Recombination Processes in a Flame

E. A. Meshkova*, A. S. Grachev

Tambov State Technical University, Tambov, Russia

*e-mail: *elvira.meshkova672@mail.ru*

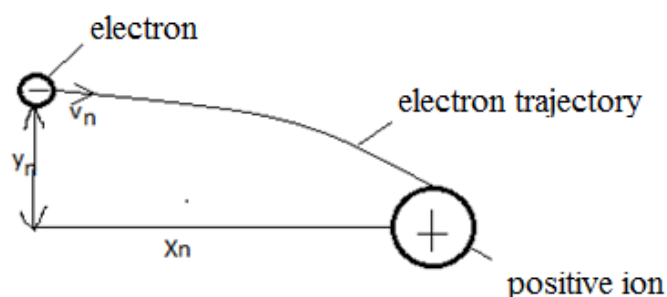
Abstract

The article shows the procedure for developing a physical-mathematical model of the interaction of electrons with positive ions in a flame.

Keywords: recombination, ions, electrons, flame.

Ionization processes in a flame are inextricably linked with reverse processes, recombination of electrons on positive ions. At the moment, a number of mechanisms are known by which recombination in a flame occurs, the main of which is triple electron-ion recombination $-A^+ + 2e \rightarrow A + e$.

We consider the scheme of electron motion in the field of action of the Coulomb forces between the ion and the electron.



x_n – initial distance from electron to ion

y_n – initial electron shift from the X-axis

Fig. 1. Scheme of motion of an electron in the direction of an ion

We consider the electron motion from the classical point of view.

It is known that when the motion of a body in the field of action of forces is described by the following law:

$$\vec{F} = \vec{a} \cdot m_e \quad , \quad (1)$$

where \vec{a} – is acceleration vector, m_e – is electron mass, \vec{F} – is force vector.

On the other hand, the Coulomb force arises between two charged particles:

$$\vec{F} = \frac{q_1 \cdot q_2}{4\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot r^2} \quad (2)$$

where q_1 is electron charge , q_2 is ion charge, ε is the dielectric constant between the electron, ε_0 is the dielectric constant, r is the distance between the electron and the ion.

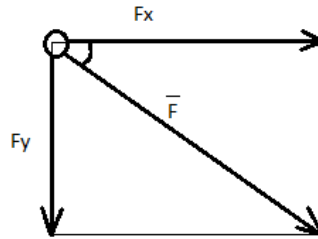


Fig. 2. Scheme of the vectors of forces acting on an electron in a Coulomb field

$$F_x = \vec{F} \cdot \cos \alpha \quad (3)$$

$$F_y = F \cdot \sin \alpha \quad (4)$$

$$\cos \alpha = \frac{x}{r} = \frac{x}{\sqrt{x^2 + y^2}} \quad (5)$$

$$\sin \alpha = \frac{y}{r} = \frac{y}{\sqrt{x^2 + y^2}} \quad (6)$$

Next, consider the change in the position of the electron during accelerated motion:

$$\Delta r = v_0 \cdot \Delta t + \frac{\vec{a} \cdot \Delta t^2}{2} \quad (7)$$

where Δr is displacement of an electron in time Δt , v_0 is the initial velocity of the electron, \vec{a} is the acceleration vector.

Wherein:

$$\Delta r = \sqrt{\Delta x^2 + \Delta y^2} \quad (8)$$

Consider the projection of movement along the X and Y axes.

Combine the equations (1), (2), (3), (4), (5), (6), (7), (8).

Then we get the following system:

$$\begin{cases} \Delta x = v_{0x} \cdot \Delta t + \frac{q_1 \cdot q_2 \cdot \Delta t^2 \cdot \cos \alpha}{8\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot (\sqrt{x_0^2 + y_0^2})^2} \\ \Delta y = v_{0y} \cdot \Delta t + \frac{q_1 \cdot q_2 \cdot \Delta t^2 \cdot \sin \alpha}{8\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot (\sqrt{x_0^2 + y_0^2})^2} \end{cases} \quad (9)$$

Considering that the values of x_0 and y_0 each Δx will be different and will depend on how much Δx and Δy will change. In this case, the change v_0 will be made at the next step. Then the system finally takes the following form:

$$(10) \quad \left\{ \begin{array}{l} \Delta x = \left(v_{0x} \cdot \Delta t + \frac{q_1 \cdot q_2 \cdot \Delta t^2 \cdot \left(x_n - \frac{t \cdot \Delta x}{\Delta t} \right)}{4\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot \left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{\Delta x^2 + \Delta y^2}}{2 \cdot \Delta t} \right)^3} \right) + \frac{q_1 \cdot q_2 \cdot \Delta t^2 \cdot \left(x_n - \frac{t \cdot \Delta x}{\Delta t} \right)}{8\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot \left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{\Delta x^2 + \Delta y^2}}{2 \cdot \Delta t} \right)^3} \\ \Delta y = \left(v_{0y} \cdot \Delta t + \frac{q_1 \cdot q_2 \cdot \Delta t^2 \cdot \left(y_n - \frac{t \cdot \Delta y}{\Delta t} \right)}{4\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot \left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{\Delta x^2 + \Delta y^2}}{2 \cdot \Delta t} \right)^3} \right) + \frac{q_1 \cdot q_2 \cdot \Delta t^2 \cdot \left(y_n - \frac{t \cdot \Delta y}{\Delta t} \right)}{8\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot \left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{\Delta x^2 + \Delta y^2}}{2 \cdot \Delta t} \right)^3} \end{array} \right.$$

Let us turn to the differential form and since $q_1 = q_2 = e$, then

$$(11) \quad \left\{ \begin{array}{l} dx = \left(v_{0x} \cdot dt + \frac{3e \cdot dt^2 \cdot \left(x_n - \frac{t \cdot dx}{dt} \right)}{8\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot \left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{dx^2 + dy^2}}{2 \cdot dt} \right)^3} \right) \\ dy = \left(v_{0y} \cdot dt + \frac{3e \cdot dt^2 \cdot \left(y_n - \frac{t \cdot dy}{dt} \right)}{8\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e \cdot \left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{dx^2 + dy^2}}{2 \cdot dt} \right)^3} \right) \end{array} \right.$$

We denote $B = \frac{e^2}{8\pi \cdot \varepsilon \cdot \varepsilon_0 \cdot m_e}$, then

$$(12) \quad \left\{ \begin{array}{l} dx = v_{0x} \cdot dt + \frac{3B \cdot dt^2 \cdot \left(x_n - \frac{t \cdot dx}{dt} \right)}{\left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{dx^2 + dy^2}}{2 \cdot dt} \right)^3} \\ dy = v_{0y} \cdot dt + \frac{3B \cdot dt^2 \cdot \left(y_n - \frac{t \cdot dy}{dt} \right)}{\left(\sqrt{x_n^2 + y_n^2} - \frac{t \cdot \sqrt{dx^2 + dy^2}}{2 \cdot dt} \right)^3} \end{array} \right.$$

The resulting system of differential equations is given implicitly. The analysis of this system made it possible to determine the order of the differential equations, which for our case is an order of at least 5 degrees. An analytical solution of the

resulting equation is currently not possible. But this problem can be solved using numerical methods.

References

1. Barshutin S.N., Ilyasov A.P., Meshkova E.A. Issledovanie skvazhnosti generatora pryamougol'nyh impul'sov [Investigation of the duty cycle of a rectangular pulse generator]. The fourth all-Russian youth scientific conference dedicated to the day of radio. Tambov State Technical University, 2019, pp. 7-9. (Rus)

2. Barshutin S.N., Meshkova E.A. Influence of thermionic emission of carbon particles on the degree of flame ionization. Bulletin of the Tambov State Technical University, 2019, 25(1), pp. 155-160.

ФИЗИКО-МАТЕМАТИЧЕСКАЯ МОДЕЛЬ РЕКОМБИНОЦИОННЫХ ПРОЦЕССОВ В ПЛАМЕНИ

Э. А. Мешкова*, А. С. Грачев

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: elvira.meshkova672@mail.ru

Аннотация. В статье показана процедура разработки физико-математической модели взаимодействия электронов с положительными ионами в пламени.

Ключевые слова: рекомбинация, ионы, электроны, пламя.

The Study of Structural and Kinetic Transformations of the Surface Layers of Ultrafiltration Membranes

M. I. Mikhailin, S. I. Lazarev, I. V. Khorokhorina

Tambov State Technical University, Tambov, Russia

e-mail: ckiburs@yandex.ru

Abstract

In this paper data on electron-microscopic analysis and kinetic research of the surface layers of semipermeable acetate ultrafiltration membranes of the UAM-50 and UAM-100 brands is obtained. Electron-microscopic analysis of the surface drainage layer was performed using a Supra 60VP electron microscope. The research showed non-uniformity of pores and their asymmetry in the active layer of UAM-50 and UAM-100 ultrafiltration membranes. Analysis of the kinetics of ultrafiltration membranes confirmed the pore asymmetry of the active layer. It is established that the water perviousness and transmembrane pressure increase with the growth of the driving force of the process.

Keywords: ultrafiltration membrane, water perviousness, active layer, pores.

Introduction

For research the kinetics and determining the efficiency of the process of baromembrane separation of technological model solutions, the term water perviousness is used.

Water perviousness is the ability of a membrane to conduct aqueous solutions only in one direction through semipermeable membranes [3]. The water perviousness of membranes is directly related to the physicochemical properties and structural characteristics of the active membrane layer [1].

Analysis of the research findings

An experimental research of the active layer and the kinetics of the water perviousness process was carried out on ultrafiltration membranes of the UAM-50 and UAM-100 brands. The membranes used for the research were tested by pressure test and operating time in a model technological solution of Zn^{+2} and Cu^{+2} ions for 24 hours. The research was performed using a CarlZeiss electron microscope according to the procedure described in [1]. The results of the experimental research by electron microscopy are shown in Fig. 1-2.

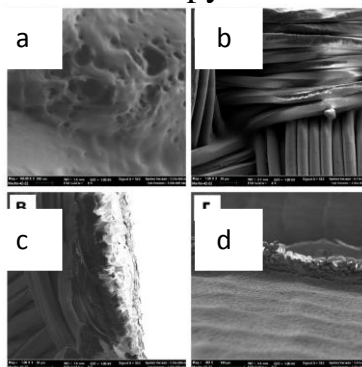


Fig. 1. Image of the UAM-50 membrane: a – top view of the active layer, b – bottom view of the substrate surface, c – cross-section of the active layer, d – cross-section of the substrate

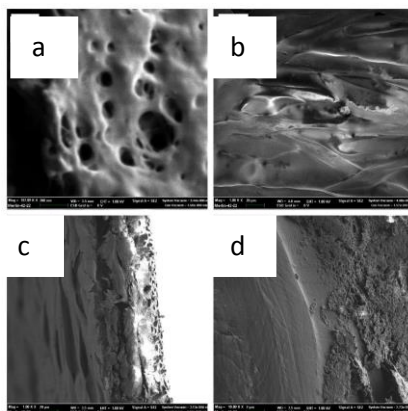


Fig. 2. Image of the UAM-100 membrane: a - top view of the active layer, b - bottom view of the substrate surface, c – cross-section of the active layer, d – cross-section of the substrate

Photos of ultrafiltration membranes show that the surface of the active layer consists of pores of different cross-sections. For the UAM-50 membrane, the pore diameter is in the range from 2.5 to 40 nm, and for the UAM-100 membrane, the pore diameter is in the range from 10 to 40 nm. The photos also show cross-sections of the active layer, from which it can be concluded that the thickness of the active layer for the UAM-50 membrane was 27 nm, and for the UAM-100 membrane it was 15 nm.

An experimental analysis of the water perviousness kinetics was carried out on a flat-chamber membrane module according to the method presented in [3]. Transmembrane pressure was used as the driving force of the baromembrane separation of the model process solution. The following formula was used to determine the water perviousness coefficient [2]:

$$\alpha = \frac{G}{\rho}, \quad (1)$$

where G is the specific capacity of the membrane, $\text{m}^3/\text{m}^2\text{s}$;

ρ is transmembrane pressure, MPa.

Fig. 3 shows diagrams of the water perviousness coefficient as a function of transmembrane pressure.

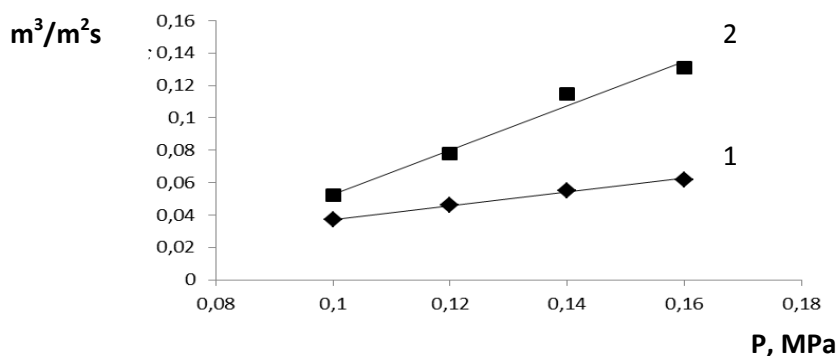


Fig. 3. Dependence of the water permeability coefficient on transmembrane pressure for ultrafiltration membranes: 1 - UAM-50, 2-UAM-100

From the diagrams on the coefficient of water perviousness, it can be seen that for the UAM-50 membrane, the coefficient is lower than for the UAM-100 membrane. This dependence is due to the fact that the UAM-50 membrane has a high concentration of pores with a smaller diameter. Also, the graphs show a tendency to increase the water perviousness coefficient depending on the increase in transmembrane pressure.

Conclusion

Analyzing the obtained data from electron microscopy and the water perviousness coefficient, we can conclude that the active layer of ultrafiltration membranes can be divided into two types: a pore substrate with cone-shaped pores that increase in diameter as they approach the substrate, and a selective layer in which the pores have a small diameter over the entire thickness of the active layer

References

1. Khorokhorina I.V., Lazarev S.I., Golovin Y.M., Arzamastsev A.A. issledovaniya poverhnostnogo i drenazhnogo sloev ultrafiltracionnyh membrane metodom rastovoj elektronnoj mikroskopii [Research of surface and drainage layers of ultrafiltration membranes using raster electron microscopy method]. Technological University Bulletin, 2019, pp. 126-129. (Rus)
2. Kocharov R.G. Kagramanov G.G. Raschet ustanovok membrannogo razdeleniya zhidkikh smesej [Calculation of installations membrane separation of liquid mixtures]. M.: Russian University of chemical, 2001, 128 p. (Rus)
3. Lazarev S.I., Mamontov V.V., Kovalev S.V. Ochistka tekhnicheskoy vody na obratnoosmoticheskoy ustanovke ploskokamernogo tipa [Purification of process water on the reverse osmosis plant of the flat-chamber type]. Proceedings of universities. Chemistry and chemical technology, 2006, vol. 9, pp. 52-54. (Rus)

ИССЛЕДОВАНИЕ СТРУКТУРНЫХ И КИНЕТИЧЕСКИХ ПРЕВРАЩЕНИЙ ПОВЕРХНОСТНЫХ СЛОЕВ УЛЬТРАФИЛЬТРАЦИОННЫХ МЕМБРАН

М. И. Михайлин, И. В. Хорохорина, С. И. Лазарев

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ckiburs@yandex.ru

Аннотация. В работе получены данные по электрономикроскопическому анализу и кинетическому исследованию поверхностных слоев полупроницаемых ацетатных ультрафильтрационных мембран марки УАМ-50 и УАМ-100. Электрономикроскопический анализ поверхностнодренажного слоя проводился на электронном микроскопе Supra 60VP. Исследование показало не однородность пор и их асимметрию в активном слое ультрафильтрационных мембран УАМ-50 и УАМ-100. Анализ кинетики ультрафильтрационных мембран подтвердило асимметрию пор активного слоя. Установлено, что с ростом движущей силы процесса возрастает водопроницаемость и трансмембранное давление.

Ключевые слова: ультрафильтрационные мембраны, водопроницаемость, активный слой, поры.

Graphene-Based Airogel Modified with Iron Oxide Nanoparticles to Extract Organic Pollutants from Aqueous Solutions

E. S. Mkrtchyan*, D. A. Kurnosov, I. A. Zaytsev

Tambov State Technical University, Tambov, Russia

*e-mail: elina.mkrtchyan@yandex.ru

Abstract

This work studies the kinetic parameters of methylene blue adsorption on created aerogel materials based on graphene under supercritical conditions. As a result, their adsorption capacity was revealed.

Key words: liquid-phase adsorption; organic dyes; aerogel; hydrogel.

Introduction

Novel materials, possessing unique chemical activity provided by a large number of open functional sites on the contact surface and having a developed transport pore system, a significant specific surface, and, at the same time, the required mechanical, physical and chemical characteristics, are the goal of studies of many world's research teams working on the problem of developing highly efficient sorption materials for fine purification of aquatic media [1].

Developing aerogel materials based on graphene under supercritical conditions seems to be one of the most promising modern solutions. The preparation of aerogels intercalated or modified with active functional substances (for instance, nanoscale metal particles) is of particular interest.

In the present paper, the authors describe a nanocomposite sorption material obtained by synthesizing a hydrogel, representing a graphene oxide (GO) aqueous paste modified with iron nanoparticles (GO/Fe₃O₄), through mixing a GO solution and iron(III) compounds in an aqueous-organic solvent and subsequent processing of the mixture at elevated temperature. Then, the hydrogel was converted to the aerogel form under conditions of supercritical drying in an isopropyl alcohol medium in an NMA 2005s high pressure autoclave (Nano-Magc Technologies Pvt. Ltd., Deli, India). The resulting product represented a light black airogel possessing high magnetic properties, which indicates the reduction of iron (III) hydroxide precipitated on graphene to form magnetite.

Fig. 1 shows scanning (SEM) and transmission (TEM) electron microscopy images of the structure of the sorption materials. The hydrogel (Fig. 1a) is characterized by the presence of graphene flakes forming the porous structure of the material. The supercritical drying of the sample (Fig. 1b) contributes to the formation of nanoscale iron particles with a diameter of 50-350 nm (due to the reduction of iron hydroxide).

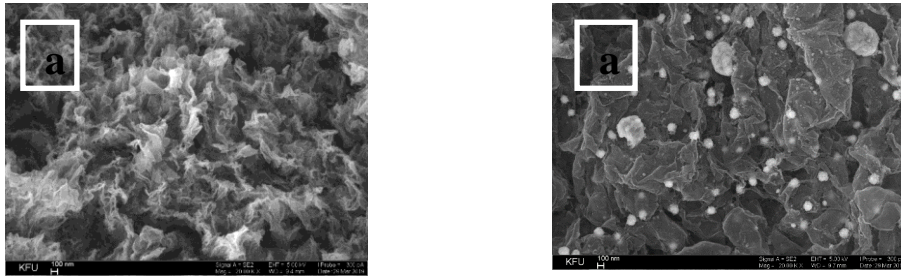


Fig. 1. SEM images of the dried hydrogel (a) and aerogel (b)

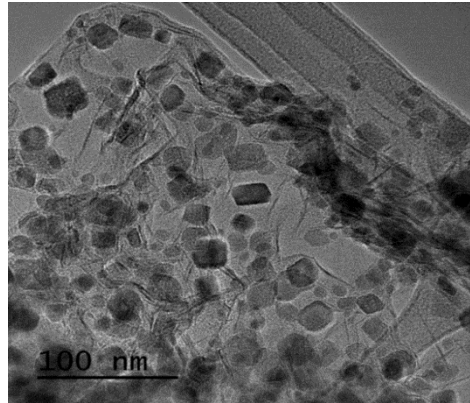


Fig.2. TEM image of the structure synthesized

The aim of this study is to develop a graphene-based aerogel modified with iron oxide nanoparticles for highly efficient removal of organic molecules from solutions.

Kinetic study

In the present research, studies were conducted to determine the sorption activity of the obtained materials with respect to the model organic pollutant – methylene blue (MB) synthetic dye. The sorption capacity of the hydrogel, dried hydrogel and aerogel was found to be ~2500, ~1500 and ~2300 mg/g, respectively (Fig. 3).

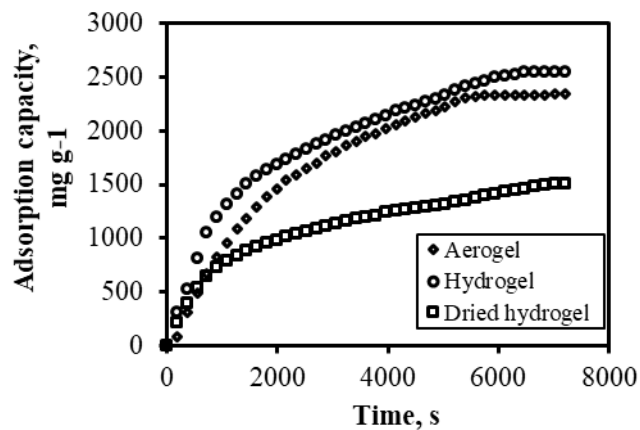


Fig.3. Kinetics of the MB sorption under dynamic conditions

Conclusion

Thus, it can be concluded that the graphene nanocomposite synthesized by the authors exhibits high sorption characteristics with respect to organic pollutants. The need to develop a sorption material in the operational form suitable for widespread use in conventional industrial sorption processes can be the most important rationale for the implementation of supercritical conditions for obtaining the aerogel form of the developed nanocomposite.

Acknowledgements

The research was funded by the Ministry of Education and Science of the Russian Federation under Project No. 16.1384.2017/PCh.

References

1. Zhang Y., Wang F., Ou P., Zhu H., Zhao Y., Wang L., Chen Z., Li S. Prepared multifunctional aerogel for high performance supercapacitors and effective adsorbents. *Materials Research Express*, 2018, 055508.

АЭРОГЕЛЬ НА ОСНОВЕ ГРАФЕНА, МОДИФИЦИРОВАННОГО НАНОЧАСТИЦАМИ ОКСИДОВ ЖЕЛЕЗА, ДЛЯ ИЗВЛЕЧЕНИЯ ОРГАНИЧЕСКИХ ЗАГРЯЗНИТЕЛЕЙ ИЗ ВОДНЫХ РАСТВОРОВ

Э. С. Мкртчян *, Д. А. Курносов, И. А. Зайцев

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: elina.mkrtchyan@yandex.ru

Аннотация. В работе изучены кинетические параметры адсорбции метиленового синего на созданных аэрогельных материалов на основе графена в сверхкритических условиях. В результате была выявлена их адсорбционная способность.

Ключевые слова: жидкофазная адсорбция; органические красители; аэрогель; гидрогель.

Factors Influencing the Quality Indicators of Organic Pigments

C. B. Motseothata

Tambov State Technical University, Tambov, Russia
e-mail: calvinmotseothata16@gmail.com

Abstract

Consumers impose strict requirements on the quality characteristics of organic synthesis products (pigments, dyes), the main ones of which are: coloristic concentration, transparency, intensity, hiding power, gloss, purity, shade. The formation of quality indicators occurs both at the stages of synthesis and at the final stages of production of the finished product. One of the ways to improve the quality indicators of the finished product (organic pigments) is to reduce the content of water-soluble impurities (sodium chloride). The aim of this paper is to reveal the composition of salts and their amount in the suspension of azo dyes for increasing the efficiency of removing water-soluble salts from suspensions of azo pigments by decantation.

Keywords: absorption of light, colour concentration, dye, impurities, pigment.

Introduction

Tough competition in the world market of manufacturers of azopigments and dyes, results in giving top priority to obtaining products with a certain set of quality characteristics (color concentration (relative coloring power)), color, intensity, opacity, transparency, gloss, purity, shade, etc.

The main indicator of the final forms of pigments and dyes is the coloristic concentration (relative coloring power). The coloring properties of organic pigments largely depend on the presence of water-soluble impurities in them, which are neutral electrolytes, most often a solution of sodium chloride. Impurities can be formed as a result of synthesis (diazotization and azo coupling reactions, by-products) and come with the raw material. The presence of an insignificant amount of table salt in the finished product, organic pigments impairs their quality indicators (in particular, the color concentration). Therefore, the development of a method that increases the removal of water-soluble impurities from pastes of pigments and dyes is of theoretical interest and of great practical importance. Rational washing with the use of waters of different cluster structures allows solving the problem of increasing the coloristic concentration of pigments.

Characteristics of organic pigments that determine the quality indicators of the product

The colour of pigment is determined by the aggregate of the phenomena of scattering and absorption of light by their particles. In the case of selective absorption of light in any part of the visible region of the spectrum of electromagnetic oscillations, the scattered light entering the human organs of vision causes the sensation of color. The visible region of the spectrum falls within the frequency range of electromagnetic oscillations from $4.0 \cdot 10^{14}$ to $7.9 \cdot 10^{14} \text{ s}^{-1}$

(wavelength 760–380 nm). An object that uniformly scatters completely or partially absorbs light in the entire visible spectrum is colorless. If a substance absorbs some part of the spectrum, it is colored in a color complementary to that absorbed. The absorption of light by a substance is characterized by an absorption curve that is built on the basis of measuring the intensities of light absorption of certain wavelengths, calculated according to the Bouguer-Lambert-Beer law.

The main importance in the processes of light absorption by molecules of organic compounds is the difference between the energies of the boundary molecular orbitals (BMO) - the highest occupied and the lowest free.

The color and dyeing ability of azo dyes, in addition to the above, are influenced by: the number and position of azo groups; the nature of aromatic nucleus; the nature, number and position of substituents in these nuclei; number and position of sulfo groups. By combining these factors, it is possible to obtain dyes with the desired properties: color concentration, transparency, intensity, hiding power, gloss, purity, shade. In this case, the color of the dye is determined by the structure of its entire molecule as a whole.

Coloristic concentration characterizing the relative colouring power

The coloring power of pigments is an important indicator of the quality of the finished product, which must be known for assessing economic efficiency, in addition, for assessing color indicators.

The concentration of the dye in a commercial dye characterizes the dyeing power of the dye for coloured pigments. Coloring power is the ability of a pigment, when mixed with other pigments, to influence the color of the resulting pigment mixture, or the ability of the pigment to impart its inherent color to the mixture into which it is incorporated. This property is characterized by a relative value obtained by comparing the test pigment with any reference pigment. It is expressed as a percentage and indicates the relative, in comparison, with the reference, the amount of the test pigment that must be mixed with another, different in color, pigment in order to obtain a colored sample with the same color characteristics as obtained using the reference pigment.

The transparency is determined by the absorbing part of the extinction (the absorption index of the medium), i.e. media with low absorption are highly transparent. Media with highly-intensity transmission of radiation are transparent.

Physical characteristics of organic pigments affecting the color characteristics of the product

In the production of pigments, it is highly important that the products have a certain set of specific pigment characteristics (coloristic concentration, color, intensity, hiding power, etc.).

The properties of pigments are determined not only by their chemical composition, but also by their crystalline properties, dispersion and amount of surface. The pigment suspension contains impurities of substances present in the raw material, by-products of reactions, adsorbed components of reaction solutions and specially introduced modifiers. Modifiers can be included in the crystal lattice

of the main pigment substance or be located only on its surface (in this case, they are surface modifiers). Surface modifiers do not change the structure of the substance, but change its properties.

Depending on the crystal structure, which is determined by the conditions of crystallization and the existence of a crystal, the same chemical substances can have different crystal lattices, and therefore differ in color, refractive index, density, etc., and, consequently, in pigment properties - coloristic concentration, intensity, lightfastness, hiding power, etc. Therefore, obtaining pigments in the required crystalline modification, with a given shape and particle size, is the most important task of the synthesis and final stages of production.

Conclusion

Water-soluble salts have a significant effect on the color of organic pigments and their main color characteristics (color concentration, transparency, intensity, hiding power, gloss, purity, shade). A small amount of sodium sulfate makes it possible to ignore its effect on the coloristic properties of azo pigment. The main attention will be paid to studying the effect of sodium chloride on the qualitative characteristics of organic pigments.

References

1. Yermilov P.I., Indeykin Ye.A., Tolmachev I.A. Pigmenty i pigmentirovannyye lakokrasochnyye materialy [Pigments and pigmented paints and varnishes]. Uchebnoye posobiye dlya VUZov. L.: Khimiya, 1987, 198 p. (Rus)
2. Mel'nikov B.N., Shcheglov T.L., Vinogradov G.N. Primeneniye krasiteley [Application of dyes]. Laboratoriya znaniy. M.: BINOM, 2010, 331 p.(Rus)
3. Belen'kiy Ye.F., Riskin I.V. Khimiya i tekhnologiya pigmentov [Chemistry and technology of pigments]. L.: Khimiya, 1974, 656 p. (Rus)

ФАКТОРЫ, ВЛИЯЮЩИЕ НА ПОКАЗАТЕЛИ КАЧЕСТВА ОРГАНИЧЕСКИХ ПИГМЕНТОВ

К. Б. Мотсеотата

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: calvinmotseothata16@gmail.com

Аннотация. К качественным характеристикам продуктов органического синтеза (пигментам, красителям) потребители предъявляют жесткие требования, основными из которых являются: колористическая концентрация, прозрачность, интенсивность, укрывистость, блеск, чистота, оттенок. Формирование качественных показателей происходит как на стадиях синтеза, так и на заключительных стадиях производства готового продукта. Одним из направлений повышения качественных показателей готового продукта (органических пигментов) является снижение содержания водорастворимых примесей (поваренной соли NaCl). Целью данной статьи является выявление состава солей и их количества в суспензии азокрасителей для повышения эффективности удаления водорастворимых солей из суспензий азокрасителей декантацией.

Ключевые слова: колористическая концентрация, красителей, пигмент, поглощения света, примеси.

The Study of Steel Protection against Corrosion by Motor Oil Waste Composition

K. Y. Nosova*, I. V. Zarapina

Tambov State Technical University, Tambov, Russia

*e-mail: nosova.ksy@yandex.ru

Abstract

The purpose of this work is to study the protective effectiveness of conservation compositions based on used motor oils of various natures. As conservation materials, it is proposed to use mineral and synthetic motor oilwaste.

Key words: corrosion, film, oilwaste, protection, steel.

According to experts, up to 84% of all waste oils are discharged into the lithosphere and hydrosphere [1, 2]. Such a large amount of pollution is a clear danger to the environment. Unlike crude oil, spent petroleum oils are even less naturally disposed of when released to the environment (for example, by biodegradation, oxidation, or photochemical reactions).

It is of interest to use used engine oils to protect metal products from atmospheric corrosion. Today, humanity annually loses hundreds of thousands of tons of high-quality structural steel due to its failure as a result of corrosion destruction.

The relevance of the chosen topic is due to the need for rational storage and use of metal stock, on the one hand, and on the other hand, the possibility of alternative use of used motor oils as anti-corrosion compositions.

The purpose of this work is to study the protective effectiveness of preservative compositions based on used motor oils of various nature. Waste oils include mineral oils obtained from crude oil, or synthetic oils contaminated with chemical and (or) physical impurities.

For experimental studies, samples were made of ST20 steel with an average surface area of 14.7092 cm². Full chemical composition ST20 following: iron (Fe) – 98%; carbon (C) from 0.17 to 0.24%; manganese (Mn) is from 0.35 to 0.65%; arsenic (As) – 0,08%; copper (Cu) – 0.25%; sulfur (S) – up to 0.04%; phosphor (P) up to 0.04%; chromium (Cr) – 0.25%; Nickel (Ni) – to 0.25%.

The steel surface was pre-prepared by chemical etching with 2m hydrochloric acid, mechanical grinding, and degreasing, after which the samples were dried in a drying Cabinet and weighed on analytical scales.

Mineral (MMO-M) and synthetic used engine oil (MMO-C) were used as conservation materials. Both types of oil have worked at least 500 motor hours in agricultural machinery and are a mixture whose composition is averaged.

To apply the coating of the composition under study, the samples were immersed in buckets with a protective composition. After that, they were kept

suspended in air at room temperature for a day to drain the excess oil composition and form a protective film. Then the excess oil was removed mechanically.

Corrosion tests were carried out in a sealed desiccator, in which 100% humidity was maintained using distilled water. The test time was 504 hours. After that, the ST20 samples were mechanically cleaned of oil film and corrosion products, degreased and weighed on analytical scales.

Corrosion losses were estimated by the gravimetric method based on the difference in the mass of samples before and after the experiment. The corrosion rate K was determined by the formula:

$$K = \frac{\Delta m}{S\tau},$$

where $\Delta m = m_1 - m_2$, m_1 and m_2 are the sample masses before and after testing, g, respectively; S is the sample surface area, cm^2 ; τ is the sample exposure time, h

Three parallel measurements were performed for each protective composition, as well as on uncoated samples

$$K_{cp.} = \Sigma K_i / n,$$

where n is the number of parallel tests.

The value of the protective effect of oil compositions was determined by the formula:

$$Z = \frac{K_0 - K}{K_0} \cdot 100\%,$$

where K_0 and K are the values of the corrosion rate of steel samples without coating and with applied preservation material, respectively.

Visual inspection of the samples after testing showed no obvious foci of corrosion damage.

The values of the corrosion rate of steel samples without coating, with MMO-M and MMO-C film, presented in Table 1, were calculated.

Table 1. Results of gravimetric measurements on steel coated with films of the studied compositions under conditions of 100% humidity

τ, h	$K_{b.p.}$	$K_{\text{MMO-M}}$	$K_{\text{MMO-C}}$
96	$3.47 \cdot 10^{-6}$	$2.66 \cdot 10^{-6}$	$2.34 \cdot 10^{-6}$
120	$6.04 \cdot 10^{-6}$	$3.84 \cdot 10^{-6}$	$2.43 \cdot 10^{-6}$
312	$8.51 \cdot 10^{-6}$	$4.87 \cdot 10^{-6}$	$2.76 \cdot 10^{-6}$
408	$9.67 \cdot 10^{-6}$	$6.99 \cdot 10^{-6}$	$3.15 \cdot 10^{-6}$
504	$9.68 \cdot 10^{-6}$	$7.89 \cdot 10^{-6}$	$3.98 \cdot 10^{-6}$

In Table 2, the value of $K_{b.p.}$ is the rate of corrosion on uncoated steel; $K_{\text{MMO-M}}$ and $K_{\text{MMO-S}}$ are the rate of corrosion on steel coated with films of mineral and synthetic engine waste oils, respectively.

The dependence of the corrosion rate on the test time is shown in Fig. 1.

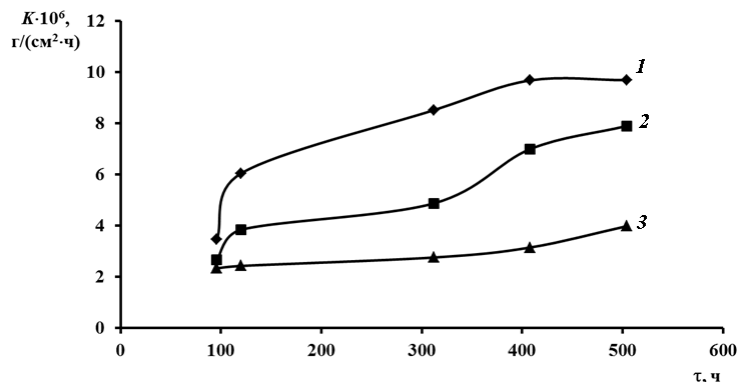


Fig. 1. The dependence of the corrosion rate on the test time: 1-uncoated steel; 2-ММО-М coating; 3-ММО-С coating

As a result of the experiments, it was found that within 504 hours the rate of corrosion on uncoated steel samples increases almost 3 times.

The obtained experimental data can be used to create conservation materials based on used motor oils, created to protect metal products during their operation and storage.

References

1. Radkevich M.V., Shipilova K.B. Jekologo-jekonomicheskie problemy ispol'zovanija otrabotannogo motornogo masla [Ecological and economic problems of using used motor oil]. Universum: technical science, 2019, 1(58). (Rus)
2. Surin S.A. Otrabotannye masla: vtoraja jizn [Used oils: second life]. World of petroleum products, 2000, No. 2, pp. 22-24. (Rus)
3. GOST 21046-2015. Otrabotannye nefteprodukty. Obshchaya specifikaciya [Used petroleum products. General specification]. M.: Standartinform, 2016, 7 p. (Rus)

ИССЛЕДОВАНИЕ ЗАЩИТЫ ОТ КОРРОЗИИ СТАЛИ СОСТАВАМИ НА БАЗЕ ОТРАБОТАННЫХ НЕФТЯНЫХ МОТОРНЫХ МАСЕЛ

К. Ю. Носова*, И. В. Зарапина

Тамбовский государственный технический университет, г. Тамбов, Россия.

*e-mail: nosova.ksy@yandex.ru

Аннотация. Целью работы является исследование защитной эффективности консервационных составов на базе отработавших моторных масел различной природы. В качестве консервационных материалов предлагается синтетические отработанные моторные масла.

Ключевые слова: защита, коррозия, отработанное масло, пленка, сталь.

Improving the Protective Efficiency of Oxide Coatings

A. A. Rybina*, A. Yu. Osetrov

Tambov State Technical University, Tambov, Russia

*e-mail: arishfish@yandex.ru

Abstract

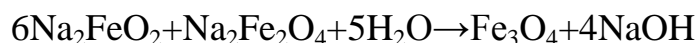
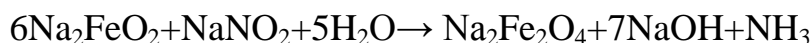
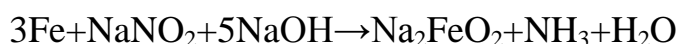
The purpose of this study is an investigation of the effect of the ultrafine carbon phase content on the protective efficiency of coatings obtained by alkaline oxidation. The study focuses on the dependence of the corrosion rate on the concentration of carbon nanotubes in the electrolyte. Oxidation is one of the most common and simple methods of corrosion protection.

Keywords: carbon nanotubes, chemical oxidation, corrosion control, protective coating.

Metals and their alloys (in particular steel) are the most important modern structural materials that are almost always susceptible to corrosion. It is estimated that about 10% of all smelted ferrous metals in the world are lost as a result of corrosion. Therefore, protection against corrosion damage is an important and significant task.

Alkaline oxidation is the process of forming an oxide film on the surface of a metal due to the interaction of his surface with an alkali and an oxidizer. The latter in this research is sodium nitrite. An electrolyte consisting of alkali, sodium nitrite and sodium nitrate. The resulting oxide film protects the metal from moisture and air.

The process of obtaining an oxide coating can be represented as three reactions:



In some literature sources, it is noted that the time of coating formation on the metal surface decreases, and the quality of the resulting coating improves with an increase in the carbon content of steel. In this connection, it is necessary to study the effect of the solution composition on the oxidation process and possible ways to improve the quality of the coating by introducing the carbon phase into the solution.

Therefore, the purpose of this paper is to study the corrosion resistance of oxide coatings obtained from an electrolyte modified with a suspension of carbon nanotubes of the Taunit series stabilized with polyvinylpyrrolidone.

For experimental studies, samples were made of steel 1020 можно дать оба названия и для каждого написать в скобках with an average surface area of

$14.7 \cdot 10^{-4} \text{ m}^2$. The surface was prepared by degreasing and chemical etching. The coating formation was carried out in five electrolytes.

Table 1 Compositions of electrolytes for oxidation

Electrolyte	Concentration of components, g / l			The number of particles of nanocarbon phase, mass %
	NaOH	NaNO ₂	NaNO ₃	
1	550	150	50	-
2	550	150	50	0.0001
3	550	150	50	0.0033
4	550	150	50	0.0066
5	550	150	50	0.01

Oxidation was carried out for 60 minutes at a temperature of 145 °C.

The corrosion resistance of the obtained coatings was checked as follows. The samples were kept in a 3% aqueous solution of sodium chloride for a day, washed, corrosion products were removed from them, and dried.

To determine the speed of corrosion, the samples were weighed before and after exposure to aggressive media and the mass loss of the samples was calculated using the formula:

$$\Delta m = m_1 - m_2,$$

m_1 is mass of the sample before corrosion testing,

m_2 is mass of a sample after corrosion testing.

The corrosion losses were determined by the formula:

$$K = \frac{\Delta m}{S \tau}$$

S is the surface area subject to corrosion,

τ –time of trial.

Table 2 Coefficients of corrosion resistance of coatings in 3% aqueous solution of sodium chloride

№	The number of particles of nanocarbon phase, wt. %	Δm	$K \cdot 10^{-4}$, g/cm ² ·h
1	-	0.0508	34.56
2	0.0001	0.0348	23.67
3	0.0033	0.0279	18.98
4	0.0066	0.0204	13.88
5	0.01	0.0112	7.62

According to the data obtained, oxide coatings formed in the presence of 0.0066 wt. % of carbon nanotubes in an alkaline electrolyte, almost twice as strong as the coatings obtained in the first electrolyte. Increasing the carbon concentration in the alkaline solution used for oxidation does not lead to significant changes in the corrosion resistance of the oxide film on the steel surface.

In the course of this work, a method for increasing the corrosion resistance of oxide coatings obtained in an alkaline electrolyte by introducing a nanocarbon phase into the electrolyte is considered. The optimal number of carbon nanotubes in the electrolyte is also determined.

References

1. Grilihes S.Ya. Oksidirovanie i fosfatirovanie [Oxidation and phosphating of metals]. Saint-Petersburg: Mechanical engineering, 1971, 120 p. (Rus)
2. Bela B. Spravochnik gal'vanostega [Electroplating guide]. Saint-Petersburg: Mechanical engineering, 1960, 396 p. (Rus)
3. Yampol'skij A.M. Tekhnologiya oksidirovaniya i fosfatirovaniya metallov [The technology of oxidation and phosphating metals]. Saint-Petersburg: Lenizdat, 1960, 106 p. (Rus)
4. Nomyakov V.G. Tekhnologiya elektrohimicheskikh proizvodstv [Technology of electrochemical productions]. Moscow: Goskhimizdat, 1960, 676 p. (Rus)

ПОВЫШЕНИЕ ЗАЩИТНОЙ ЭФФЕКТИВНОСТИ ОКСИДНЫХ ПОКРЫТИЙ

А. А. Рыбина, А. Ю. Осетров

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: arishfish@yandex.ru

Аннотация. Целью данной работы является исследование влияния содержания ультрадисперсной углеродной фазы на защитную эффективность покрытий, полученных методом щелочного оксидирования. В ходе исследования будет изучена зависимость скорости коррозии от концентрации углеродных нанотрубок в электролите. Оксидирование является одним из наиболее распространенных и простых методов защиты от коррозии.

Ключевые слова: углеродные нанотрубки, химическое оксидирование, борьба с коррозией, защитные покрытия.

Features of Identification of Microstructural Inhomogeneities of the Nanofiltration Membrane Surface

V. Yu. Ryzhkin

Tambov State Technical University, Tambov, Russia
e-mail: volodya.rijkin@yandex.ru

Abstract

The purpose of this paper is to study the automated method for calculating microstructural inhomogeneities of the selectively permeable surface of the OPMN-P and OFAM-K nanofiltration membranes.

Keywords: automated calculation method, histogram, clogging coefficient, nanofiltration membranes.

Introduction

The efficiency of electro-membrane, electrobaromembrane, and baromembrane separation processes is directly related to the morphology and microstructural characteristics of the surface (active) layer of the membrane, which determine its selective and permeable characteristics, as well as affect the effect of membrane fouling. The study of membrane fouling, along with the selective and permeable characteristics of the process, is a necessary stage for the use of baromembrane, electromembrane, and electrobaromembrane processes for separating solutions and wastewater.

Object of study

The object of the study was OFAM-K and OPMN-P nanofiltration membranes, the characteristics of which are presented in Table 1. Table 1 shows the performance characteristics of OFAM-K and OPMN-P membranes. [1, 2].

Table 1. Working characteristics of OPMN-P and OFAM-K membranes.

Performance	Membrane type	
	OFAM-K	OPMN-P
Operating pressure, MPa	3.0	1.6
Minimum performance by water, at T = 298 K, m ³ /m ² ·s	2.22·10 ⁻⁵	2.77·10 ⁻⁵
Delay coefficient, not less	0.15 % NaCl	
	0.95	0.55
Working range, pH	2–12	
Maximum temperature, K	323	

The OFAM-K membrane is a semi-permeable medium-pressure nanofiltration composite membrane consisting of a surface (selectively permeable) layer and a porous substrate. OPMN-P membrane is a semi-permeable nanofiltration

composite polymer film consisting of a surface (selectively permeable) layer and a porous substrate.

The calculation was made using a program that studies the description of the basic functions of the imaging processing toolbox. To do this, the software tools Matlab 2017 was used the task, as well as the software Development and experimental approbation of a software package for determining the fraction of ion-conducting membrane surface using scanning electron microscopy data [3]. The obtained images of nanofiltration OPMN-P and OFAM-K were subjected to optical examination (surface visualization using an Axio Observer Z1 optical microscope (Produced by Carl Zeiss)) with the required magnification. The procedure of image fixing was carried out using the Axiovision image analysis program.

The selected areas of the OPMN-P and OFAM-K nanofiltration membranes with an area of 100 X 100 μm were processed using Matlab 2017, so that the main parameters were obtained, such as the average contamination diameter (microstructural heterogeneity and membrane contamination coefficient). We present an example of image processing of OPMN-P and OFAM-K membranes (Fig. 1).

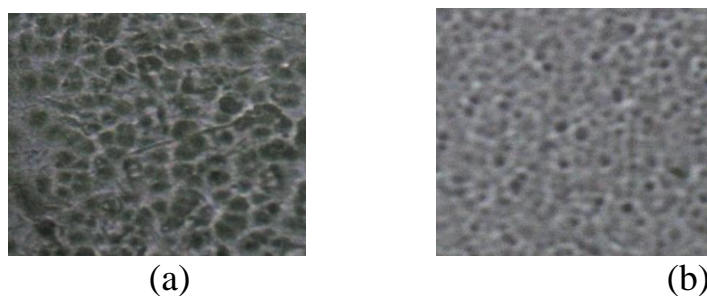


Fig. 1. Selected areas of the image of the OPMN-P nanofiltration membranes (a) and OFAM-K (b) with an area of 100 x 100 microns

Conducting a visual analysis of the selected areas of the OPMN-P and OFAM-K nanofiltration membranes, it is noted that the image is not contrast (Fig. 1 a, b).

Next, the image is converted to black and white. A special function is used to create a grayscale image that converts the components of red, green, and blue colors into a full-color image in the same elements of brightness values.

Then the global image threshold is determined. In this case, the task is solved using Otsu's method (determining the brightness threshold). The algorithm allows you to divide pixels into two classes ("useful" and "background"). Using the built-in function (level), Matlab 2017 determines the optimal threshold value according to Otsu's method. This threshold value is important, because if the threshold value is incorrect, you will get completely incorrect values in the image output.

The Matlab package works with white color, for which we translate the image to a black background using the built-in function. Next, to get circles, we will use morphological processing with a structural element of the "disk" type with a certain radius of the disk.

Using the built-in functions, we determine the area of objects in the binary image. Program Matlab 2017 stores them in an array with the values of the area. Next, a histogram of the distribution of areas from their number is constructed with a certain step depending on the amount of data received.

We judge accuracy by the histogram. Based on the deviation from the standard value, you can get the main statistical data, which determines the number of pixels per unit length and converts the value to the units accepted by the SI system (microns) [4].

Conclusion

The calculated membrane clogging coefficient predicts and determines the effective life of nanofiltration membranes, elements, devices, and installations for baromembrane separation, concentration, and treatment of industrial solutions and effluents. The calculation is performed using a program that studies the description of the main functions of the imaging processing toolbox. The Matlab software package provides the necessary tools to complete the task. In practice, the method is implemented using the example of a nanofiltration process using semipermeable polymer membranes.

References

1. Lazarev S.I., Ryzhkin V.Yu., Kovaleva O.A., Golovin Yu.M., Kholodilin V.N. Raschet parametrov morfologii poverkhnosti nanofil'tratsionnykh membran [Calculation of parameters of the surface morphology of nanofiltration membranes]. Certificate of state registration of computer programs No. 2018611402. (Rus)
2. Membrany, fil'truyushchiye elementy, membrannyye tekhnologii [Membranes, filter elements, membrane technologies]. Vladimir: Vladipor, 2004, 22 p. (Rus)
3. Sirota Ye.A., Kranina N.A., Vasil'yeva V.I., Malykhin M.D., et al. Razrabotka i eksperimental'naya aprobatsiya programmnoy kompleksa dlya opredeleniya doli ionoprovodyashchey poverkhnosti membran po dannym rastrovoy elektronnoy mikroskopii [Development and experimental approbation of a software package for determining the fraction of ion-conducting membrane surface using scanning electron microscopy data]. Vestnik VSU, Series: Chemistry. Biology. Pharmacy, 2011, No. 2, pp. 53-59. (Rus)
4. Lazarev S.I., Ryzhkin V.Yu., Golovin Yu.M., Kovalev S.V. Metod avtomatizirovannogo opredeleniya morfologii selektivno-pronitsayemoy poverkhnosti polimernykh membran OPMN-P i OFAM-K [The method of automated determination of the morphology of the selectively permeable surface of polymer membranes OPMN-P and OFAM-K]. Journal Factory Laboratory. Diagnostics of materials, 2018, vol. 84, No. 9 pp. 34-40. (Rus)

ОСОБЕННОСТИ ИДЕНТИФИКАЦИИ МИКРОСТРУКТУРНЫХ НЕОДНОРОДНОСТЕЙ ПОВЕРХНОСТИ НАНОФИЛЬТРАЦИОННЫХ МЕМБРАН

В. Ю. РЫЖКИН

Тамбовский государственный технический университет, Тамбов, Россия.

e-mail: volodya.rijkin@yandex.ru

Аннотация. Проведено исследование автоматизированного метода расчета микроструктурных неоднородностей селективно проницаемой поверхности нанофильтрационных мембран ОПМН-П и ОФАМ-К.

Ключевые слова: автоматизированная методика расчёта, гистограмма, коэффициент засоренности, нанофильтрационные мембраны.

Formulation of the Problem of Mathematical Description of Power Characteristics in the Process of Mechanical Mixing of Liquid Media

N. O. Safonova

Tambov State Technical University, Tambov, Russia
e-mail: natashanistratova@mail.ru

Abstract

The purpose of this study is to analyze the existing methods for calculating mechanical mixing devices. In the course of the study, the most accurate method will be selected, and a mathematical model for performing calculations will be developed. The relevance of the study lies in the fact that the calculation of mixing devices manually is a laborious process. Also, a mathematical model will reduce the calculation error.

Keywords: mathematical model, mixing devices, mechanical engineering, chemical technology, modeling

In the chemical industry, about 80% of the equipment park is a batch-type capacitive apparatus with mixing devices. The latter play an important role, provide the necessary hydrodynamic regime inside the apparatus to equalize the temperature and concentration gradients. Accordingly, the calculation of the mixing device is an urgent problem, especially for suspensions and media that change their properties in the process of physicochemical transformations.

There are various techniques for calculating mixing devices, such as the compilation of a criterion equation for calculating the power consumed by the mixer as a function of the Reynolds criterion, Froude's criterion and geometric similarity simplices characterizing the mixer design, the effect of the height of the liquid layer and other geometric factors [1].

Also known is a universal method for calculating the power of all types of mixers according to a single formula, where the power consumed for mixing depends on the filling factor of the vessels with liquid, the factor that takes into account the excess power at start-up, the coefficient of increase in hydraulic resistance for different types of mixers, mixing power and power losses in gland.

In addition, there is a technique based on the similarity equation, which characterizes the movement of a liquid in an apparatus while stirring with stirrers, which is the dependence of the Euler criterion as a function of the Reynolds criterion [2].

There is also a calculation method based on the fact that in a steady state of fluid flow, the equilibrium conditions of all forces and moments applied to the system must be satisfied. With the rotational movement of the liquid relative to the axis of the apparatus, the moment equilibrium condition is expressed in the form of equality of the torque applied to the fluid during the movement of the stirrer blades and the moment of

resistance on the walls, bottom of the apparatus and internal devices installed in the vessel [3].

The error of the above calculation method, except for specially stipulated cases, is $\pm 10 \div 15\%$, which is less than in other cases.

This technique provides for the possibility of manual calculations in tabular form. This is a very laborious process, so it is advisable to present it as a mathematical model. To do this, it is necessary to determine all the parameters of the future model.

From the point of view of automated calculation systems, the mathematical model is represented by a set of equalities, inequalities and conditions that reliably and adequately describe the key processes taking place in a real object. To compile a mathematical model, it is necessary to determine the composition of the input (X), control (U), disturbing (F) and output (Y) vectors.

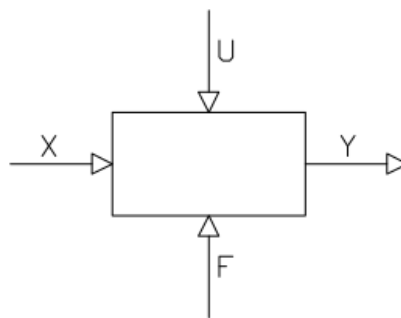


Fig. 1. Scheme of the mathematical model

Input parameters for this mathematical model: the inner diameter of the apparatus, the filling height of the apparatus, the diameter of the mixer, the number of revolutions of the mixing device, the geometric characteristics of the internal devices located in the apparatus, the number of mixers on the shaft, resistance coefficients.

The disturbing parameters are the pressure and temperature in the system, as well as the presence of impurities in the suspension and their magnitude.

Output parameter is a criterion of the power spent on mixing.

Control parameters are represented by the presence, dimensions and location of reflectors and partitions

This structure will be implemented in a future mathematical model.

During the development of the model, the following will be done:

1. Inspection of the object of modeling and the formulation of technical specifications for the development of the model.
2. Conceptual and mathematical problem statement.
3. Qualitative analysis and validation of the model.
4. Selection and justification of the choice of methods for solving the problem.
5. Search for a solution or implementation of the algorithm in the form of computer programs. This stage will be considered when describing the computational experiment.
6. Model validation: comparison of calculated data with power values obtained in a laboratory reactor.
7. Using the resulting mathematical model for practical calculation.

Thus, various methods for calculating mechanical stirring devices were studied and the most accurate one was chosen. The chosen technique takes into account most of the factors affecting mixing. Unfortunately, the calculated power values for suspensions did not coincide with the experimental data and the data obtained from production. Therefore, in the future, we plan to set up an experiment at a laboratory reactor. Using the example of a suspension of chalk with different concentrations of the solid phase, the real values of the power spent on mixing will be taken and the criterion dependences will be established. These dependencies will be further used in the written mathematical model.

References

1. Pavlov K.F., Romankov P.G., Noskov A.A. Primery zadach po kursu protsessov i apparatov khimicheskoy tekhnologii [Examples of tasks for the course of processes and devices of chemical technology]. L: Khimiya, 1987, 576 p. (Rus)

2. Tarantseva K.R., Tarantsev K.V. Protsessy i apparaty khimicheskoy tekhnologii v tekhnike zashchity okruzhayushchey sredy: Uchebnoye posobiye [Processes and devices of chemical technology in the technology of environmental protection: Textbook]. M: NITS INFRA-M, 2014, 412 p. (Rus)

3. Barabash V.M. Rukovodyashchiy normativnyy dokument mekhanicheskiye peremeshivayushchiye ustroystva [governing regulatory document mechanical mixing devices]. URL: <http://docs.cntd.ru/document/1200043740> (Accessed 21 November 2020). (Rus)

4. Timonin A.S. Osnovy konstruirovaniya i rascheta khimiko-tekhnologicheskogo i prirodzhookhrannogo oborudovaniya oborudovaniya [Fundamentals of design and calculation of chemical-technological and environmental protection equipment] Kaluga: Izdatel'stvo N. Bochkarevoy, 2002, 852 p. (Rus)

ПОСТАНОВКА ЗАДАЧИ МАТЕМАТИЧЕСКОГО ОПИСАНИЯ СИЛОВЫХ ХАРАКТЕРИСТИК В ПРОЦЕССЕ МЕХАНИЧЕСКОГО ПЕРЕМЕШИВАНИЯ ЖИДКИХ СРЕД

Н. О. Сафонова

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: natashanistratova@mail.ru

Аннотация. Проведен анализ существующих методик расчета механических перемешивающих устройств. В ходе исследования выбрана наиболее точная методика, а также разработана математическая модель для выполнения расчетов. Актуальность исследования заключается в том, что расчет перемешивающих устройств вручную трудоемкий процесс. Также математическая модель позволит сократить погрешность при расчете.

Ключевые слова: математическая модель, перемешивающие устройства, машиностроение, химическая технология, моделирование.

Optimization of Belofor Suspension Drying on a Spray Dryer

E. E. Sibileva

Tambov State Technical University, Tambov, Russia

e-mail: katrinbell69@yandex.ru

Abstract

When any product is mass-produced, losses occur, which in the future may lead to an increase in the cost of the product and loss of profit by the enterprise. The article considers possible product losses in the belofor production and proposes a method which can reasonably reduce product losses at the drying stage.

Keywords: losses, production, filtration, drying, product.

Rational use of resources (without deterioration of product quality) is relevant for all enterprises. The problem of resource conservation is particularly acute for large industries. The paper deals with the problem of optimizing the production process in this article.

In any production, there are losses in the production of the product. In addition, every company strives to ensure that the loss of manufactured products tends to zero. In the modern world, successful companies are those that have competitive advantages in terms of minimizing the loss of their products.

We have considered the filtration and drying process because at these stages the most significant losses of the final product occur. Throughout the entire production process, belofor and the substances used in its creation are in a liquid state, so the product comes to the filtration stage in the form of a suspension.

Filtration is the process of separating inhomogeneous (dispersed) systems (for example, suspension, and aerosol) by means of porous partitions. In our production, there is a possibility of drying on two different devices. In the first device, belofor paste is unloaded immediately without additional manipulations. Inside the device, using hot air and “hammers”, the product is dried and wetted to the required product size.

In order for us to use another drying method, it is necessary to add about 3 tons of water to the paste. Drying takes place on the principle of atomization. The product is sprayed with small drops and dries in hot air. A spray dryer provides the necessary drying effect.

On each of these drying methods, losses of about 1% occur. At first glance, it may seem that the losses of 1-1.5% are insignificant, but it is worth taking into account that these are losses from just one product removal, which is about 2.5 tons. It turns out that we lose about 60 kg of finished products from each operation.

After analyzing the entire process, we proposed to exclude the filtration stage from this process, i.e. after the production of the product, it immediately passes

into the spray dryer in suspension, for which the product in the liquid state is just necessary.

An experiment was conducted in the laboratory, and it showed that the quality of the product does not deteriorate, because the raw material from which belofor is produced comes to production in sealed packages and meets all quality certificates, and the manufacturing process itself does not provide for the possibility of contamination, since all semi-finished products can be easily removed with ordinary artesian water.

Thanks to our offer, we reduce production losses by about 40 kg. The effect has been achieved, but we wanted not only to reduce losses, but also to make it appropriate in relation to other factors that affect the cost of the product, and this is the cost of water and gas.

Economic effect

The average price of Belfort dry grades is 310,000 rub per ton (310 rub behind kg) when removed from a single operation under normal conditions, at the moment, the product loss is 40 kg. In this regard, the company incurs financial losses in the amount of 12,000 rub from each operation dry bleach.

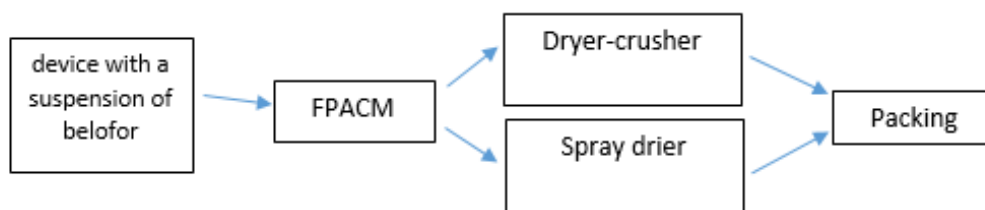


Fig. 1 Belofor production plan according to the regulations

Because artesian water is added at the drying stage for the correct operation of the spray dryer, there was a proposal not to carry out pre-filtration, but to bring the suspension of belofor directly into the dryer.

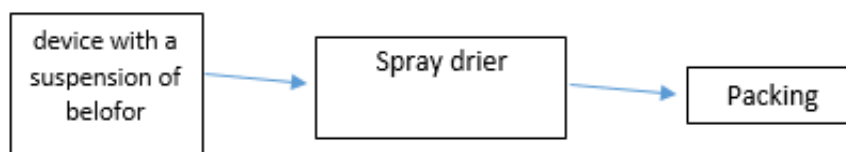


Fig. 2. Optimized belofor production plan

Thus, we reduce the loss of product by 12000rub and save artesian water in the amount of 6000 liters at Tambov prices for cold water (20rub behind 1 m³) we save 120rub.

However, more natural gas will be used to evaporate almost 17,500 liters. The evaporation of 4,000 liters of water requires 337 m³ of natural gas. For 18,000 liters of water, 1500 m³ of natural gas will be required. At a price per m³ of 5.75 rubles per tons, the amount of overspending will be 5,800 rub. In total, we get savings of approximately 6,300 rubles.

At most enterprises, they have been working for a long time to reduce the loss of both raw materials and finished products, thanks to this, we see an increase in the quality of products that we use constantly. However, we understand that this is not the end, despite the fact that many processes are already optimized to 98-99%, you can optimize them further.

References

1. Chernomurov F.M., Anufriev V.P., Teslyuk L.M. Energo- i resursosberezhenie v neftegazohimicheskom komplekse [Energy and resource conservation in the petrochemical complex]. Ekaterinburg, 2014, 247 p. (Rus)
2. Klimova G.N. Energosberezhenie na promyshlennyh predpriyatiyah [Energy saving in industrial plants]. Tomsk 2007, 161 p. (Rus)
3. Tekhnologicheskij reglament No. 395 proizvodstva belofoora cekha No. 20 [Technological regulations No. 395 belofoor production in the workshop No. 20]. Tambov: Pigment, 2014. (Rus)

ОРГАНИЗАЦИЯ “ПРЯМОЙ” СУШКИ СУСПЕНЗИИ БЕЛОФОРА НА РАСПЫЛИТЕЛЬНОЙ СУШИЛКЕ БЕЗ ФИЛЬТРАЦИИ НА ФПАКМЕ

Е. Е. Сибилева

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: katrinbell69@yandex.ru

Аннотация. При получении любым вещей в производственных масштабах происходят потери, которые в дальнейшем могут привести к повышению себестоимости продукта и потери прибыли предприятием. В данной статье мы рассмотрим возможные потери продукта в производстве белофора и предложим способ, при котором мы сможем целесообразно уменьшить потери продукта на стадии сушки.

Ключевые слова: потери, производство, фильтрация, сушка, продукт.

A Method for Numerical Calculation of Effective Modules of Porous Material Elasticity

A. I. Skomorokhova*, A. O. Glebov, D. S. Aleksentsev

Tambov State Technical University, Tambov, Russia

*e-mail: nasta373@mail.ru

Abstract

A method is proposed for the numerical calculation of the effective elastic moduli of a porous material, based on the application of the continuum hypothesis. The essence of the proposed method is to determine the effective moduli of volumetric compression and shear by solving two independent problems on the deformation of a representative cell of a porous material by the finite element method. As an example, a cantilever beam with a regular arrangement of cubic cavities is used. The verification calculation of the beam undergoing bending confirmed the validity of the method.

Keywords: continuum hypothesis, porous material, effective elastic moduli, finite element method.

Introduction

Materials with a porous structure are widely used in many modern industries due to their specific properties, analogues of which are difficult, and in some cases impossible to find among traditional structural materials [1]. To ensure reliability and perform the functions required from a product during operation, it is important to assess in advance the properties of the material from which it is made. This makes the development of new techniques for predicting the physical and mechanical properties of porous materials quite urgent. In particular, elastic properties are considered, knowing which it is possible to predict the behavior of parts under the action of various loads.

Methods and Materials

The development of a method for the numerical calculation of effective elastic moduli is based on the continuum hypothesis, according to which it is assumed that in a heterogeneous medium there is a characteristic size of inhomogeneity, that is, a certain characteristic pore size, and there is a length scale within which it is possible to reasonably average the properties. Moreover, it is necessary to choose the scale of the averaging length so that it significantly exceeds the characteristic pore size and, if possible, is small in comparison with the characteristic size of the entire body. In this case, it is enough to find the properties inherent in a representative cell, determine the required effective modules and further consider an equivalent homogeneous environment [2-4].

To create a computational model, the ANSYS system was used, which allows solving the problems of mechanics of a deformable solid by the finite element method.

We consider a cantilever beam with dimensions of $40 \times 40 \times 150$ mm with a regular arrangement of cubic cavities in the amount of $4 \times 4 \times 15$ (see Fig. 1). Relative density of effective beam material $\rho = 0,5$. Based on these data, the side of the cubic cavity 7.937 mm was determined. Young's modulus of the beam material was $2 \cdot 10^{11}$ Pa, the Poisson's ratio was 0.3. The direct calculation of this

beam by the finite element method leads to an excessive amount of computation due to the small thickness of the inner walls.

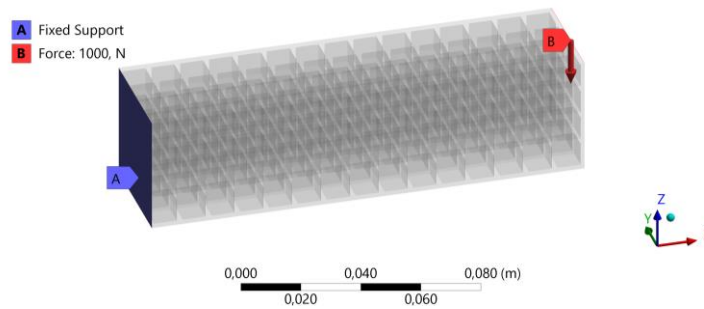


Fig. 1. Design diagram of a cantilever beam with cubic cavities

The representative cell in this case is a cube with a side of 10 mm. Since the geometry of the cell and the scheme of action of the loads in determining the effective moduli of elasticity are symmetric, only 1/8 of the cell with the corresponding conditions of symmetry was considered. Fig. 2 shows the design models of the eighth part of the representative cells.

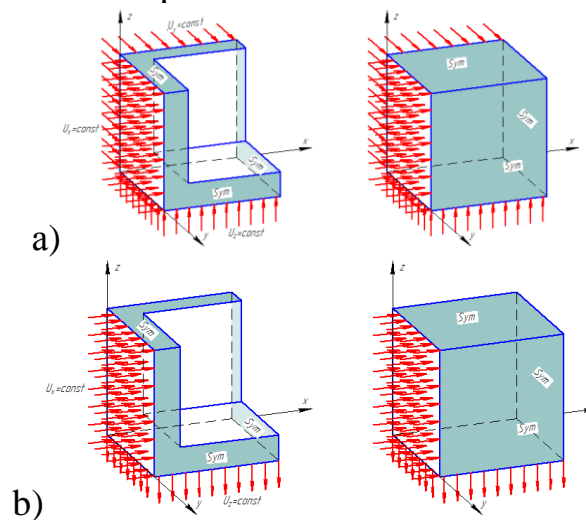


Fig. 2. Design models of representative cells:
a) all-round compression; b) pure shift

On the left there is a model of a hollow cell, on the right there is a solid one. Red arrows indicate the directions of the applied external forces. Two independent tasks were solved: comprehensive compression and pure shear. In this case, for a hollow cell, it is necessary to specify on the outer faces subjected to deformation, a set of nodes with associated degrees of freedom, i.e. ensure their uniform movement. Restrictions were imposed on the nodes of the remaining outer faces, which are shown in the figure, to exclude movement along the normal.

This formulation of problems allows one to independently determine the effective moduli of volumetric compression and shear from the condition of equality of potential energies of deformations, when fulfilled, the same stress-strain state of the cells is ensured. The effective moduli values were determined numerically using the bisection method. The effective bulk modulus was Pa, while the effective shear modulus was Pa.

Results and discussion

As a check, two calculations of the cantilever beam shown in Figure 1 were carried out: a straight with real elastic moduli and a calculation of an equivalent beam without cavities with effective elastic moduli.

The maximum deformation of the first beam is $7.3064 \cdot 10^{-2}$ mm, the second $7.3635 \cdot 10^{-2}$ mm, which indicates good convergence of the results.

The verification calculation confirmed the validity of the application of the continuum hypothesis for theoretical calculations of the effective elastic moduli even for bodies with sufficiently large pores.

It should be noted that the mesh of the computational model of a beam with cavities contains 280354 nodes, an equivalent beam – 3591 nodes. The geometry of real objects with an internal porous structure significantly exceeds the considered example in complexity. In this regard, the calculation of the stress-strain state of such objects is not possible without the application of the continuum hypothesis.

Conclusion

Thus, the presented method for the numerical calculation of effective elastic moduli in the ANSYS system has confirmed the possibility of using the continuum theory to predict the elastic properties of porous materials. The advantage of this technique lies in the possibility of calculating the effective elastic moduli of materials with an arbitrary shape of cavities. Analytical calculation methods are applicable only for special cases (for cells with a cubic or spherical cavity).

References

1. Van Der Voort P., Leus K., De Canck E. Introduction to Porous Materials. John Wiley & Sons, 2019, 448 p.
2. Chritensen R. M. Mechanics of Composite Materials. NY etc.: Wiley, 1979.
3. Ramakrishnan N., Arunachalam V.S. Effective elastic moduli of porous solids. Journal of Materials Science, 1990, 25(9), pp. 3930-3937.
4. Fedotov A.F. Prediction of effective elasticity moduli of porous composite materials. Russian Journal of Non-Ferrous Metals volume, 2016, 57(3), pp. 251–255.

МЕТОДИКА ЧИСЛЕННОГО РАСЧЕТА ЭФФЕКТИВНЫХ МОДУЛЕЙ УПРУГОСТИ ПОРИСТОГО МАТЕРИАЛА

А. И. Скоморохова*, А. О. Глебов, Д. С. Алексенцев

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: nasta373@mail.ru*

Аннотация. Предложена методика численного расчета эффективных модулей упругости пористого материала, основанная на применении гипотезы континуума. Суть методики заключается в определении эффективных модулей объемного сжатия и сдвига с помощью решения методом конечных элементов двух независимых задач о деформировании представительной ячейки пористого материала. В качестве примера использована консольная балка с регулярным расположением полостей кубической формы. Проверочный расчет балки, подвергающейся изгибу, подтвердил справедливость методики.

Ключевые слова: гипотеза континуума, пористый материал, эффективные модули упругости, метод конечных элементов.

Review of Implementation and Calculation Methods for Groundwater Deferrization Processes

A. G. Streltsova*, A. V. Rukhov

Tambov State Technical University, Tambov, Russia

*e-mail: *stranastasya@yandex.ru*

Abstract. This article presents the main methods of deferrization of groundwater. Each cleaning method is considered by the author and has a brief description and description of the process, which allows the selection of the method in certain conditions.

Key words: aeration, groundwater, ferrous iron, purification methods, ferric iron.

Introduction

Ground waters are closely located water masses, for which they got their second name - subsoil waters. The volume of groundwater is quite large, primarily due to the close location of water masses to the soil. Water replenishment is carried out by precipitation during the year. In terms of its composition, groundwater is unique; it is a complex system that includes components of organic and inorganic chemistry.

The use of groundwater in the water supply system is complicated by the presence of iron compounds in its composition. But not all sources meet the required readings of the iron concentration for further water use. There are four main types of iron compounds:

- ferrous iron - in the composition of water it is in a dissolved form, invisible under normal conditions, during prolonged contact between water and atmospheric air it turns into a trivalent state, and water turns reddish;

- ferric iron — in water it is present in an undissolved state in the form of the smallest particles of red color, which precipitate during settling;

- colloidal iron - is an undissolved compound in water, particles do not precipitate, the water turns red;

- bacterial iron - characterized by the presence of living and dead bacteria in its composition, form deposits inside pipelines, as well as on sanitary appliances;

- in cases of replenishment of an aquifer by river or swamp water, iron in groundwater can be in the form of complex organic compounds. In the waters of surface sources, iron is part of organic compounds, for example, aqueous humus.

The use of waters with a high content of iron compounds is fraught with unfavorable consequences. Waters of this composition have an effect not only on metal structures, which causes corrosion, but also on the human body. Therefore, the main task of water supply services is to reduce the iron component to the maximum permissible concentration as much as possible.

Basic methods of groundwater deferrization

The required degree of groundwater deferrization is determined by further purposes of use. Currently, there is no universal method for treating groundwater from iron compounds, therefore, for each specific case, a specific treatment scheme is used, based on the desired result.

Simplified aeration

Aeration is one of the simplest technological methods for deironing groundwater. During the process, the oxygen in the air oxidizes ferrous iron, as a result of which carbon dioxide is removed, which helps to accelerate the oxidation process, as well as hydrolysis with the formation of iron hydroxide.

This method is applicable with the following quality indicators of water:

- the content of ferrous iron is not less than 70%, and the total iron content is up to 10 mg / l;
- pH of the solution is not less than 6.8;
- oxidizable with permanganate no more (0.15 [Fe²⁺] + 5 mg / l O₂);
- the amount of hydrogen sulfide is not more (1 + [Fe²⁺] / 28 mg-eq / l).

If one of the conditions is not maintained, preliminary aeration of the water with the addition of reagents is also required.

The calculation method for simplified aeration is carried out according to the following formulas, which take into account all the necessary parameters for deferrization of water.

Sand layer thickness in the filter: $L = 20dep\sqrt{V [Fe]}$

Air flow for aeration: $q = \frac{q_0^0(L_{en} - L_{ex})}{K_1 * K_2 * K_3 * K_T * (C_a - C_0)} m^3/m^3$

Oxygen solubility in water: $C_a = 1 + \frac{(ha)}{20,6} * C_T, mg/l$

Aeration intensity: $J_a = \frac{q_{air} * H_{at}}{t_a}$

Wastewater temperature coefficient: $K_T = 1 + 0,02 * (T_W - 20)$

When additional conditions are introduced, the parameters of the calculation formula change.

Coagulation and clarification

The method is based on the introduction of specialized substances of reagents-coagulants, hence the name of the method itself. The process of action is quite simple, the coagulant in the aqueous medium forms flakes that are adsorbed as a sediment. The dose of the coagulant is determined by the trial coagulation method.

Ion exchange method

For this purification process, various types of cation exchangers are used. In turn, cation exchangers remove dissolved iron from water, as well as other types of metals. In theory, this ion exchange method is excellent for removing high concentrations of iron. It should be noted that synthetic resins are increasingly being used in this method.

Reverse Osmosis

The process is based on forcing masses of water through membrane plates under the action of hydraulic pressure. As a result, water that has passed all stages of this treatment meets the required parameters.

Introduction of oxidizing reagents

The method is applicable for deferrization of groundwater with the introduction of various oxidizing agents. During the reaction, the oxidizing agent destroys organic iron compounds and converts them into the form of inorganic salts, undissolved ferric iron. The ferric iron obtained in the course of the reaction precipitates out.

Filtration through catalytic loads

The mechanism of action is based on the ability of manganese compounds to relatively easily change the valence state. Divalent iron in the source water is oxidized by higher manganese oxides. The latter are reduced to the lowest stages of oxidation, and then re-oxidized to higher oxides with dissolved oxygen and potassium permanganate. Subsequently, most of the oxidized iron retained on the filter material is flushed out into the drain during backwashing. Thus, the bed of granular catalyst also serves as a filtering medium.

Method of "dry" filtration

The process proceeds as follows, in an air-water emulsion through a "dry" granular load by creating a vacuum in the filter or by injecting a large amount of air with subsequent suction from the bottom space on the surface of the filtering load an adsorption-catalytic film is formed from iron compounds. Sand, expanded clay, anthracite, vinyl plastic, etc. are usually used as the loading. A feature of the process is the formation of a dehydrated film on the loading grains, consisting of magnetite, siderite, goethite and hematite. These compounds have a dense structure, and their volume is 4–5 times less than that of iron hydroxide.

Conclusion

The above methods of deferrization of groundwater are working and are applicable in all industries. Each cleaning method is unique and individual in its own way. The method should take into account the quality, the chemical composition of the water, as well as economic aspects. Besides the obvious advantages, there are also disadvantages of each cleaning method. Thus, it is most economically expedient to use the method of simplified aeration, provided that the iron concentration is up to 10 mg / l. It should also be noted that the methods can be used in conjunction to achieve the required iron limits.

References

1. Zhurba M.G., Sokolov L.I., Govorova Zh.M. Vodosnabjenie. Proektirovanie system i sooruzhenii v 3h tomah. T. 2. Ochistka i kondicionirovanie prirodni h vod.red. [Watersupply. Design of systems and structures: in 3 volumes. Vol. 2. Treatment and conditioning of natural waters]. M.: Publishing house of the Association of building universities, 2010, 552 p. (Rus)
2. Kulakov V.V., Soshnikov E.V., Tchaikovsky G.P., Udalenie jeleza i demanganizaciya podzemni h vod: uchebni k [Iron removal and demanganization of groundwater: textbook]. Khabarovsk: FVGUPS, 1998, 100 p. (Rus)

3. Iron removal from wells. Increased iron content in water. Reasons [Electronic resource]. URL: <http://doktora.by/povyshennoe-soderzhanie-zheleza-v-vode-prichiny-posledstviya-metody-obrabotki-vody/> (date of access: 06.12.2020). (Rus)

4. Hallberg R.O., Martinell R. Vyredox – insity purification of ground water. Ground water, 1976, vol. 4, 2.

ОБЗОР СПОСОБОВ РЕАЛИЗАЦИИ И МЕТОДИК РАСЧЕТА ПРОЦЕССОВ ОБЕЗЖЕЛЕЗИВАНИЯ ГРУНТОВЫХ ВОД

А. Г. Стрельцова*, А. В. Рухов

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: stranastasya@yandex.ru*

Аннотация. Представлены основные методы обезжелезивания грунтовых вод. Каждый метод очистки рассмотрен автором и имеет краткую характеристику и описание процесса, что позволяет осуществлять подбор метода в определённых условиях.

Ключевые слова: аэрация, грунтовые воды, двухвалентное железо, методы очистки, трехвалентное железо.

Used Motor Oils as Anticorrosive Conservation Compounds to Protect Metals in Sulfur-Containing Atmospheres

I. V. Zarapina, O. I. Zaytseva*

Tambov State Technical University, Tambov, Russia

*e-mail:ole.oleolechka@yandex.ru

Abstract

The aim of this article is to find ways of recycling used motor oils to reduce environmental pollution. The corrosion of carbon steel in saturated solutions of SO₂ in equilibrium with the gas phase of sulfur oxide (IV) was investigated. The initial oxide concentration in the gas phase was in the range of 0.1 ... 10 vol.%, its equilibrium concentration was $1.1 \cdot 10^{-5}$... $6.7 \cdot 10^{-2}$ vol.%. The protective efficacy of the emulsion was studied when it was contained in a film based on used engine oil 1 ... 10 wt.%.

Keywords: corrosion, protection, steel, film, waste oil.

In the Tambov region a significant number of vehicles, and therefore the problem of increasing waste of oil products and used engine oil is more relevant than ever. Accumulated used engine oil (MMO) in trucking companies and private individuals must be collected and disposed of. Proper disposal, recycling of used engine oils will certainly lead to a decrease in environmental pollution [1].

Used engine oil is a mixture of mineral petroleum and synthetic engine oils. Using it as a base solvent for creating anticorrosive compositions allows you to solve a number of problems, namely:

- economic problems since the cost of compositions based on used engine oil is significantly lower than that based on fresh oils;
- environmental problems due to the alternative use of large quantities of used commercial petroleum oils [4].

Gravimetric corrosion tests were carried out in distilled water saturated with sulfur dioxide, as well as in the gas phase in equilibrium with it. For the study, we used samples of steel grade St3 with the following mass composition, %: iron Fe – 98.36; carbon C – 0.2; manganese Mn – 0.5; silicon Si – 0.15; copper Cu – 0.2; nickel Ni – 0.2; chrome Cr – 0.3; phosphorus P – 0.04; sulfur S – 0.05.

As a multifunctional additive, it is proposed to use an emulsifier, which had the following component-mass composition, %: primary aliphatic amines fractions C₁₆...C₂₀₋₂₂ ... 30; secondary aliphatic amines fractions C₁₀...C₁₅ – 12...23; primary aliphatic amines fractions C₁₀...C₁₅ – 5...20; secondary aliphatic amines fractions C₁₆...C₂₀₋₁₀ ... 26; paraffinic hydrocarbons fractions C₁₈...C₂₀ – the rest.

It was interesting to find out and evaluate the effectiveness of emulsin as an inhibiting additive to used commercial motor oils when protecting steel products from corrosion in an atmosphere of sulfur oxide (IV) SO₂. For this, we calculated the protective effect (Z, %) of oil conservation compositions MMO in relation to steel St3. In each series of experiments, the relative humidity of the air atmosphere

was considered equal to 100 %. The duration of the corrosion tests was 14 days (336 hours).

The results of the study of the inhibitory effectiveness of oil conservation compositions of emulsifier in a solvent-based in the absence of SO₂ are shown in Tables 1 and 2. Experimental data from table 1 indicate that with an increase in the concentration of the emulsifier additive, there is an increase in the thickness of the films (h, mcm are indicated in Table 1) of the preservation materials covering the metal product. They range from 18.8 microns for pure MMO coatings to 108.09 microns for coatings containing 10 wt.% emulsifier in solvent-based solution.

Table 1. Thickness of the preservation film at different concentrations of the multifunctional additive emulsifier in oil

$C_{\text{emulsifier}}$, mass. % in oil	0	1	3	5	7	10
h , mkm	18.80	19.73	32.51	35.44	50.23	108.0

Table 2. The influence of the emulsifier concentration on the protective effect (Z, %) of the oil composition based on MMO

$C_{\text{emulsifier}}$, mass.% in oil	Z, %	$K \cdot 10^3$, g/m ² ·h
0	98.45	0.333
10	99.19	0.173
7	99.03	0.202
5	98.94	0.219
3	98.88	0.228
1	98.77	0.261
no composition	–	20.960

Table 2 shows that with an increase in the concentration of analgin in MMOs from 1 to 10 wt.% the corrosion rate K is slightly reduced, and the protective efficiency increases accordingly. The greatest inhibitory effect is exhibited by coating films containing 10 wt% emulsigine in MMO, the Z value was 99.19%.

Table 3. Effect of the emulsifier concentration on the protective effect of an oil composition based on MMO in an atmosphere containing 10 vol.%SO₂

$C_{\text{emulsifier}}$, mass.% in oil	Z, %	$K \cdot 10^3$, g/m ² ·h
0	68.29	10.62
10	88.13	3.98
7	84.35	5.24
5	80.05	6.68
3	78.97	7.05
1	77.68	7.48
no composition	–	33.49

With the introduction of air in the atmosphere of about 10,0. % of corrosive sulfur dioxide SO₂ there is a clear increase in the corrosion rate (Table 3) and on uncoated samples reaches a maximum value of $33.49 \cdot 10^{-3} \text{ g/m}^2 \cdot \text{h}$. However, the protective ability also increases with increasing thickness of the protective film and the concentration of emulsifier in the solvent-based, having the value 88.13 % when covering the surface with films containing 10 wt.% solvent-based additives.

Then sulfur dioxide was introduced into the working atmosphere (Table 4).

The data obtained in table 4 indicate that the inhibitory efficacy. The proposed oil coatings differ slightly from previous tests. As before, the decrease in the concentration of corrosive gas leads to an increase in the rate of corrosion of the uncoated sample to the value of $31,69 \cdot 10^{-3} \text{ g/m}^2 \cdot \text{h}$. And again, the best protective effect is shown by a film with 10 wt.% of the additive in MMO.

Table 4. Effect of the emulsifier concentration on the protective effect of an MMO-based oil composition in a SO₂ atmosphere containing 5 vol. % SO₂

$C_{\text{emulsifier}}$, , mass.% in oil	Z, %	$K \cdot 10^3$, g/m ² ·h
0	85.34	4.64
10	91.65	2.69
7	90.74	2.92
5	89.59	3.31
3	89.05	3.51
1	87.79	3.85
no composition	–	31.69

Then the concentration of sulfur dioxide was changed again. Drop in the concentration of sulfur (IV) oxide in the air atmosphere to 3 (Table 5) and 1 (Table 6) vol. this picture does not change significantly and it remains approximately the same.

From the data in Tables 5 and 6, it follows that the inhibitory effect of conservation oil compositions is in the range of 90...96%. It reaches a maximum value of 96.83% when films containing 10% of the protective additive in an oil-based solvent are applied to the electrodes.

Table 5. Effect of the emulsifier concentration on the protective effect of an oil composition based on MMO in an atmosphere containing 3 vol.%SO₂

$C_{\text{emulsifier}}$, mass.% in oil	Z, %	$K \cdot 10^3$, g/m ² ·h
0	90.29	2.58
10	94.29	1.52
7	94.02	1.59
5	93.11	1.85
3	92.58	2.00
1	92.43	2.03
no composition	–	26.62

Table 6. Effect of the emulsifier concentration on the protective effect of an MMO-based oil composition in an atmosphere containing 1 vol.% SO₂

$C_{\text{emulsifier}}$, , mass.% in oil	Z, %	$K \cdot 10^3$, g/m ² ·h
0	94.14	1.390
10	96.83	0.749
7	96.22	0.894
5	95.73	1.011
3	95.04	1.181
1	94.71	1.261
no composition	–	23.640

When introduced into the air atmosphere 0.1 vol. % SO₂ there is still an increase in the corrosion rate (Table 7). With an increase in the thickness of the cover film and the concentration of emulsifier in the solvent-base, the protective ability also increases, reaching 99.00 % when applied to a sample of a composition containing 10 wt.% of the additive in a solvent-based solution.

Table 7. Effect of the emulsifier concentration on the protective effect of an MMO-based oil composition in an atmosphere containing 0.1 vol.% SO₂

$C_{\text{emulsifier}}$, , mass.% in oil	Z, %	$K \cdot 10^3$, g/m ² ·h
0	98.39	0.356
10	99.00	0.220
7	98.78	0.271
5	98.77	0.279
3	98.59	0.307
1	98.34	0.366
no composition	–	21.950

It can be unequivocally stated that the investigated emulsifier additive exhibits a sufficiently high inhibitory ability with respect to corrosion of low-carbon steel in a sulfur-containing air atmosphere. At the same time, as the concentration of the multifunctional additive increases, the protective effect of compositions based on used motor oils increases, reaching 99.00%.

References

1. Lukanin V.N. Promyshlennaja i transportnaja jekologija [Industrial and transport ecology]. M: Hightschool, 2001. (Rus)
2. Knyazeva L.G., Akolzin A.P., Vigdorovich V.I., Shel N.I. Some problems of inhibition of steel atmospheric corrosion by the waste motor oils. Anticorrosion Protection Practice, 2012, 1(63), pp. 60-65.
3. Kolotyркиn Ya.K. Metall i korroziya [Metal and corrosion]. M : Metallurgy 1985. (Rus)
4. Shekhter Yu.N., Shkolnikov V.M., Bogdanova T.I. Konservacionnye smazki [Conservation lubricants]. M.: Chemistry, 1979. (Rus)

ПРИМЕНЕНИЕ ОТРАБОТАННЫХ МОТОРНЫХ МАСЕЛ В КАЧЕСТВЕ АНТИКОРРОЗИОННЫХ КОНСЕРВАЦИОННЫХ СОСТАВОВ ДЛЯ ЗАЩИТЫ МЕТАЛЛОВ В СЕРСОДЕРЖАЩИХ АТМОСФЕРАХ

И. В. Зарапина, О. И. Зайцева*

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail:ole.oleolechka@yandex.ru

Аннотация. Исследована коррозия углеродистой стали в насыщенных растворах SO₂, находящихся в равновесии с газовой фазой оксида серы (IV). Исходная концентрация оксида в газовой фазе находилась в интервале 0,1...10 об.%, соответственно его равновесная концентрация составляла $1,1 \cdot 10^{-5}$... $6,7 \cdot 10^{-2}$ об.%. Изучена защитная эффективность эмульгина при его содержании в плёнке на основе моторного отработанного масла 1...10 масс.%.

Ключевые слова: защита, коррозия, отработанное масло, плёнка, сталь.

Electrophysical Characteristics of a Polymer-Based Material Modified With CNT

N. V. Zemtsova

Tambov State Technical University, Tambov, Russia
e-mail: natasha_paramonova_68@mail.ru

Abstract

This paper presents a technology for manufacturing composites based on a polymer modified with CNTs. The effect of various mass contents of CNTs in the polymer on both the specific volumetric and surface values of electrical resistivity has been investigated. It was also found that the highest power is achieved at a lower voltage value with an increase in the CNT mass content.

Keywords: carbon nanotubes; elastomer; heater; surface resistivity; temperature self-regulation; volume resistivity.

Introduction

Today, the creation of new energy-efficient materials and technologies is an important scientific and technological problem. Nanomaterials are of particular importance for the development of modern materials science. First of all, this applies to carbon nanotubes. The development of self-regulating heaters is related to technologies for producing electrically conductive composites.

Conductive composites differ in both the polymer matrix and the conductive components. Polymer / CNT composites are prepared by dissolution, such as in situ polymerization [1], and solutions are mixed [2]. Dissolution provides better dispersion of nanostructures in the polymer matrix and a lower threshold of electrical percolation than those obtained by compounding the melt. The influence of CNTs on the properties of conducting polymers with PTCR was studied in [3-4]. Different types of heater materials allow to get a different form of the final commercial products, which determines the specialization of their application.

The goals of this work are: 1) to study the electrical conductivity of elastomers modified by CNTs synthesized on various catalysts; 2) to investigate the effect of different concentrations of CNTs in an elastomer on their dissipation under DC voltage.

Methods and materials

The UNI-T UT333: thermohygrometer (Uni-Trend Technology Ltd., Kowloon, China) was used for measuring the relative air humidity, and 2TRM1 microprocessor-based meter/controller (Oven, Moscow, Russia) was used for measuring the ambient temperature. The polymer matrix material – high-strength Silagerm 8030 silicon (Element-14 LLC, Moscow, Russia) – represented an organosilicon compound consisting of a base and a catalyst. Composite components were weighed on an OHAUS Pioneer analytical balance (Changzhou, China) with an accuracy of 10⁻⁵ g.

For the research purposes, nanomodified composites containing 1, 3, 5 and 7 wt.% CNTs were prepared. The CNTs were synthesized over two types of catalysts: Fe–Co/2,1Al₂O₃ (CNTs No1) and Co–Mo/Al₂O₃–MgO (CNTs No2). For preparing 15 g of the elastomer composite containing 1 wt.% CNTs, 0.15 g of the CNTs and 7.425 g of the organosilicon compound base were added to a 50-mL beaker, and then mixed using an HT-120 DX vertical rotary mixer (Daihan Scientific Co. Ltd., Seoul, South Korea) at a propeller stirrer rotation speed of 1000 rpm for 20 min. It was placed into the UlabUT-4686V vacuum oven (Shanghai Jingke Scientific Instrument Co. Ltd, Shanghai, China) to remove air for 15 min at 25 °C and 0.1 MPa. All the CNTs-modified composites were prepared according to this technology.

Results and discussion

The measurement results (Fig. 1) show that the ETM1-1 has a high resistivity (more than 10⁶ Ohm x cm) and, accordingly, has a low electrical conductivity.

When increasing the mass content of CNTs No1 in ETM1 from 1 to 3 wt. % a decrease in the specific volume resistance occurs. For ETM1-3 this value is 55 Ohm x cm. A further increase in the mass content of CNTs No1 in the elastomer to 7 wt.% leads to a slight decrease in specific volume resistance. The increase in viscosity ETM1 when using CNTs No1 more than 7 wt.% leads to the impossibility of molding composites and obtaining samples in the study. For ETM2, the percolation threshold for specific volume resistance is in the range of 3...5 wt.%.

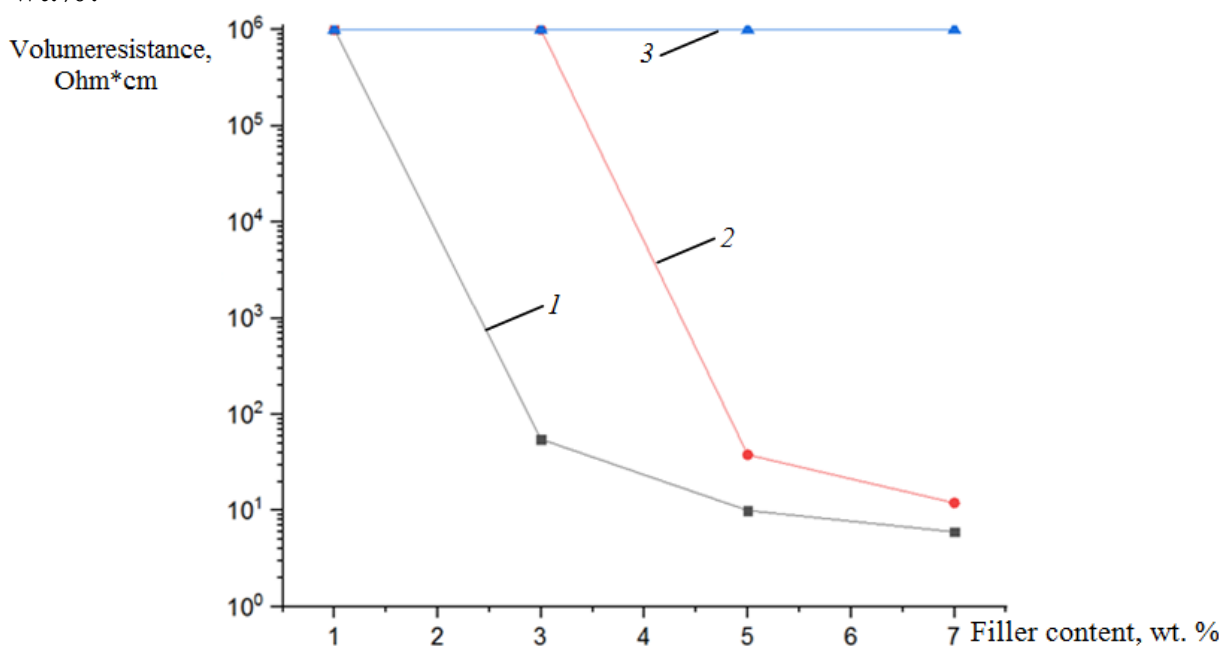


Fig. 1. Graphs of the specific volumetric resistance of the ETM:
1 - ETM1; 2 - ETM2; 3 - instrument measurement limit

Since the composites ETM1-1, ETM2-1 and ETM2-3 have high electrical resistance, connecting the heaters ETM1-1, ETM2-1 and ETM2-3 to a constant voltage of up to 15 V does not lead to the conversion of electrical energy into heat. The operating mode of OH ETM1-3, ETM1-5 and ETM1-7 is accompanied by

inrush currents (Fig. 2). For these composites, inrush currents were 30; 7.5 and 14 mA. After 100s of operation, the current value decreased and stabilized. Values of stabilization current for samples were for ETM1-3: 7.5 mA; for ETM1-5: 1.3 mA.

Connecting the ETM to the supply voltage, the value of which exceeds the nominal supply voltage, leads to damage to the samples. Heater samples show a uniform temperature field on their surface. Different types of CNTS with corresponding concentrations affect the values of the electric power of heat release and, accordingly, the heating temperature.

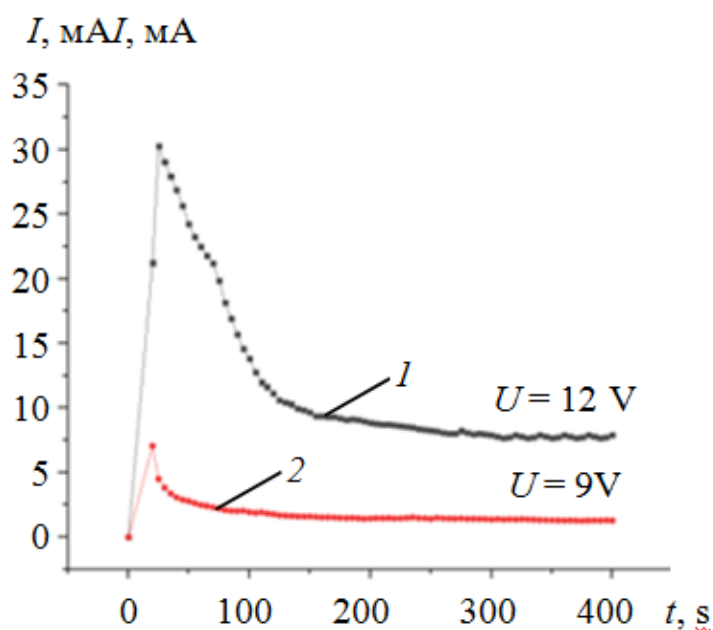


Fig. 2. Graphs of current value changes of heaters' samples ETM1: 1 - ETM1-3; 2 - ETM1-5

Conclusion

In this study, it was found that the mass content of CNTS based on Silagerm 8030 elastomer for the manufacture of an electrically conductive composite is in the range of 3...7 wt.%. The maximum values of the specific volume resistance for modified elastomers are 7 wt. % UNI-T are 12 and 6 Ohm x cm.

We also developed a method for modifying CNT elastomers synthesized on two types of catalysts: Fe-Co/2. 1Al₂O₃ and Co-Mo/Al₂O₃-MgO. It is found that with increasing mass content of CNTS in the elastomer, the value of the maximum possible DC supply voltage decreases.

Acknowledgements

The study was funded by the Fund for the Promotion of Innovations as part of a scientific project under contract No. 15535GU / 2020 (ext. 0059250) dated July 4, 2020.

References

1. Tessonnier J., Rosenthal D., Hansen T., Hess C., Schuster M., Blume R., et al. Analysis of the structure and chemical properties of some commercial carbon nanostructures. Carbon, 47 (7), 2009, pp. 1779-1788.

2. Tibbetts G., Lake M., Strong K., Rice B. A review of the fabrication and properties of vapor-grown carbon nanofiber/polymer composites. *Compos SciTechnol*, 67 (7–8), 2007, pp. 1709-1718.

3. Almasri A., Ounaies Z., Kim Y., Grunlan J. Characterization of solution- processed double-walled carbon nanotube/poly(vinylidene fluoride) nanocomposites. *Macromol Mater Eng*, 293 (2), 2008, pp. 123-131.

4. Tjong S., Liang G., Bao S. Electrical behavior of polypropylene/multiwalled carbon nanotube nanocomposites with low percolation threshold. *Scripta Mater*, 57 (6), 2007, pp. 461-464.

ЭЛЕКТРОФИЗИЧЕСКИЕ ХАРАКТЕРИСТИКИ МАТЕРИАЛА НА ОСНОВЕ ПОЛИМЕРА, МОДИФИЦИРОВАННОГО УНТ

Н. В. Земцова

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: natasha_paramonova_68@mail.ru

Аннотация. В данной работе представлена технология изготовления композитов на основе полимера, модифицированного УНТ. Исследовано влияние различных массовых содержаний УНТ в полимере как на удельные объемные, так и на поверхностные значения удельного электрического сопротивления. Также было установлено, что наибольшая мощность достигается при более низком значении напряжения с увеличением массового содержания УНТ.

Ключевые слова: обогреватель; объемное сопротивление; поверхностное сопротивление; углеродные нанотрубки; удельное саморегулирование температуры; эластомер.

Improving the Manufacturing Technology of Rubber Products

A. A. Zhilo

Tambov State Technical University, Tambov, Russia

e-mail: zhilo97@mail.ru

Abstract

Modeling of temperature fields of rubber products, including thermal effects of the vulcanization process, is supposed to be performed in the ANSYS finite-element analysis system. To do this, it is necessary to develop a module for calculating the degree of polymerization of the rubber compound in each final element in the command language APDL of the ANSYS system. The degree of polymerization is calculated using the Arrhenius equation in differential form.

Keywords: vulcanization, press form, finite element method, ANSYS.

Introduction

Vulcanization is a chemical reaction that is the transformation of raw rubber into a vulcanization grid, due to the addition of other chemical compounds to it. At the same time, rubber improves its hardness, elasticity, and resistance to high and low temperatures.

This process is energy-intensive. To select the optimal technological parameters in terms of energy consumption and product quality, it is necessary to simulate the thermal state of the product during its polymerization. Thermal behavior of the products must be such that curing is completed throughout the thickness of the insulating layer. Because the rubber compound has a low coefficient of thermal conductivity, the heating to complete vulcanization even a relatively thin (few mm) layers is large periods of time (tens of minutes). In addition, the heating intensity should be such that the surface temperature of the rubber compound does not exceed the temperature of the beginning of thermal decomposition of the material. The energy efficiency of the considered technological process depends largely on the accuracy of predictive modeling of non-stationary temperature fields of the rubber mixture during its vulcanization.

Methods for calculating temperature fields for rubber products

The authors of [1] set themselves the task of numerical modeling of temperature fields of cable products under vulcanization conditions, taking into account the main significant factors. In the course of this work, they come to the following conclusions:

- when modeling the vulcanization process of typical cable products, it is necessary to take into account the actual configuration and heat exchange by radiation of cable industry products;

- * neglect of the form factor and heat transfer by radiation should lead to a significant increase in energy consumption for the implementation of the considered technological process.

In [2], the authors were faced with the task of modeling the vulcanization process of a thick-walled rubber product.

As a result of calculations, a series of vulcanization curves are obtained that characterize the behavior of different tire layers, taking into account their joint vulcanization. Based on the obtained curves, it is possible to correct the composition of rubbers and the mode of tire vulcanization in order to optimally distribute the degrees of vulcanization of the tire layers.

The article [3] is devoted to the problem of selecting the vulcanization mode for thick-walled products, taking into account the unevenness of the temperature field. During the work was considered the problem of curing the massive products, it is shown that in the process of structuring the composite elastomeric materials, the temperature distribution across the section varies, and also calculated the temperature field in the slices of the product and set according to the changes of the structural parameters.

As a general disadvantage of [1]-[3], we should note the solution of the non-stationary heat equation in a one-dimensional formulation using the finite difference method. Implementation of this approach for calculating the temperature fields of products of complex configuration is difficult.

The article [4] considers a mathematical formulation and an algorithm for numerical solution of the problem of calculating the temperature field in a vulcanized product whose thermophysical characteristics depend on temperature. In the course of this work, the following issues were considered:

- a method of finite-difference approximation of the system of differential equations of thermal conductivity, which allows taking into account the complex configuration of elements of the vulcanized product;
- numerical algorithm for solving the problem.

In [4] the following drawbacks were identified:

- during calculations, the shape of the projector drawing is neglected;
- temperature calculations are performed only at individual points, not over the entire surface of the product.

In [5], the authors considered the problem of modeling the vulcanization process in the production of pneumatic tires to improve their quality and reduce energy consumption for production. In the course of their work, the authors [5] came to the following conclusions:

- currently, there is no theory that could describe the vulcanization process accurately and physically correctly, taking into account the phenomenon of thermal conductivity

* the practice of developing new development methods dictates the need to design vulcanization modes and select heat carriers and equipment based on numerical modeling

The obvious drawback of the work [5] is the solution of the problem in a one-dimensional formulation.

Conclusion

Thus, the analysis of publications on the topic of modeling the temperature fields of rubber products in the process of their vulcanization leads to the following conclusions. In most cases, the finite difference method is used to solve the non-stationary heat equation. As a consequence, the problem is considered in a one-dimensional formulation. The use of modern systems of finite element analysis for calculating the temperature fields of rubber products is hindered by the lack of modules that allow taking into account the thermal effect of the polymerization reaction. Therefore, the task of developing an appropriate software module is relevant. To solve this problem, we plan to use the command language APDL of the ANSYS system.

The practical application of the module for calculating the thermal effects of the polymerization reaction can result in recommendations for improving the manufacturing technology of RTP based on the study of the effect of their size on the vulcanization time.

References

1. Kuznetsov G.V., Ivanova E.V. Mathematical modeling of temperature fields in the process of vulcanization of typical cable products. Proceedings of Tomsk Polytechnic University, 2010, vol. 316, No. 4, pp. 38-41.
2. Markelov V.G., Solov'ev M.E. Modeling of the vulcanization process of thick-walled rubber products. Izvestiya Vuzov. Chemistry and chemical technology, 2007, № 4.
3. Molchanov V.I., Karmanova O.V., Tikhomirov S.G., Pyatakov Yu.V., Kasperovich A.V. Modeling the kinetics of non-isothermal vulcanization of massive rubber products. Proceedings of BSTU, Series 2: Chemical technologies, biotechnology, Geocology, 2014, 4(168).
4. Tikhomirov S.G., Pyatakov Yu.V., Karmanova O.V., Molchanov V.I. Numerical algorithm for calculating the temperature fields of pneumatic tires during vulcanization. Vestnik VGUIT, 2015, 2(64).
5. Tikhomirov S.G., Molchanov V.I. Modeling of the vulcanization process in the production of pneumatic tires. Materials of the LII reporting scientific conference for 2013: Part 2, 2014, pp. 70-72.

СОВЕРШЕНСТВОВАНИЕ ТЕХНОЛОГИИ ИЗГОТОВЛЕНИЯ РЕЗИНОТЕХНИЧЕСКИХ ИЗДЕЛИЙ

А. А. Жило

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: zhilo97@mail.ru

Аннотация. Моделирование температурных полей РТИ, в том числе тепловых эффектов процесса вулканизации, предполагается выполнять в системе конечно-элементного анализа ANSYS. Для этого необходимо на командном языке APDL системы ANSYS разработать модуль для расчета степени полимеризации резиновой смеси в каждом конечном элементе. Степень полимеризации рассчитывается по уравнению Аррениуса в дифференциальной форме. Удельная теплота реакции полимеризации пропорциональна ее скорости. Таким образом, объемное тепловыделение в каждом конечном элементе меняется во времени. Следовательно, на каждом шаге по времени необходимо решать уравнение Аррениуса для каждого конечного элемента.

Ключевые слова: вулканизация, пресс-форма, метод конечных элементов, ANSYS.

УДК 62-26
ББК 34.5

The Development of a Cylindrical Vibration Mill and its Calculation Method

S. S. Aldawood

Tambov State Technical University, Tambov, Russia
**e-mail: eng.saif.suhail@gmail.com*

Abstract

In many industries, millions of tons of different materials are finely milled. Improving the final product quality with minimal energy consumption is an urgent matter. Commonly vibration mills are used to produce powders with a final particle size less than 5 μm . Mills are classified by drive design and the vibrations nature of a milling chamber into harmonic, biharmonic and polyharmonic vibrations. Mills stagnant zones inside the mill during the milling process are the common disadvantage of these mills which reach 30% of the product volume, which causes reduced milling efficiency. Many researchers tried to develop designs of these mills or create new ones to reducing stagnant zones, which increases the productivity and milling precision of the final product.

Keywords: cylindrical vibration mills, mill productivity, stagnant zones, harmonic vibrations, biharmonic vibrations, milling chamber.

The first designs of vibration mills appeared in the late 1930s and are still widely used in many industries for milling a Micro and Nano materials [1-3]. The main advantage of vibration mills is using to obtain powders with the particle size of the final product less than 5 μm . In addition, when comparing vibration mills with types of mills [4], which produce fine powders of large quantities, vibration mills have the lowest specific energy consumption. Using the milling bodies and special materials lining will get a final product without milling yield from the material of milling bodies and lining [5].

the most common type of Vibration mills is which consist a cylindrical milling chamber installed on springs fitted with a single unbalance vibration motor.

When the vibration motor is operating, the milling chamber, together with the milling bodies, performs harmonic oscillations in a plane along a trajectory close to a circular. At all points in the cross-sectional area of the milling chamber, the trajectory of movement of the milling bodies is uniform, because these trajectories have the similar parameters.

Milling bodies move in opposite direction to the rotation of the unbalanced motors. Also, in this process, each milling body rotates around it his center, grinding material particles by crushing, impact, and abrasion.

Stagnant zones in the cross section of the milling chamber are formed in the center, in these zones arise the separation of the milling bodies and the product

particles. The milling bodies move to up the milling chamber, and the product particles accumulate at the bottom of the milling chamber. In this case, the efficiency of the vibration mill considerably reduces

The vibration mills performance depends on the frequency and amplitude of the milling chamber. The mill productivity is directly proportional to the frequency at constant amplitude; that means that with an increase in frequency of oscillations the mill productivity increases. Also, the mill productivity is directly proportional to the amplitude at constant frequency, with some limitations. Where increasing the amplitude the stagnant zones reduce fractionally in the milling chamber and the milling efficiency improved. Nevertheless, there are some limitations, Where Increasing the amplitude this increases the load on the mill parts, which causes considerably wear in these parts, and reduces the mill operational reliability. The maximum acceleration carried out in vibration mills should not exceed 9 g [6].

One of the methods to develop the vibration mills design is to improve the milling process efficiency (productivity and milling accuracy) by constructing mills chamber with biharmonic vibrations [6-7].

Some researchers [6] in Germany developed mill with a cylindrical milling chamber, unbalanced vibratory motors fixed on both sides of the ends, which had the capability to control the speed and direction of rotation of the unbalanced blocks. The axes of unbalanced shafts rotation harmonize with the longitudinal axis of the milling chamber, which passes through the gravity center of the completely oscillatory system. In this improved design of the vibration mill, the milling chamber and the milling bodies execute biharmonic oscillation motion along complicated trajectories, under the effect of two vibratory motors, which are considerably different from the circular oscillations in traditionally vibration mills.

Milling bodies in harmonic oscillations mill have a circular path of (Fig.1.a). The path of these bodies in a biharmonic oscillations mill (Fig.1.b,s,d,e,f) depends on the direction of rotation, frequency, and mass of unbalanced blocks (Fig.1.b,s,d,e,f).

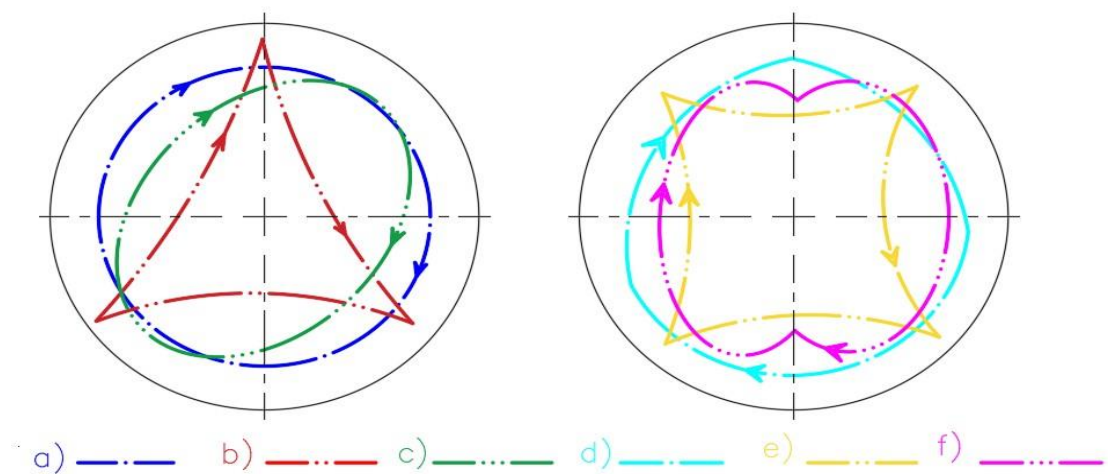


Fig. 1. a) The path of the milling bodies in the vibration mill chamber with harmonic vibrations. b,c,d,e,f) The path of the milling bodies in the vibration mill chamber with biharmonic vibrations.

Thus, the general analysis of existing designs of vibration mills made it possible to develop the vibration mills. one of the ways is improving the process of milling materials in vibration mills by create a new design with new motion pattern of milling bodies which would reduce stagnant zones in the Central part of the chamber, providing selective conditions for milling process. One of the available develops the vibration mills is a new design with polyharmonic vibrations of the milling chamber and vibration motor fixed with specific distance from the mass center of the oscillating system.

References

1. Balaz P. Mechanochemistry in nanoscience and minerals engineering. Berlin Heidelberg, Springer, 2008.
2. Rose H.E., Sullivan R.M. Vibration mills and vibration milling. London, Constable, 1961.
3. Beenken W., Gock E., Kurrer K.E. The outer mechanics of the eccentric vibration mill. Int. Journal of Minerals Processing. 1996, pp. 44–45.
4. Fadin Yu.M., Gavrilenko A.V., Arkatova K.G., Avdeev Yu.A., Bogdanov N.E. Kinematika sharovoy nagruzki v trubchatykh sharovykh mel'nitsakh s naklonnymi mezhkamernymi peregorodkami [Ball load kinematics in tubular ball mills with inclined baffles]. Journal of Engineering and Applied Sciences, 2014, vol. 9, pp. 2351-2357. (Rus)
5. Gavrunov A.Yu., Bogdanov N.E., Karagodina K.I., Shekhovtsova Yu.A. Vliyaniye rezhima protsessa izmel'cheniya v vibratsionnoy mel'nitse na udel'nyye energozatraty [Influence of the mode of the grinding process in a vibration mill on the specific energy consumption]. Vestnik BGTU im. V. G. Shukhova (Belgorod), 2017, pp. 98-103. (Rus)
6. Stejskal J. Schwingmuhle. DE Patent No. 3224117A1, 29 June 1982.
7. Artemenko K.I., Bogdanov N.E. Vibracionnaya mel'nica [Vibration mill]. RU Patent No. 2673215, 15 February 2017. (Rus)

РАЗРАБОТКА БАРАБАННОЙ ВИБРАЦИОННОЙ МЕЛЬНИЦЫ И МЕТОДИКА ЕЕ РАСЧЕТА

С. С. Альдавуд

Тамбовский государственный технический университет, Тамбов, Россия
*e-mail: eng.saif.suhail@gmail.com

Аннотация. Во многих отраслях тонко измельчаются миллионы тонн различных материалов. Повышение качества конечного продукта при минимальных энергозатратах - актуальная задача. Обычно вибрационные мельницы используются для производства порошков с конечным размером частиц менее 5 мкм. По конструкции привода и характеру колебаний камеры измельчения мельницы подразделяются на гармонические, бигармонические и полигармонические колебания. Зоны застоя внутри мельницы во время процесса измельчения являются общим недостатком этих мельниц, которые достигают 30% объема продукта. Это приводит к снижению эффективности фрезерования. Многие исследователи пытались разработать конструкции этих мельниц или создать новые, чтобы уменьшить застойные зоны, что увеличивает производительность и точность помола конечного продукта.

Ключевые слова: барабанной вибрационные мельницы, производительность мельницы, застойные зоны, гармонические колебания, бигармонические колебания, помольная камера.

Defects Arising from Plastic Deformation of Metal and Methods for their Detection

Y. S. Ivanchey

Tambov State Technical University, Tambov, Russia
e-mail: yuliya.ivanchey@yandex.ru

Abstract

The article deals with the problems of metal defects and solutions in the production of metal products, because some operations can be excluded or performed repeatedly.

Keywords: plastic deformations, defects, researches.

Introduction

The production of metal products is a complex technological cycle. Some operations can be excluded from the chain and performed repeatedly. During the processing process, the metal undergoes changes, and defects may appear on it. Next, we will analyze the main problems and ways to identify them.

When rejecting workpieces, it is quite common to encounter inclusions of foreign metal or non-metallic bodies, and the latter are of various sizes and shapes.

Plastic defects of metal products

The tear is local non-through breaks that are located across or at an angle to the direction of processing the material. Such defects are formed due to the disclosure of internal discontinuities of the material, as well as non-compliance with the standards established for the processing process.

A through gap differs from the previous type in that there are through discontinuities on the metal product. They are formed by deformation of a flat billet having an uneven thickness, or the cause of a through gap can be rolled foreign bodies.

The puncture looks like non-continuous single or group point depressions. They appear when using contaminated lubricating and cooling fluids, when small metal and foreign elements get on the workpiece. Another reason for the formation of a puncture can be protrusions and stuck particles on the rolls.

Dents are individual individual depressions of various sizes and shapes that have flat edges. Dents appear due to damage to the metal during production, transportation, storage.

The nub is an irregularly shaped depression. Usually, such a defect has sharp edges, since it appears when a metal product is struck.

Imprints are periodically repeated depressions, protrusions located throughout the metal product or on some of its sections. Imprints appear under the influence of irregularities on rolling and regular rolls.

The bully looks like a wide longitudinal depression with an uneven bottom and edges. The reason for its appearance is the sharp friction of the workpiece on the parts of the equipment with which the processing is carried out.

A scorch mark is a longitudinal narrow channel, the bottom of which can be rounded or flat. It is formed when the workpiece of a metal product is scratched by protrusions on the surface of the equipment.

A scratch is an irregularly shaped channel that has an arbitrary direction. It appears due to mechanical damage, for example, during storage, transportation of metal products.

Scuffing is a violation of the gloss on a single section of a metal product, as well as the accumulation of small multidirectional scratches. Such defects appear due to the friction of metal products with each other.

Sticking occurs as a result of sticking to the metal product of particles or a layer of metal from the tool.

Backfin is formed by pressing into the product of particles of the processed metal, burrs, protrusions and other defects that have appeared in the processing process.

Burnout is manifested in the form of dark, melted or oxidized spots on the metal product, which are formed if the temperature and heating time of the material were exceeded. Stratification looks like the separation of a layer of material at the ends, edges of a metal product, or a blank. The reason for the stratification is the same-initially there were defects inside the metal, such as looseness, inclusions, internal breaks, burnout.

The film is a bundle, usually in the form of a tongue running in the direction of processing and one edge connected to the base metal. Such stratification occurs if the metal initially had tears, cracks, bubbles, or when the material was heated, it was allowed to burn out, melt.

Scaliness is a plastic deformation caused by burnout or insufficient plasticity of the metal of the peripheral zone. In accordance with the name, such breaks on a metal product are most similar to scales or mesh. Ripple looks like a cluster of depressions that appeared on a metal product during rolling or melting.

A crumpled surface is a type of deformation in which folds, bends, and waves appear on a metal product, while not causing the metal to break.

A break is a strip across the rolling direction or at an angle to it. Kinks appear due to a sharp bend in the process of winding, unwinding rolls, or when shifting thin sheets.

Underpickling looks like spots, stripes that appeared on a metal product due to uneven etching.

Overdrawing is a local or general corrosion of the surface of the product, which manifests itself as point or contour depressions (formed, as well as nettrav, failure to comply with the mode of etching).

Contamination spots can take the form of streaks, drips, and streaks. They are left on the surface of the metal product technological emulsion, contaminated oil, fuel oil.

Corrosion spots can be light or dark, usually have a rough texture, as they appear under the influence of corrosion.

The colors of the run appear in the form of oxidized areas, that is, spots and stripes of various colors and shapes. Such spots are characterized by a smooth surface, as they appear in violation of the norms of heat treatment and etching.

Ringiness is characteristic only for round metal workpieces – repeated ring-shaped protrusions and depressions appear on their surface. The reason for this is plastic deformation, melting.

The traces of melting are somewhat similar to the ringiness, they look like repeated light and dark stripes. However, in this case, the strips go along the workpiece in any direction: they can be longitudinal, transverse or spiral. They are formed during melting.

Copper plating is manifested as redness of some areas of the surface of a metal product. Such spots are formed after contact separation of copper, which is associated with a violation of the modes of heat treatment and etching.

The Crescent shape of strips and ribbons is a deviation of the shape of a metal product from the calibration ruler. Such a defect is measured in millimeters per meter of the length of the semi-finished product.

Ovality is the deviation of the cross-section of the product from the shape of a circle. If C is the maximum, d is the minimum, and t is the average cross – section diameter, then the $C-d/m \times 100$ formula can be used to calculate the deviation from the ideal shape as a percentage.

Difference is the discrepancy between the wall thickness along the length of the pipe and the nominal thickness or the difference in the thickness of the workpiece over its area.

Thickness difference is the deviation of the thickness of a flat product along the length and width from the set parameters or the difference in the wall thickness along the length of the metal pipe.

Festooning is the appearance of protrusions along the edge of a metal product during deep stamping of sheets and tapes. The direction of the protrusions corresponds to the direction of the rolling axis.

Methods for detecting defects in metal products

There are several levels of investigation that are used for different depths and sizes of defects: submicroscopic examination, microanalysis and macroanalysis.

Under the defects of the crystal structure of metals, it is customary to understand deviations from the structure of an ideal, that is, defect-free, crystal.

1. *Submicroscopic examination.* Its purpose is to detect defects at the boundaries of crystals or grains. The fact is that due to uneven crystallization or insufficient nutrition of the embryos with a liquid solution, thin layers appear between the blocks of crystals. Or the reason may be hidden in the release of insoluble compounds and elements on the surface of the solid phase crystals.

2. *Microanalysis.* In such a study, microscopes with a magnification of more than 100 times are used to detect defects. It is microanalysis that is most often used in the search for casting defects. This method allows you to determine the grain

score, the presence and number of inclusions of non-metallic nature, copper, sulfur and phosphorus, and the structure of the metal.

The proportion of carbon and alloying elements contained in steel determines which solid phases are released during crystallization. Note that these stages have different strength, hardness and ductility. In corrosion-resistant steel grades, austenite, martensite or ice-borite phases are formed at different cooling temperatures.

Also, the main characteristics that determine the quality of the metal include the grain score. The fact is that when this indicator decreases, the ductility of the metal increases, but its strength decreases. However, alloying with carbide-forming agents or refractory materials allows you to achieve hardening of steel, while maintaining its original ductility. One of the main directions of microanalysis research is the determination of the proportion of harmful impurities and non-metallic inclusions (as a percentage). Most often, the role of harmful impurities is played by sulfur and phosphorus, because of which steel acquires such properties as red-breaking and cold-breaking.

In order for the metal to be used for the production of products, the proportion of these two elements must meet the established standards. Due to the control of non-metallic inclusions, it is possible to determine the content of oxides, sulfides, nitrides and other compounds in steel. Note that such impurities can affect the metal in both positive and negative ways.

3. *Macroanalysis*. This method of studying is a visual detection of defects in metal products, in other words, with its help, the surface is considered at an increase of up to 30 times. Such a study allows you to detect large defects in the surface or deep layers of the metal. It should be understood that macroscopic defects can be formed at any stage of production of a metal product-from smelting to storage. Most often, after detecting such deformations, the metal is rejected or returned for revision.

Conclusion

Thus, the article analyzes in detail the defects that occur during plastic deformation of metal, and gives the ways of their recovery.

References

1. Gubkin S.I. Plastic deformation of metals. Moscow, 1961, vol. 3, 376 p. (Rus)
2. Vafin R.K., Pokrovskii A.M. Basic parameters and criteria of fracture mechanics. Moscow, 1992, vol 1, 295 p. (Rus.)

ДЕФЕКТЫ, ВОЗНИКАЮЩИЕ ПРИ ПЛАСТИЧЕСКОЙ ДЕФОРМАЦИИ МЕТАЛЛА, И МЕТОДЫ ИХ ОБНАРУЖЕНИЯ

Ю. С. Иванчей

Тамбовский государственный еехнический университет, Тамбов, Россия
e-mail: yuliya.ivanchey@yandex.ru

Аннотация. В статье рассматриваются проблемы дефектов металла и пути их решения при производстве металлопродукции, поскольку некоторые операции могут быть исключены или выполнены повторно.

Ключевые слова: пластические деформации, дефекты, исследования.

Design of Heating Plates for Vulcanization Presses: Comparative Analysis of Approaches

Yu. A. Kardakova*, A. A. Rublev, F. I. Vshivkov
Tambov State Technical University, Tambov, Russia

*e-mail: Chikunyaschka@mail.ru

Abstract

The aim of this study is to compare the design of the heating plates of vulcanization presses for the manufacture of rubber products with integrated, differential and complex approaches. The relevance of the study is that the production of rubber-based products is steadily increasing. There is therefore a need to upgrade obsolete equipment and create new equipment that produces quality products at the lowest cost.

Keywords: design, heating plate, modeling, mold, vulcanization press.

Practice shows that the formation of a given temperature distribution on the surface of the slab is not always possible due to external heat transfer. In addition, the press plate is a complex system for heating molds for rubber products, the task of which is to create the required temperature field in the volume of the pressed product. To solve this problem, it is necessary to calculate the processes of heat propagation in the «plate - mold – product» system [1]. It is important to note that this problem should be considered as a three-dimensional non-stationary one and take into account the nonlinear dependences of the thermophysical properties of materials on the heating temperature.

1. *Integral approach:* obtaining a uniform temperature field on the working surface of the heating plates of the press, and the range of manufactured products and the geometry of the molds are not taken into account.

Obtaining a uniform field on the entire working surface of the slab has a significant advantage: the slabs designed in this way are universal and suitable for the production of a wide range of industrial rubber goods. At the same time, operating experience and numerical calculations of the plates show that such an approach to the design of heating plates sometimes turns out to be suboptimal for the following reasons:

- the real temperature spread on the working surface of the heating plate in the best cases is about 10 ° C, often exceeding 15°C;
- the principle of energy saving is violated, since it is necessary to increase the total power of the stove to compensate for the heat losses of inductors located near the edges of the working surface;
- molds of rubber products during the vulcanization process occupy an area much smaller than the entire working surface of the plate, so there is no point in heating this entire area.

Such an approach is advisable to use in the manufacture of products having dimensions commensurate with the press plates, as well as in the case of using molds of a simple configuration for the manufacture of simple products.

2. *Differential approach*: using zone heating to the design of heating plates does not require a uniform temperature field over the entire working surface.

In the case of vulcanization of rubber products, the dimensions of the pressed parts and the molds themselves can be much smaller than the working surface of the plates; therefore, it is necessary to minimize temperature differences within certain zones corresponding to the required size ranges of rubber products. For optimal performance of the vulcanization process, it is sufficient to obtain a uniform field only in the areas covered by the molds.

Conventionally, the surface of the slab can be divided into rectangular areas, inside which to form zones of a uniform temperature field corresponding to the dimensions of the molds. The surface outside the working areas may heat up unevenly. To reduce heat losses, the edges of the slab, if possible, should be made “cold”, because as a result, the required power of the inductors may be reduced.

When using the differential approach for the design of induction heating plates, the formulation of the problem [2] will not change, but will be supplemented. Based on the analysis of the order for manufactured rubber products, it is required to zone the surface of the plate into areas that best correspond to the planned products, and ensure temperature uniformity within the working areas. Considering the above, the following conclusions can be drawn: (1) the use of a differential approach to design provides a more uniform temperature field than with an integral approach; (2) the differential approach ensures the achievement of energy savings: a decrease in the total power of the stove and heat losses to the ambient air.

Note that for any press, you can prepare a set of typical heating plates for a known nomenclature and range of standard sizes of manufactured rubber products. This will allow you to quickly work with the consumer and have an advantage over other manufacturers due to the ability to use heating plates of the optimal design for the production of specific rubber products.

With the differential approach, the problem of calculating and designing induction heating plates is solved for the surface of the working areas. This adjustment is due to the analysis of the order for the rubber products intended for production, taking into account the versatility of the designed heating plates within a given range of products. The differential approach is advisable to use when designing slabs for the production of a known range of products.

3. *Integrated method*: design of heating plates, taking into account the applied molds and manufactured products.

In this case, the design of plates is carried out using non-stationary thermal finite element analysis of the system «plate - mold – product». The goal is to obtain a given temperature field in the volume of the product by changing the design parameters of the plates.

The complex method, more fully taking into account the properties of the system “plate - mold – product”, allows you to more accurately assess the suitability of the designed plate and the optimality of its design [3].

It should be noted that information on temperature changes during the vulcanization process is of exceptional importance in the production of large tires and industrial rubber goods. For this reason, the use of an integrated approach to the design of equipment for the production of such products is of particular importance.

The quality of products is determined by the degree of conformity of the temperature field in the volume of the product to the requirements of the technological regulations, first of all, by the degree of unevenness. In general, in addition to the heating system, the temperature field of the product is influenced by the parameters of the mold and its location on the surface of the plate.

In view of the above, there are three general approaches to the design of heating plates: (1) an integral approach that allows you to obtain the temperature field of a given profile on the working surface of the slab; (2) a differential approach, which is focused on obtaining the temperature field of the working surface of the plate, taking into account the geometry and properties of the products manufactured on the press; (3) an integrated method consisting in the design of plates based on modeling the process of joint heating of plates, molds and vulcanizable products.

References

1. Karpushkin S.V, Karpov S.V. Modelirovaniye protsessa nagreva press-formy dlya proizvodstva rezinotekh-nicheskikh izdeliy na induktsionnom vulkanizatsionnom presse [Determination of efficiency of press molds for industrial rubber product manufacture and system for their heating in vulcanizing press Chemical and Petroleum Engineering]. Fundamental'nyye i prikladnyye problemy tekhniki i tekhnologii, 2012, 48(3-4), pp. 153-162. (Rus)

2. Malygin Ye.N., Krasnyanskiy M.N, Mokrozub V.G. Design optimization of heating plates for hydraulic presses. MATEC Web of Conferences, 2017, 129(01008). (Rus)

3. Karpushkin, S.V, Karpov S.V, Glebov A.O. Otsenka effektivnosti nagrevatel'nykh platin pressov, ispol'zuyemykh pri proizvodstve rezinotekhnicheskikh izdeliy [Estimating the efficiency of the heating plates of presses used in the fabrication of rubber-mechanical products]. Chemical and Petroleum Engineering, 2015, 51(5-6), pp. 388-395. (Rus)

ПРОЕКТИРОВАНИЕ НАГРЕВАТЕЛЬНЫХ ПЛИТ ВУЛКАНИЗАЦИОННЫХ ПРЕССОВ: СРАВНИТЕЛЬНЫЙ АНАЛИЗ ПОДХОДОВ

Ю. А. Кардакова*, А. А. Рублев, Ф. И. Вшивков

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: Chikunyaschka@mail.ru

Аннотация. На основе анализа существующих требований к нагревательным плитам вулканизационных прессов для изготовления резинотехнических изделий предложены интегральный, дифференциальный и комплексный подходы к проектированию плит. Основные положения и особенности предлагаемых способов рассмотрены на примере проектирования нагревательной плиты для производства резиновых прокладок. Актуальность исследования заключается в том, что производство резинотехнических изделий имеет устойчивую тенденцию к увеличению. В связи с этим возникает необходимость модернизации устаревшего и создания нового оборудования, выпускающего качественную продукцию с наименьшими издержками производства.

Ключевые слова: вулканизационный пресс, моделирование, нагревательная плита, пресс-форма, проектирование.

Design and Research of Massing Operations of the Stainless Steel Housing Part

A. A. Kazankov

Tambov State Technical University, Tambov, Russia
e-mail: kazankov.alex68@mail.ru

Abstract

The article considers the wrapping of stainless material under the influence of a cooling lubricant type based on the results of the tests. The analysis and selection of the best material processing were made taking into account the load on machine equipment, as well as the cutter and its components.

Keywords: stainless steel, cooling lubricants, heating, wear and tear.

Introduction

At this point in time, it is not possible to imagine life without stainless steel. The development of such an alloy made it possible to make a qualitative breakthrough not only in metallurgy, but also in many other areas. Stainless steels differ from the classic in that they contain chrome in addition to iron and carbon. It is the addition of chromium that gives the alloy anticorrosive properties. The physical properties of the finished steel depend on the amount and type of impurity. It should be noted that some stainless-steel grades are corrosive after a long service life. This is due to the composition, that is, the addition of one or another metal. Such an alloy has other advantages which are offset by susceptibility to oxidation.

Stainless steels have high strength and reliability, high-quality steel retains its properties for more than 10 years. Resistance to an aggressive external environment is one of the main qualities of steel. Such steel is practically not subject to changes due to environmental conditions. This allows long-term preservation of the product performance.

Also, stainless steel products are resistant to high temperatures, even with an open fire, steel retains its properties. The choice of stainless steel with certain physical properties depends on the purpose of its use. Today, the variety of components for stainless steel production allows you to create a material with the necessary characteristics.

The chemical composition of stainless steel depends on the type and grade of the alloy. The main features that stainless steel characterizes are the presence of at least 10.5% chromium and low carbon content in the composition. Carbon is very important in the manufacture of steel, since it gives the necessary strength, the percentage of which in an anticorrosive alloy should not exceed 1.2%. Also, Titanium, Phosphorus, Molybdenum, Sulfur, Nickel and Niobium can be included in the stainless-steel composition. Depending on the chemical composition, stainless steel is divided into several types. The most widely used is stainless steel of the A2 group.

The A2 group contains 10% nickel, 18% chromium and 0.05% carbon. Most are occupied by the base, namely iron with associated components. The steels of this group include 0.05% carbon, 2% molybdenum, 12% nickel and 17% chromium. Due to the presence of molybdenum in the composition, the alloy is resistant to acid, so the name “acid-resistant” is often applied to it.

Corrosion-resistant steels have been used only in high-tech production in such areas as aircraft engineering, nuclear power, petrochemical production and mechanical engineering. Today, stainless steels are widely used in various areas of our lives. One of the main areas of use of stainless alloys is mechanical engineering. Stainless steel is massively used for the production of cars, industrial machines and various units. Ferrite and austenitic types are usually used.

The stainless-steel treatment makes it possible to provide the products of this material with the necessary properties and qualities, as well as to improve their appearance. To do this, different technologies can be used. Competent selection of optimal methods of stainless-steel processing allows you to manufacture different parts in accordance with the requirements of customers.

The stainless-steel process includes four main steps. At the first stage, stainless-steel is cut. Steel sheets need to be cut into blanks from which the finished product will be assembled. To do this, manual and automated processing methods are used. Modern technologies allow you to achieve high accuracy and minimal scrap in the process of manufacturing parts. At the second stage, the workpiece is fixed in processing machines. At the same time, it is important to prevent the appearance of distortions. Machining of stainless steel on a lathe allows producing articles of complex shape.

The purpose of the work is to develop and research the shaping operations of a stainless-steel part.

Objects and methods of research

The study used stainless steel sheets and was machined on a lathe. Processing was carried out by hard-alloy cutters of T15K6. To reduce the negative properties of stainless steel, the treatment was carried out at increased speeds, and the thickness of the removable layer was minimal. The lubricant used was oleic acid and sulfofresol in a ratio of 1:4. Lubricant is supplied under pressure from cutter.

Results and discussion

The results were evaluated by thermometer and visual inspection of the instrument. The following options were compared: (1) tool wear; and (2) preform heating.

The preform, when processed using a frequently used cooling lubricants with an oil content of 3-4%, received maximum heat during processing and an inclination was formed on the preform. When oleic acid and sulfofresol with an oil content of 8-9% are used as SOG, it turned out to reduce the heating of the workpiece and avoid gluing, as well as preserve the cutter and reduce the load on the machine itself.

Conclusion

In the work, the indicators of the change in the temperature of stainless steel using special cooling lubricants were considered. This made it possible to reduce the load on the machine and the cutting tool, as well as to reduce the heating temperature of the workpiece. This option was the best result in processing, but this processing option requires a lot of consumption and processing costs.

References

1. Artinger I. Instrumental'nye stali i ih termicheskaya obrabotka [Instrumental steels and their thermal treatment]. Metallurgiya, 1982, 18 p. (Rus)
2. Anuryev V.I. Spravochnik konstruktora-mashinostroitel'ya [Handbook of the designer-machine engineer]. M.: Mashinostroyeniye, 2001, 3(12), pp. 18-21. (Rus)
3. Lozhkina E.A., Lozhkin V.S., Mali V.I., Esikov M.A. Obrabotka metallov (tekhnologii, oborudovanie, instrument) [Metal processing (technology, equipment, tools)]. Novosibirsk, 2016, No. 3, pp. 31-42. (Rus)
4. Makarov A.V., Gavrilov N.V., SamoiloVA G.V., Mamaev A.S., Osintseva A.L., Savrai R.A. Obrabotka metallov (tekhnologii, oborudovanie, instrument) [Metal processing (technology, equipment, tools)]. Novosibirsk, 2017, No. 2, pp. 5. (Rus)

РАЗРАБОТКА И ИССЛЕДОВАНИЕ ОПЕРАЦИЙ МАССИРОВАНИЯ КОРПУСНОЙ ЧАСТИ ИЗ НЕРЖАВЕЮЩЕЙ СТАЛИ

А. А. Казанков

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: kazankov.alex68@mail.ru

Аннотация. Рассмотрена обработка нержавеющей стали под влиянием разновидности СОЖ, по итогам испытаний произведен анализ и выбор лучшего результата обработки материала, с учетом нагрузки на станочное оборудование, а также резец и его составляющие.

Ключевые слова: нержавеющая сталь, СОЖ, нагрев, износ.

Improving Energy-Saving Characteristics of Liquid-Ring Vacuum Pumps and the Effect of Heat and Mass Transfer Processes on its Working Characteristics

M. A. Mahmood*, Yu. V. Rodionov

Tambov State Technical University, Tambov, Russia

**e-mail: Mr.mohammedali1993@gmail.com*

Abstract

The relevance of using vacuum technology based on liquid-ring vacuum pumps and its advantages in various applications and industries have been discussed. The main directions of increasing energy-saving and the influence of heat and mass transfer processes on the working characteristics of liquid-ring vacuum pumps have been reviewed.

Keywords: energy-saving, liquid-ring vacuum pump, heat and mass transfer process, working characteristic.

A vacuum can be defined simply as a place or area devoid of matter. An exact example that can be explained the phenomenon of creating a vacuum is the vacuum of refrigeration systems/devices before charging the system by the refrigerant to remove the humidity from the system using the well-known vacuum pumps. The technology of vacuum applies to the technological processes using the required energy mechanical equipment and machines for achieving a vacuum.

The most common applications of vacuum technology are chemical, pharmaceutical processes, cooling, air conditioning, and heating systems, electronic devices, solar photovoltaic, vacuum drying, metallurgical, evaporation and crystallization, vacuum filtration, construction, radio engineering, and agriculture.

It is preferable to use vacuum technology for drying purposes instead of thermal drying because it is characterized by fast work, efficient use of energy, and it preserves the quality of the products and beneficial ingredients such as fruits and coffee. This technology is suitable for use in drying food, medicines, chemical materials, and others. Excessive use of heat causes several damages such as reduces the equipment life cycle, reduces product quality, and increases energy costs [1].

The technology of vacuum is widely used for drying plant materials using liquid ring vacuum pumps (LRVPs) and available in single and dual stage designs. LRVP are positive displacement rotary machines that can work as a compressor and a pump. Figure 1 shows the schematic diagram of the operation of the LRVP. Usually, water or oil is used as a working fluid in systems which operation is based on these types of pumps. The main advantages of these pumps include high reliability, durability, simplicity of design, high productivity, low cost, ideal for maintaining a low vacuum, achieved vacuum stability, compliance with

environmental requirements. Appropriate selection of the working fluid allows the gas to be pumped out without contaminating it with liquid vapors, and to reduce the risk of ignition of flammable gases [2].

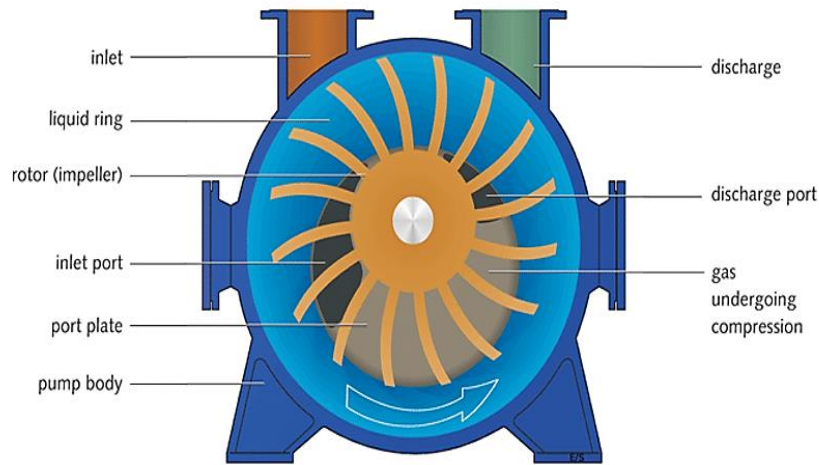


Fig.1. Schematic diagram of the operation of a liquid ring vacuum pump

However, due to the great technological development of the industry and the increase in population and quantity of production, the issue of energy saving and reduction of energy costs has become an urgent matter. Failing to keep pace with technological development and the lack of the automatic control systems and modern devices in technological processes leads to a decrease in the efficiency of the use of the equipment and makes it impossible to control process indicators and identify faults in the system. Therefore, LRP have several design defects, which lead to a deterioration in their technical characteristics [3].

The LRVPs have the ability to regulate the outlet or exhaust gas compression process because in these pumps the liquid ring works as a hydraulic piston where it comes into contact with the gas that is pumped out. This process causes additional compression to the gas because of the heat and mass transfer processes that occur in conjunction with the compression process. This process is accompanied by a change in the temperatures and flow rates of the liquid and the gas that is pumped out, and about 90% of the energy is consumed to run-over the force of friction between the walls of the pump housing and the rotating ring and, then caused a generation of heat [4].

At present, great attention is being given to the use of vacuum on a large scale depending on liquid-ring vacuum pumps to intensify the heat and mass transfer processes more effectively.

Currently, one of the priority problems is providing the population with high quality and safe food with low energy consumption. As it's known energy and food are very important resources in human life. In this modern world, researchers and experts are focused on looking for ways to improve energy savings in life support systems.

Based on all of the aforementioned above, so enhancement the efficiency of liquid-ring vacuum pumps, reducing energy costs, development, and improvement of a calculating methodology and new designs of LRVPs for the heat and mass transfer processes is an urgent task, because of its substantial impact on its working characteristics, and this work is dedicated to solving it.

It is concluded from all the above, that searching for modern technical methods to improve energy savings for liquid-ring vacuum pumps is an important matter that must be solved. The heat and mass transfer processes have a major impact on the energy efficiency of these pumps, as the heat increases energy consumption. This heat can be used and exploited to dissipate by using the necessary machinery as well as scientific methods to solve this problem.

References

1. Karlsen-Davies N.D., Aggidis G.A. Regenerative liquid ring pumps review and advances on design and performance. *Applied Energy*, 2016, vol. 164, pp. 815 – 825.

2. Rodionov Y.V., Selivanov Y.T., Nikitin D.V., Sychev M.V., Kombarova P.V. Novel construction of liquid ring vacuum pumps. *Chemical and Petroleum Engineering*, 2019, vol. 55, No. 5-6, pp. 473-479.

3. Rodionov Y.V., Nikitin D.V., Mahmood M.A., Kombarova P.V. Goryushin R.S. [Design ways and principles of automation for improving the efficiency of liquid-ring vacuum pumps]. *Spornik Statia Mishdonarodni Nawjna Asliadavskva Konorsa "Scientific achievements of higher school 2020"*. Petrozavodsk, 2020, pp. 99 – 105. (Rus)

4. Frolov E.S., Minaichev E.V., Aleksandrova A.T. *Vacuum Technology*. M.: Mashinostroenie, 1992. (Rus)

ПОВЫШЕНИЕ ЭНЕРГОСБЕРЕЖЕНИЯ ЖИДКОСТНО-КОЛЬЦЕВЫХ ВАКУУМ-НАСОСОВ И ВЛИЯНИЕ ПРОЦЕССОВ ТЕПЛО- И МАССООБМЕНА НА ИХ РАБОЧИЕ ХАРАКТЕРИСТИКИ

М. А. Махмуд*, Ю. В. Родионов

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: *Mr.mohammedali1993@gmail.com*

Аннотация. Обсуждена актуальность использования вакуумной техники на основе жидкостно-кольцевых вакуум-насосов и их преимущества в различных применениях и отраслях промышленности. Рассмотрены основные направления повышения энергосбережения и влияния процессов тепло- и массопереноса на рабочие характеристики жидкостно-кольцевых вакуум-насосов.

Ключевые слова: энергосбережение, жидкостно-кольцевой вакуум-насос, процесс тепломассообмена, рабочая характеристика.

A Decision Support System for Process Maintenance of Horizontal Boring Machines

V. A. Parskov

Tambov State Technical University, Tambov, Russia
e-mail: parskov@list.ru

Abstract

The paper discusses the problems of decision support during the process maintenance of horizontal boring machines before and during process operations ensuring high quality of part manufacturing, increase of interchangeable productivity by 15-17% and reduced downtime due to technical reasons up to 10%.

Keywords: support system; decision-making; process maintenance; horizontal boring machine 2620A.

Introduction

One common group of equipment in the metalworking industry is boring machines. This group of machines is widely used in both individual and large-scale manufacturing. A distinctive feature, according to which boring machines are separated into a separate group, is the possibility of performing metal cutting operations in hard-to-reach places of processed parts.

The main distinguishing feature of the horizontal boring is the horizontal arrangement of the spindle. This type of machine somewhat resembles a conventional turning-screw machine. But there are several key differences in the horizontal boring machine. Firstly, there is no hind head. Instead of the tailstock, a movable lunette is installed. Secondly, the faceplate equipped with the spindle is able to shift the cutter relative to the axis of rotation, which is uncharacteristic of the lathe. Third, there is a table on which the part [1] can be fixed.

It should be noted that no perfect machine equipment is produced; operations for its adjustment and control of process parameters are inevitable. This is due both to wear of working elements and to the difference in the technology of manufacturing parts [2].

Development of a decision support system

The study considers the issues of development of information-logic model (ILM) for decision-making support during the process maintenance and adjustment of horizontal boring machines before and during process operations.

In general, a decision support LMI is a combination of data sets and relationships between them in the form of rules. A separate production rule consisting of elementary sentences connected by logical links contained in the knowledge base consists of two parts: conditional, “and”, “or”, and a conclusion including one or more sentences expressing either some fact or an indication of a certain action to be executed.

Thus, the ILM can be represented by the following tuple

$$M = (d_1, \dots, d_i, \dots, d_N, p_1, \dots, p_j, \dots, p_S),$$

where: M is the operator of ILM;

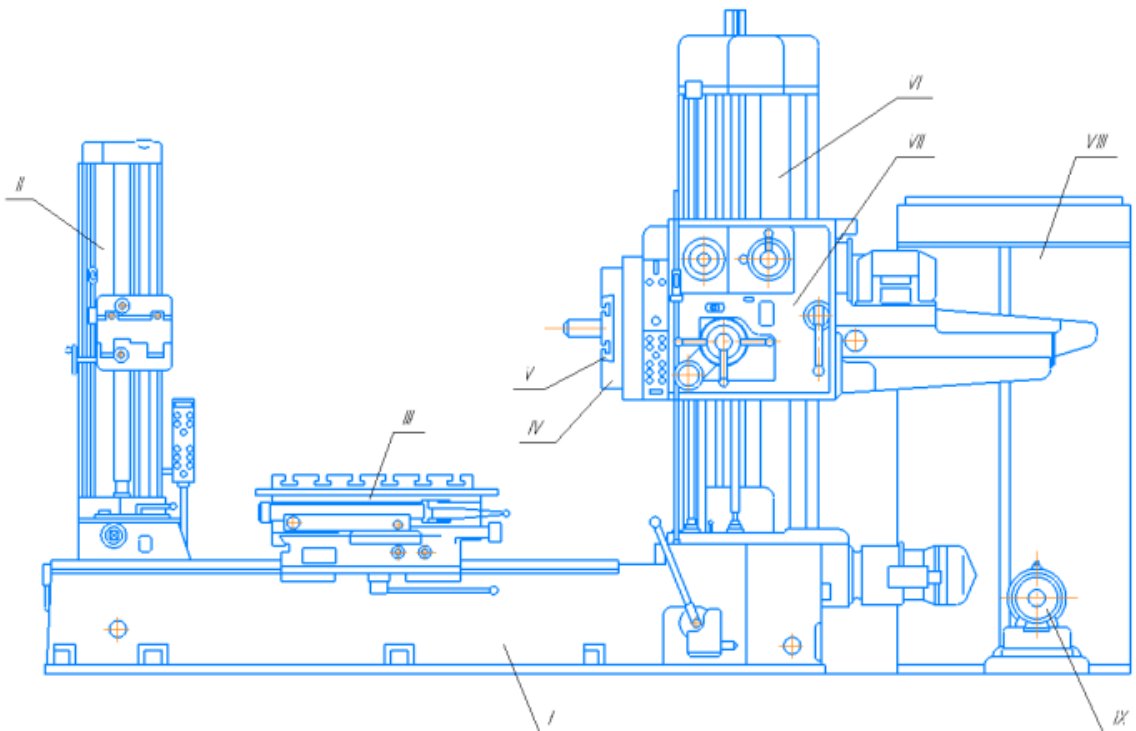
d_1, \dots, d_N area plurality of HLR data;

p_1, \dots, p_5 are a plurality of rules.

In turn, the rules included in the model are built by the type: if... “conditions are met”, then... “isimplemented”.

Consider the rules on the basis of which decisions should be made on the formation of a list of technological maintenance activities for horizontal boring machines before and during technological operations.

The following is an example of the rules for horizontal boring machines using the example of 2620A (Fig. 1).



*Fig. 1. The main components of the horizontal boring of the 2620A model:
I - frame; II - rear strut; III - table; IV - faceplate; V - radial caliper; VI - front strut; VII - spindle head; VIII – cabinet with electrical equipment; IX - electric machine unit*

Rules for selection of measures in case of elimination of scrap during operation on horizontal boring machine 2620A

- if “failure when boring holes occurs” = “part of the hole surface remains untreated”, then “workpiece dimensions are incorrect” = “inspect the workpiece and check dimensions”;

- if “failure when boring holes occurs” = “part of the hole surface remains untreated”, then “incorrect installation of the workpiece” = “check the workpiece for correctness of installation”;

- if “failure when boring holes occurs” = “the dimensions of the bored surface are incorrect, i.e, the diameter is less than the desired”, then “setting of the cutter to the cutting depth is inaccurate” = “check the cutting depth and re-bore to the desired diameter”;

- if “failure when boring holes occurs” = “bored surface is oval”, then “spindle swing” = “replacement of bearings and necks”;
- if “failure when boring holes occurs” = “the treated surface is unclean”, then “large feed of the cutter” = “check the correctness of the choice of supply, perform finishing” [3];

Rules for selection of measures in case of spindle failure on horizontal boring machine 2620A

- if “spindle failure occurs” = “increased radial run-out”, then “working shaft bending” = “spindle shaft adjustment”;
- if “spindle failure occurs” = “increased radial run-out”, then “insufficient tightening of bearings, clearances” = “adjustment of bearings, tightening of nut”;
- if “spindle failure occurs” = “upper bearing noise”, then “bearing diagnostics” = “dirt bearing flushing with lubrication replacement or bearing replacement”.

Rules of measures in case of various malfunctions

- if “machine failure occurs” = “machine does not start”, then “power supply voltage drop or absence” = “check presence and value of voltage in the network”;
- if “machine failure occurs” = “arbitrary motor shutdown during operation”, then “insufficient belt tension” = “increase belt tension”;
- if “machine failure occurs” = “the oil indicator disk does not rotate”, then “no oil in the system” = “fill the oil”;
- if “machine failure occurs” = “cooling pump does not work”, then “lack of liquid” = “add liquid”;
- if “machine failure occurs” = “machine vibrates”, then “wear of caliper guide joint” = “tighten pressure bars and wedges”;
- if “machine failure occurs” = “caliper feed force is less than specified in the manual”, then “G-load device spring is not tightened enough” = “tighten the spring”.

Conclusion

The research has resulted in the development of an information and logic model to support decision-making in the maintenance of horizontal boring equipment. The testing was performed during maintenance of horizontal boring machines and contributed to an increase in production efficiency: high quality of the finished part, reduction of scrap to 5%; 15-17% increase in interchangeable productivity; reduced downtime due to technical reasons up to 10%.

References

1. Nemtinov V.A., Zazulya A.N., Kapustin V.P., Nemtinova Yu.V. Analysis of Decision-Making Options in Complex Technical System Design. Journal of Physics: Conference Series, 2019, vol. 1278(1), pp. 012018.
2. Egorov S., Nemtinov V., Egorov E., Nemtinova Y. Development of an online application for determination of thermo-physical properties of substances. Journal of Physics: Conference Series, 2019, pp. 012016.
3. Nemtinov V., Sergeev V., Nemtinova Y. Design development of technological complex for friction welding of thin-walled products made of armlen. IOP Conference Series: Materials Science and Engineering. International Conference on Modern Trends in Manufacturing Technologies and Equipment, 2019, pp. 033072.

**СИСТЕМА ПОДДЕРЖКИ ПРИНЯТИЯ РЕШЕНИЙ
ПРИ ПРОВЕДЕНИИ ТЕХНОЛОГИЧЕСКОГО ОБСЛУЖИВАНИЯ
ГОРИЗОНТАЛЬНО-РАСТОЧНЫХ СТАНКОВ**

В. А. Парсков

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: parskov@list.ru

Аннотация. Рассмотрены вопросы поддержки принятия решений при проведении технологического обслуживания горизонтально-расточных станков перед началом и в ходе выполнения технологических операций, обеспечивающих высокое качество изготовления детали, увеличению сменной производительности на 15 – 17 %; сокращению простоев по техническим причинам до 10 %.

Ключевые слова: система поддержки; принятие решений; технологического обслуживания; горизонтально-расточной станок 2620А.

Modernization of SP-49

A. A. Rublev*, Yu. A. Kardakova

Tambov State Technical University, Tambov, Russia

*e-mail: lescha.rub1993@mail.ru

Abstract

This article proposes the modernization of the SP-49 pile driver. The field of research is mechanical engineering. The purpose of the modernization is to save financial resources and extend the service life of the SP-49 unit. The retrofit consists of lengthening the headframe mast, making it possible to use the rig with longer piles and more powerful diesel hammers than before. The solution to this problem is to create an additional mast section. During the research, a 3D model of the section was developed using CAD systems.

Keywords: Modernization, relevance, section, segment, welding.

Introduction

Currently, more and more new types of production and new enterprises appear in Russia. During the construction of all these facilities, it is impossible to do without heavy equipment. Sometimes it is economically expedient to modernize existing units instead of using equipment of a different class. We will consider an example of such modernization on the Russian SP-49 pile driver - this machine has proven itself in reliability, flexibility of use, price-performance ratio and high maintainability due to the prevalence of spare parts. In the realities of modern production, it is important to design using CAD systems. With their help, you can both design a 3D model of a product, and calculate loads, welds, and simulate a stress test of a product.

Justification of the modernization of SP-49

For the construction of multi-storey buildings and factories, a pile foundation is required, because the weight of such buildings is several hundred tons. The length of the piles depends on the characteristics of the soil (the denser, the shorter the pile with equal load). For the SP-49 pile driver, the nominal length of the submerged pile is 12 meters. In practice, there are situations when the project requires piles with a length of 13 meters, and the use of an installation different from SP-49 is impractical. Or, the design load is very high, and then it is necessary to immerse a 12-meter-long pile into hard ground, which is not possible with the length of the pile driver. The maximum length of the submerged pile for SP-49 is 12 meters, the height of the pile mast is 18.5 meters, and the height of the diesel hammer assembly is 5.28 meters. Considering that in order to avoid an accident, it is always necessary to have a supply of cable up to a crotch of 20-40 centimeters, then we have that in order to catch the pile in the head the crew has a small window - 70-80 centimeters. The most running diesel hammer for the SP-49 at the moment is the SP6-VM diesel hammer, with a shock mass of 2.5 tons and a kinetic impact energy of 36.7 kJ. We are considering the case when this energy is not enough for effective work. In such cases, SP6 - VM is changed to DD-25, made in China, with a mass of the striking part of 2.5 tons and an impact energy of 57.5 kJ.

Structurally, the DD-25 hammer differs from the SP6-VM in a large piston volume and a height increased by 70 centimeters. It is these 70-80 centimeters that turn out to be superfluous. The proposed modernization assumes an increase in the length of the SP-49 mast by 1 meter by adding an optional additional mast segment. The practical value lies in saving a lot of money, because the modernization offered by us costs an insignificant amount in relation to the purchase price of a new expensive unit, the price of which can exceed 10,000,000 rubles. The relevance of modernization is to maintain production productivity. The existing method of driving butt piles reduces productivity by half, since each pile to be driven is required to be welded, which takes time.

Design modification

The additional section is a welded structure made of a channel according to the standard GOST 20s, for installation of which metal plates GOST 400462 are welded to the mast on both sides. The section is mounted on the mast by means of a bolted connection. This modification was developed in the Autodesk Inventor environment, but it can be designed in other CAD systems that have the necessary tools. Below are the pictures showing the developed section.

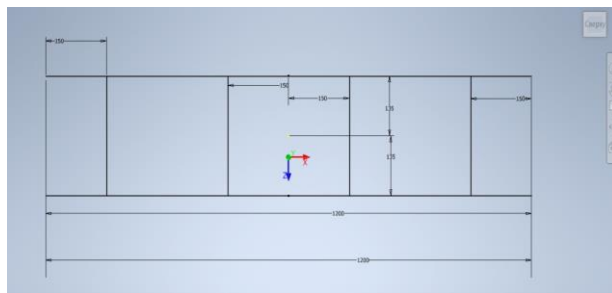


Fig. 1. 2D section sketch

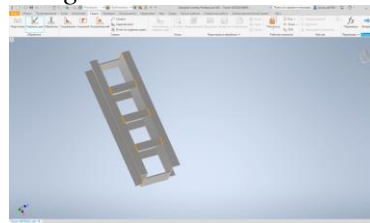


Fig. 2. 3D view of the structure, welds are marked in orange

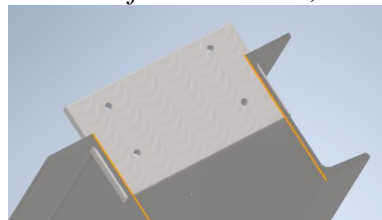


Fig. 3. Bolted connection for bolts GOST M24

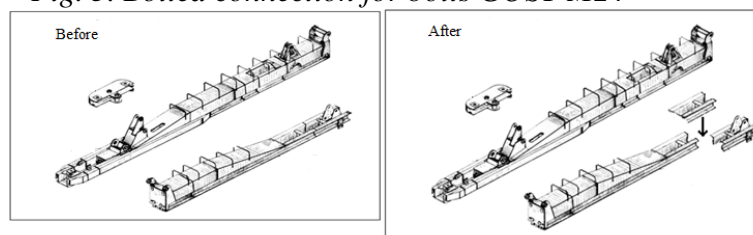


Fig. 4. Mast SP-49 before and after modernization

Description of the weld model

The way these elements are specified in the design scheme directly affects the results. Weld seams are often replaced with absolutely rigid bodies connecting parts, or simply by combining movements. In both the first and second cases, the real stiffness of the weld is not taken into account. The most accurate way would be to simulate welding using solid or flat finite elements, however, in the case of non-standard nodes; this can cause certain difficulties in generating the finite element mesh. In our particular case, the design itself does not allow us to refuse a large number of welds. The seams in the structure are T-shaped.

The MathCAD system has the ability to calculate the welding mode depending on the selected electrode cross-section, the design penetration depth, the type and polarity of the current and the type of seam and has four design parameters - the value of the welding current, welding speed, seam width, bead height. The rest of the parameters of the welding mode are dependent and can be determined by solving the system of equations. The initial assignment of the welding speed is made from the condition of the optimal value of the product of the welding current and the welding speed, which is a condition for the satisfactory formation of the weld. The values of the arc voltage, electrode melting coefficient, deposition coefficient, coefficient of influence of the type and polarity of current, penetration coefficient and heat input are determined as functions of two variables: electrode diameter and welding current, so that during intermediate calculations the values of these parameters remain correct. Coefficients of melting and surfacing are determined by digitizing a diagram that simulates a function of two arguments (electrode diameter and welding current). The program for calculating the melting coefficient was prepared in preparation for the student scientific conference of NIRS by approximating and interpolating the diagram. The system of equations includes the well-known equations:

$$V = \frac{\alpha(d,I) \times I \times 10^3}{(F_H(h) + 0,73 \times b \times g) \times p};$$
$$h = 0,76 \left(\frac{U(d,I) \times I \times \eta \times 0,01 \times 3600}{V \times \Psi(d,I)} \right)^{0,5};$$
$$b = h \times \Psi(d,I);$$
$$\Psi = (d,I) = 2,2$$

where h , V , η , are the depth of penetration, welding speed and heat utilization rate, respectively, in submerged-arc welding ($\eta = 0.85$); α , $F_H(h)$, b , g is coefficient and area of deposition, respectively, without taking into account the area of the bead, width and height of weld reinforcement. The last equation allows you to set the required penetration shape factor in accordance with the design specified dimensions.

Bolt model

The most common bolt models are a spatial bar and an elastic connection between two nodes. In this setting, it is possible to evaluate the forces in the bolts and compare their deviation from the allowable ones. However, this simplification does not take into account various factors of the local scale: crushing of the plates

by the bolt body, squeezing the part under the washer, etc. To solve this problem, one can use volumetric elements, but this will significantly complicate the scheme and increase the calculation time. Preliminarily, it is supposed to use critical bolts M 24 250 mm long. After the nut has been extended, place the locknut and the cotter pin on the bolt in the groove of the bolt body, since the loss of the nut and locknuts is unacceptable due to the danger to the crew.

Effort and stress assessment

When simulating welds by combining displacements, the assessment of their strength becomes impossible. Although it is in them that plastic deformations often develop. If welded seams are defined by volumetric elements, then to assess the bearing capacity of the seam, a large amount of data will have to be analyzed - the values of normal and shear stresses in each finite element. Accounting for constructive nonlinearity and local effects

With a large number of contacting surfaces, modeling contacts becomes a complex problem, for the solution of which it is necessary to define special finite elements that work only in compression. This is also true for the contact areas of the washer and plate in the bolted joint.

Conclusion

Thus, this thesis outlines the economic feasibility of modernizing pile drivers. The designers of the SP-49 have incorporated a great potential for modernization in their installation, and in addition to this modernization, several more can be introduced. Each of them will increase the productivity of a seemingly outdated machine. Separately, it should be noted that modern computing tools and software make the designer's work comfortable and productive, the use of CAD is necessary here.

References

1. Kvashnin V. D., Rybin V. S. Raschet rezhimov svarki s ispol'zovaniyem sovremennogo programmnogo obespecheniya [Calculation of welding modes using modern software]. Chelyabinsk: Yuzhno-Ural'skiy gosudarstvennyy universitet, pp. 42-45. (Rus)
2. Instruktsiya po ekspluatatsii svayeboynogo kopra SP-49D [Operating instructions for the SP-49D pile driver]. Sterlitamakskiy Zavod Stroitel'nykh mashin, pp. 4-52. (Rus)

МОДЕРНИЗАЦИЯ КОПРА СП-49

А. А. Рублёв*, Ю. А. Кардакова

Тамбовский государственный технический университет, Тамбов, Россия
**e-mail: lescha.rub1993@mail.ru*

Аннотация. В данной статье предложена модернизация сваебойного копра СП-49, область исследования - машиностроение. Целью модернизации является экономия финансовых средств и продление службы установки СП-49. Модернизация заключается в увеличении длины мачты копра, что дает возможность применять установку с более длинными сваями и более мощными дизельными молотами, чем раньше. Решение данной задачи заключается в создании дополнительной секции мачты. В ходе исследования была разработана 3D-модель секции при помощи САПР-систем.

Ключевые слова: Актуальность, модернизация, сварка, секция, сегмент.

The Problem of Optimum Galvanic Process Control

V. I. Skvortsov*, E. M. Solomatina

Tambov State Technical University, Tambov, Russia
*e-mail: valerijskvortcov1998@gmail.com

Abstract

The purpose of this study is to analyze one of the most important parameters of galvanic coating, the name of which is uniformity. In the course of the study, the process of a uniform applied coating is considered as a system of differential equations using both partial and ordinary derivatives. The relevance of the study lies in the fact that it improves the quality of the applied galvanic coating in enterprises.

Keywords: derivatives, differential equations, electrical field, functions, galvanic coating, scalar criterion, vector.

Uniformity represents the essential quality parameter of the galvanic coating. Let us summarize the statement of the electrical field control problem using the scalar criterion to achieve maximum uniformity of applied coating.

The process is described as a system of differential equations, using both partial and ordinary derivatives as follows:

$$\frac{\partial \psi_i}{\partial \tau} = f_i(\mathbf{x}, \tau, \boldsymbol{\psi}, \boldsymbol{\psi}_{\mathbf{x}2}, \mathbf{u}), \quad i = 1, 2, \dots, n \quad (1.1)$$

$$\mathbf{x} \in X,$$

$$\mathbf{x} \equiv (x, y, z), \quad \mathbf{u} \equiv (u_1, u_2, \dots, u_m), \quad \boldsymbol{\psi} \equiv (\psi_1, \psi_2, \dots, \psi_n),$$

$$\boldsymbol{\psi}_{\mathbf{x}2} \equiv \left(\frac{\partial^2 \psi_1}{\partial x^2}, \frac{\partial^2 \psi_1}{\partial y^2}, \frac{\partial^2 \psi_1}{\partial z^2}, \dots, \frac{\partial^2 \psi_n}{\partial x^2}, \frac{\partial^2 \psi_n}{\partial y^2}, \frac{\partial^2 \psi_n}{\partial z^2} \right), \quad x, y, z \text{ is the position of points inside the}$$

region X where the process is implemented, τ is time, $u_k = u_k(\mathbf{x}, \tau)$, $k = 1, 2, \dots, m$ are the components of control vector, which is generally distributed across the region X , $\psi_i = \psi_i(\mathbf{x}, \tau)$, $i = 1, 2, \dots, n$ are functions describing the system condition at point \mathbf{x} at the time τ .

Functions $\psi_i(\mathbf{x}, \tau)$ meet the following boundary conditions:

$$g(\mathbf{x}, \tau, \boldsymbol{\psi}, \boldsymbol{\psi}_{\mathbf{x}}, \mathbf{w}) = 0, \quad \mathbf{x} \in G \quad (1.2)$$

and the following initial conditions:

$$(\psi_i)|_{\tau=0} = \psi_{i0}(\mathbf{x}), \quad \mathbf{x} \in X, \quad i = 1, 2, \dots, n, \quad (1.3)$$

$$\text{Here, } \boldsymbol{\psi}_{\mathbf{x}} \equiv \left(\frac{\partial \psi_1}{\partial x}, \frac{\partial \psi_1}{\partial y}, \frac{\partial \psi_1}{\partial z}, \dots, \frac{\partial \psi_n}{\partial x}, \frac{\partial \psi_n}{\partial y}, \frac{\partial \psi_n}{\partial z} \right),$$

$\mathbf{w}_k = \mathbf{w}_k(\mathbf{x}, \tau)$, $k = 1, 2, \dots, m$, $\mathbf{x} \in G$ are the control functions distributed along with the border G of the region X .

The system (1.1) is closed in relation to $\boldsymbol{\psi}$ but includes functions u_k , $k = 1, 2, \dots, m$, which can be arbitrarily prescribed, and thus the solution $\boldsymbol{\psi}$ depends on the vector function \mathbf{u} .

The solution $\boldsymbol{\psi}$ will depend on the border G of the region X . Border G can also function as control (for multi-anode galvanic baths - arrangement of anodic

sections inside the electrolytic solution). The shape of G must not be dependent on time, is continuous and can have lines of fracture.

Vector functions $\mathbf{u}=\mathbf{u}(\mathbf{x},\tau)$ and $\mathbf{w}=\mathbf{w}(\mathbf{x},\tau)$ are assumed to be piecewise continuous with discontinuities into finite quantity at finite number of points or lines and lying within the closed region U of admissible controls. Vector function $\boldsymbol{\psi}(\mathbf{x},\tau)$ is continuously differentiable everywhere except for the control discontinuity lines where it remains continuous and its derivatives may have the first type of discontinuities.

We also assume the existence of isoperimetric relations

$$\int_0^T Q(\mathbf{x},\tau,\boldsymbol{\psi},\mathbf{w})d\tau=c, \quad (1.4)$$

which, in our case, represent the need to obtain the target thickness upon the completion of the coating process.

It is assumed that, when given the admissible controls \mathbf{u} , \mathbf{w} , and G , the system (1.1) - (1.4) has only one solution.

Let us define the composite function

$$J = \int_0^T \int_G P(\mathbf{x},\tau,\boldsymbol{\psi},\mathbf{w})dGd\tau, \quad (1.5)$$

which describes the uniformity of coating thickness distribution across the workpiece surface for galvanic processes.

\mathbf{u} , \mathbf{w} , and G controls that provide the extreme point for the composite function (1.5) given the relationships (1.1) - (1.4) need to be found.

The theory of solving the set optimization problems does not exist for non-linear boundary conditions (1.2). Therefore, direct variational methods were used.

The finite-dimensional problem of optimal control of voltage across independent anodes is stated as follows:

Let us assume that the performance of galvanic bath is determined by the criterion of uniformity

$$\mathfrak{R}_2 = \frac{1}{S_k} \int_{S_k} \frac{\delta_j(x,y,z) - \delta^{\min}}{\delta^{\min}} dS_k$$

of applied coating.

We need to find the control vector $\mathbf{u}^*=\{U_1^*, U_2^*, \dots, U_N^*\}$ at which $\mathfrak{R} \rightarrow \min$ given the following relationships:

$$\delta(x,y,z) = \frac{\vartheta}{\rho} \eta i_k(x,y,z) T_1,$$

$$\eta = \eta(t, i_k(x,y,z), C_1(\tau_j^H), C_2(\tau_j^H), \dots, C_m(\tau_j^H)), j=1,2,\dots,k,$$

$$i_k(x,y,z) = -\chi \text{grad } \varphi(x,y,z),$$

$$\frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2} + \frac{\partial^2 \varphi}{\partial z^2} = 0,$$

$$\varphi + F_1(i_a) \Big|_{s_j} = U_j,$$

$\varphi - F_2(i_k) \Big|_{S_k} = 0,$
and the following limitations

$$\left\{ \begin{array}{l} \delta(x,y,z,T_{1,j}) \geq \delta_j^{\text{зад}}, j=1,2,\dots,k, \\ 0 \leq C_{0i}, i=1,2,\dots,m, \\ 0 \leq h_{xj} \leq X, \quad 0 \leq h_{yj} \leq Y, \quad 0 \leq h_{zj} \leq Z, \\ 0 \leq U_{i,j} \leq U_{\text{max}}, i=1,2,\dots,N, \quad j=1,2,\dots,k, \end{array} \right.$$

In the course of our research, we identified a differential equation using partial and ordinary derivatives for the most important parameters of the galvanic coating. Our research can improve the quality of electroplating in factories.

References

1. Litovka Y.V., Elizarov A.M. Metod rascheta tolshchiny pokrytiya na elektrodakh slozhnoy formy [Method for calculating the thickness of the coating on electrodes of complex shape]. Theoretical foundations of chemical technology, 2003, No. 1, pp. 45–48. (Rus)
2. Litovka Y.V. Optimal'noye upravleniye gal'vanicheskoy vannoy s uchetom dvuperiodichnosti protsessa [Optimal control of a galvanic bath taking into account two-periodicity process]. Mathematical methods in chemistry and technology, Vladimir, 1998, pp. 74–76. (Rus)
3. Soloviev D.S., Litovka Y.V., Milovanov I.V. Sistema optimal'nogo upravleniya gal'vanicheskoy vannoy s tsiklicheskim vklyucheniye anodnykh sektsiy [Optimal control system for a galvanic bath with cyclic switching on of anode sections]. Radiotekhnika, 2010, No. 12, pp. 44–48. (Rus)

ПОСТАНОВКА ПРОБЛЕМЫ УПРАВЛЕНИЯ ОПТИМАЛЬНЫМ ГАЛЬВАНИЧЕСКИМ ПРОЦЕССОМ.

В. И. Скворцов*, **Е. М. Соломатина**

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: valerijskvorcov1998@gmail.com

Аннотация. Проведен анализ одного из важнейших параметров гальванического покрытия, название которого - однородность. В ходе исследования процесс равномерного нанесения покрытия рассмотрена система дифференциальных уравнений с использованием как частных, так и обыкновенных производных. Актуальность исследования будет заключаться в том, что оно позволит улучшить качество наносимого гальванического покрытия на предприятиях.

Ключевые слова: вектор, гальваническое покрытие, дифференциальные уравнения, производные, скалярный критерий, функции, электрическое поле.

Development of an Acoustic Method for Predicting Wear of Commercial Cutting Tools

F. J. Usman*, M. V. Sokolov

Tambov State Technical University, Tambov, Russia
**email: f.usman@futminna.edu.ng*

Abstract

The system of forecasting or predicting wear of cutting tools in different turning operations of work pieces using acoustic method is studied. This work is based on the analysis of the conditions characteristics of the mechanical processing, laws of wearing and decomposition of cutting tools on the basic characteristics of the cutting process. The paper presents and studies research methods of the efficiency of cutting tools during turning operations. This work also researches the physical, chemical and mechanical phenomena occurring at the micro-level that lead to a change in the properties of the materials at the macro-level and this change is largely unpredictable due to the random nature of the motion of atoms and particulars at first glance and the scattered arrangement of the primary properties of products intended for the same purpose.

Keywords: acoustic method, composite material, cutting tools, turning process, vibration, wear prediction.

Introduction

Until now, the mechanical treatment of materials by pressure and cutting has remained one of the most important shaping operations in technological processes. Along with the formation of the characteristics of metal products, large volumes of materials, such as wood, printing materials, plastics, glass, composite materials, etc., are processed by mechanical means the efficiency of machining processes is the basis for the production of competitive products. an increase in productivity, flexibility, reliability and efficiency while ensuring the quality and accuracy of the products obtained is currently associated with a scientifically based choice of optimal tool materials, geometric parameters of tools and cutting conditions, and the introduction of systems control over the condition of the tool, etc.

Physical, chemical and mechanical phenomena occurring at the micro-level lead to a change in the properties of the material at the macro-level, and this change is largely unpredictable due to the random nature of the movement of atoms and the seemingly insignificant spread of the primary properties of products intended for the same purpose maintaining a given level of reliability in this case is possible by timely adjusting the technical condition of the machine, through the use of effective diagnostic methods, in particular, vibration diagnostics methods [1]. Moreover, it is necessary to approach this problem more broadly and apply diagnostics not only to monitor the state of the machine, as such, but also to monitor the state of the cutting tool used in the process of its manufacture.

Recommendations for optimization of machining processes are based on modern concepts of material deformation processes [2]. At the same time, many of the observed physical regularities during mechanical deformation still have no explanation from the standpoint of the mechanics of a deformable solid. Despite

the increasing number of publications with a mathematical description of certain machining processes, a unified theory, which, in full accordance with the level of modern science, would make it possible with sufficient accuracy and reliability to assess the influence of various factors on the results, the process has not yet been created. This is largely due to the fact that most scientists who are engaged in the mechanical processing of materials do not have sufficient training in the field of solid mechanics and the theory of plasticity.

Taking this into consideration, the subject of concern in our article is the use of a linear-deformable half-space of stress and strain to explain the stress state of the surface layer of the product during wear of the cutting tool.

Materials

An important factor in the efficiency of machining is the ability to provide a stable physical-chemical-mechanical state of the surface layer of the product [3]. Practice shows that this task is quite difficult, thus the level of residual stresses can vary significantly within the same machined surface. In combination with fluctuations in the physicochemical state of the surface layer at the Nano-level, this leads to the appearance on the treated surface and in the near-surface layer of foci with an increased tendency to cracking, corrosion, adhesion and abrasion of the product. As a result, the presence of areas with variable properties creates the prerequisites for premature failure of the part during operation, especially under conditions of alternating loads and temperatures, high pressures and friction rates.

The physical essence of the formation of a surface layer with inhomogeneous properties is due, on the one hand, to the specific features of the development of deformation of the processed material, and, on the other hand, to its probabilistic nature. The first feature is the scheme of loading the material being processed, which can be supplemented by an explanation of the deformation and the phenomena of destruction and wear of the cutting tool that accompany it.

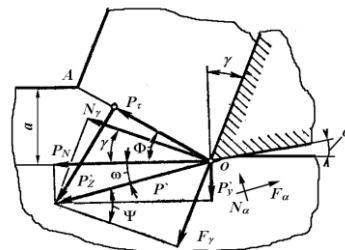


Fig.1.1. Simplified diagram of the chip formation process

Many scientists for theoretical research and analysis of experimental data in the machining of materials by cutting adopted a simplified chip formation scheme with one shear plane (Fig. 1.1) [4]. A characteristic feature of the contact interaction of the cutting tool with the chips and the work piece is the difficult friction conditions on the front and rear surfaces of the tool, caused by high temperature and contact loads. The forces acting on the front surface of the blade N_λ and F_λ are calculated by the formulas:

$$\begin{aligned} F_\gamma &= P_{z0} \sin \gamma + P_{y0} \cos \gamma \\ N_\gamma &= P_{z0} \cos \gamma - P_{y0} \sin \gamma \end{aligned} \quad (1)$$

where; P_Z and P_Y are the components of the chip formation force; N_α , F_α - normal and tangential forces acting on the back surface.

The friction force F_α can be found using the expression:

$$F_\alpha = \mu \cdot N_\alpha, \quad (2)$$

where μ is the coefficient of friction along the rear surface.

Often, to assess the friction conditions, the average coefficient of friction μ_c is used, which is determined by the ratio of the friction force F to the force of normal pressure N [5]:

$$\mu_c = \mu_0 + \mu_A = \mu_0 + \frac{q_F}{q_N}, \quad (3)$$

where μ_0 is the true coefficient of friction determined by the atomic-molecular interaction; μ_A - adhesive component.

S.S. Silin proposed the following formula for calculating the average coefficient of friction μ_c [1]:

$$\mu_c = \frac{\cos \gamma + \sin \gamma - B \cdot (\cos \gamma - \sin \gamma)}{\cos \gamma - \sin \gamma + B \cdot (\cos \gamma + \sin \gamma)}, \quad (4)$$

where γ is the front angle of the cutter; - value characterizing the degree of plastic deformation of the metal of the removed allowance and the surface layer of the work piece; φ - angle of inclination of the conventional shear plane.

Experimentally, the angle φ can be determined by the formulas

$$\operatorname{tg} \Phi = \frac{\cos \gamma}{\xi - \sin \gamma} \quad \text{Or} \quad \sin \Phi = \frac{\cos \gamma}{\sqrt{\xi^2 - 2 \cdot \xi \cdot \sin \gamma + 1}}, \quad (5)$$

where ξ is the coefficient of shrinkage of the chips, numerically equal to the coefficient of thickening of the chips $K\alpha = \alpha C / \alpha$ or the coefficient of its shortening $KL = L / LC$ (L is the cut length; LC is the length of the chips).

The normal force N_α acting on the rear surface of the cutting blade is determined from the expression:

$$N_\alpha = \frac{P_Y \cdot (1 + \mu \cdot \operatorname{tg} \gamma) - P_Z \cdot (\mu - \operatorname{tg} \gamma)}{1 + 2 \cdot \mu \cdot \operatorname{tg} \gamma - \mu^2}, \quad (6)$$

The average normal stress q_N on the back surface can be determined by the formula:

$$q_N = \frac{N_\alpha}{A_\alpha} = \frac{N_\alpha}{b \cdot (h_3 + C_\alpha^0)}, \quad (7)$$

where A_α is the area of the contact pad along the back surface ($A_\alpha = C_\alpha \cdot b$ where C_α is the length of the contact along the back surface); b is the width of the cut layer; h_3 is the size of the wear area on the flank surface; N_α is contact length in the absence of wear. According to A.M. Rosenberg and O.A. Rosenberg the value q_N can be taken for carbide tools equal to 0.1 mm [6].

Any cutting tool always has a cutting-edge rounding radius ρ , the value of which depends on the properties of the tool material and the technology for preparing the working surfaces.

For a blade sharp-cut instrument from diamond and cubical barium nitride the $\rho = 1 \dots 3$ microns, from hard tungsten-cobalt alloys $\rho = 10 \dots 16$ microns, from hard alloys of the TK group $\rho = 20 \dots 30$ microns, from high-speed steels $\rho = 8 \dots 10 \mu\text{m}$ [3].

The nature of the loading determines the shape and size of the presumed fracture zone (shaded area in Fig. 1.2); the zone in which the acting stresses are close to the ultimate tensile strength of the processed material. Point B is shown as the coordinate of a possible nucleus of a ductile fracture crack dividing the processed material into chips and the surface layer of the part. It is usually above the theoretical cutoff line AA A. The value Δh of the material, which rises by the rounded part of the cutting edge, is related to the rounding radius ρ by the ratio $\Delta h \geq (0,3 \dots 0,5)\rho$.

The material, which is located above the AA' line, is crumpled, creating additional hardening of the surface layer, and partially elastic is restored after passing the tool, even with constant parameters of the cutting mode and the tool, the coordinate of point B - the point of separation of the work piece material - will be a random variable and, accordingly, the layer thickness *соответственной* will change, creating the prerequisites for inhomogeneous hardening of the surface layer and height fluctuations micro-roughness on the treated surface. The position of the material separation point is limited by the size of the fracture zone near the cutting edge. The larger the source of destruction, the higher the likelihood that the specified point will move further and further from the AA' line. Accordingly, the fluctuations in the thickness of the crumpled layer Δh and the characteristics of the hardening substructure will increase. Thus, the larger the fracture zone in the cutting zone, the higher the probability of the formation of a surface layer with unstable properties along the length of the treatment in turn, the size of the fracture site is associated with the intensity and nature of the distribution of stresses on the processed material, acting from the cutting tool.

Contact interactions of the cutting edge of the tool with the material being processed is characterized by the value of the contact stress σ_K arising at the point of their contact (Fig. 1.3).

The average value of the contact voltage is determined by the following formula.

$$\bar{\sigma}_K = \frac{P}{2 \cdot R \cdot L_B}, \quad (9)$$

where L_B is the length of the cut; P is the effort developed during cutting; R is the radius of the cutting edge.

The diagram of stresses arising at the contact area of the tool with the work piece material is shown in Fig. 1.3. The parameters of the contact area are shown in Fig. 1.2. The tool contour is described by the following equations.

$$f(x) = \begin{cases} -\frac{(x-c)^2}{2R}, & x \geq b, \\ x \operatorname{tg} \varepsilon + d, & x < b, \end{cases} \quad (10)$$

where $c = b + R \operatorname{tg} \varepsilon$,

$$d = -btg\varepsilon - \frac{(b-c)^2}{2R}$$

Normal stresses in the contact area are determined by the formula:

$$\sigma_{y|y=0} = -\frac{2P}{\pi} \left(a^2 \arccos \frac{b}{a} - b\sqrt{a^2 - b^2} \right)^{-1} \times \left(\arccos \frac{b}{a} \sqrt{a^2 - x^2} + (x-b) \ln \frac{[\sqrt{(a+b)(a-x)} + \sqrt{(a-b)(a+x)}]^2}{2a|b-x|} \right), \quad (11)$$

The ratio a/b is determined from the transcendental equation:

$$\sqrt{1 - \left(\frac{b}{a}\right)^2} - \frac{b}{a} \arccos \frac{b}{a} = \pi \frac{R}{a} tg\varepsilon, \quad (12)$$

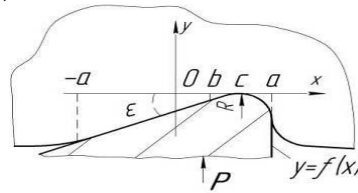


Fig. 1.2. Area of contact of the tool with the work piece material:
a - the size of the contact zone, ε is the angle of inclination of the cutting edge, *R* - the radius of the cutting edge,
b - transition of the straight-line generatrix of the blade into curvilinear (rounded), *c* - the point where the maximum contact stresses act, *P*-cutting force.

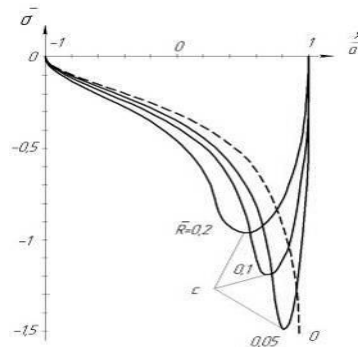


Fig. 1.3. Dimensionless diagrams of normal stresses in the contact area

$$\left(\bar{\sigma} = \frac{a}{P} \sigma_y |_{y=0}, \bar{R} = \frac{R}{a} tg\varepsilon \right)$$

From Fig. 1.3 it follows that as the tool becomes blunt (increasing the radius of the cutting edge), the voltage value decreases and its maximum (point C) approaches the center of the contact area. The nature of the change in the maximum value of the diagram (point C, Fig. 1.3) as the radius *R* grows is shown in Fig. 1.4. Correspondingly, the average contact voltage also decreases.

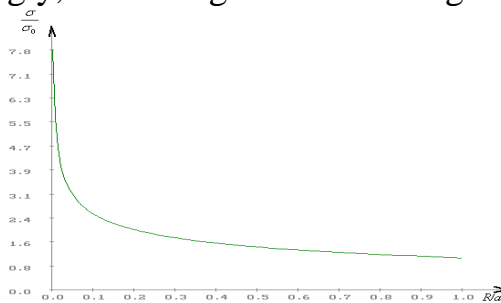


Fig. 1.4. Change in the maximum stress diagram (point C, Fig. 1.3) depending on the increase in the radius *R* of the cutting edge of the tool

Let us express the amount of wear of the cutting-edge h through its radius R (Fig. 1.4)

$$h = \frac{R}{\operatorname{ctg} \frac{\beta}{2}} - R. \quad (13)$$

Substituting (9) into (13), we obtain an expression linking the amount of wear with the average contact stress

$$h = \frac{P}{2 \cdot L_E \cdot \bar{\sigma}_K} \cdot \left(\operatorname{ctg} \frac{\beta}{2} - 1 \right). \quad (14)$$

From (14) it follows that the value of the cutting-edge wear h is inversely proportional to the value of the averaged contact stress

$$h \approx \frac{1}{\bar{\sigma}_K}. \quad (15)$$

The level of wear of the instrument can be determined by the following formula:

$$dh(t) = \frac{h(t) - h_0}{h_0}, \quad (16)$$

where $h(t)$ is the current amount of wear; h_0 is the initial value of the h parameter.

In practice, it is practically impossible to quickly assess the technical condition of the cutting tool using formula (16), so here it is necessary to use indirect methods that are widely used in technical diagnostics of machines. For example, you can estimate the degree of tool wear by the magnitude of the acoustic signal that is generated by the machining process of the material.

The amplitude of the sound pressure is directly proportional to the amplitude of deformation of the surface of the processed material. This deformation, in turn, is proportional to the magnitude of the contact stress created in the material being processed by the cutting tool. According to (15), the values of contact stress and wear are inversely proportional to each other.

$$A \sim \sigma_K \sim 1/h. \quad (17)$$

With this formula (16) will become the following:

$$dh(t) = \frac{A_0 - A(t)}{A(t)}, \quad (18)$$

where $A(t)$ is the current value of the amplitude of the sound pressure; A_0 is the initial value of the amplitude of the sound pressure (pressure generated by a sharp instrument).

Expression (18) allows you to control the degree of wear according to the results of regular monitoring of the magnitude of the acoustic signal generated by the process of machining the material. However, knowledge of the current degree of tool wear is not enough, it is also necessary to determine the operating time of the T_{zat} tool before its next sharpening. This parameter is determined in the process of approximating the results of monitoring the acoustic signal by a graph of a curve reflecting the mechanics of the tool cutting edge wear. This curve

describes the process of decreasing the amplitude of the acoustic signal with the wear of the tool.

The approximation procedure is performed using a computer by minimizing the following functional.

$$U = \sum_{i=0}^m \left[A(t_i) - A_0 \left[1 - \alpha \left(\frac{t_i - t_0}{T_{zam} - t_i} \right)^n \right] \right]^2, \quad (19)$$

where α , n are the parameters of the analytical dependence.

Having determined the parameters T_{zab} , α and n , expression (18)) can be represented in the following form.

$$dh(t) = \quad (20)$$

These theoretical positions have been verified experimentally.

Research methods

Experimental setup

To study the operability of the system for diagnosing the state of the tool and to study the effect of tool wear on the AI, an experimental setup was developed on the basis of a universal lathe-cutting machine type 1I611P, with the following characteristics.

Name of Parameter	Unit.	Value
Largest diameter of material that can be installed on the lathe	mm	250
The distance between the centers	mm	500
Height of the center	mm	130
Largest diameter of the rod	mm	24
Largest diameter over the lower part of the support	mm	125
Largest diameter turning piece	mm	500
Pitch of the cut metric thread	mm	0.2...48
Pitch of the cut modular thread	modules	0.2...30
Pitch of the cut Inch thread	inch	24...0.5
Number of cutting tools in the tool holder	pieces	4
Largest width of the tool holder	mm	16
Largest height of the tool holder	mm	16
Largest longitudinal displacement by hand	mm	500
Largest transverse displacement by hand	mm	180
Longitudinal displacement of limb division value	mm	0.1
Transverse displacement of limb division value	mm	0.02
Displacement on one round of limb of longitudinal displacement	mm	20
Displacement on one round of limb of transverse displacement	mm	3
Number of turns of the spindle motor	rmp	1430
Power of the spindle motor	kWt	3
Type of the spindle motor		4A100S4

The general view of the experimental setup is shown in Fig. 2.1. The work piece is processed by the tool; the registration of the AI signal was carried out

using a receiver (microphone) placed at the required point in the processing system space.

The AI receiver attaches to the computer's sound card. The signal coming from the microphone is converted from analog to digital using an analog-to-digital converter installed on the sound card. The obtained data are stored in the computer memory using the Wave program for further processing by a specially developed program.

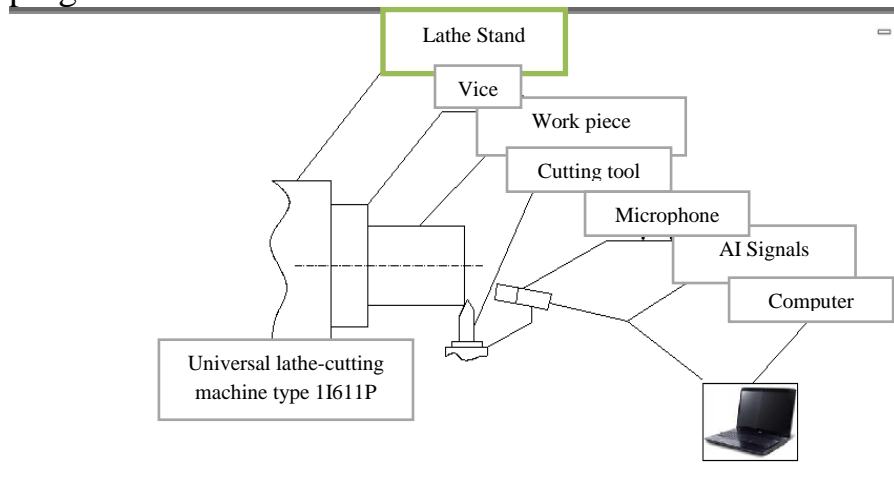


Fig. 2.1. The scheme of the experimental setup

During the experiments, it was found that the dynamic range of amplitudes perceived by the AI sensor depends both on the place of its attachment and on the method. This is due to the fact that acoustic waves that arise when cutting in metal, with increasing distance get damp.

Stable results were obtained by attaching the sensor to the body using a special device. In this case, the sensor attachment point was equipped with a soft gasket. The use of a soft gasket for fixing the sensor did not reduce the dynamic properties of the signal in comparison with its rigid fixing.

Thus, the sensor reacted only to acoustic vibrations arising during the turning of parts, machine vibration did not affect it. To carry out the experiments, we used right-hand boring cutters T15K6 and an angle of insertion with plasticity equal to 10° . The cutter section in most cases of work piece processing was ($h \times b = 16 \times 12$) mm made of P6M5 material made in accordance with GOST 1050-88. The parameters of the cutters are shown in the figure. The choice of high-speed steel cutters as a material was determined by the need to blunt the cutter on the experimental work piece during several tool passes. Turning was carried out without the use of coolant. Machining was carried out with different spindle speeds and feeds per cutter at a constant depth of cut.

The blanks used in the experiment were made of steel. The size of the work pieces was 15 mm in diameter and 100 mm in length.

The amplitude-frequency characteristics (AFC) of the turning process signal taken with a microphone in the Adobe Audition 3.0 environment, one of which is shown in Fig. 2.2, made it possible to conclude that they can be used to analyze the

state of the cutting tool. In a real system machine-device-tool-part, at medium cutting conditions, after a short time interval from the beginning of cutting, lasting a few seconds, a stationary self-oscillating mode is established. This is due to the high inertia of the machine-device-tool-part system, since self-oscillations cannot occur immediately after the tool is cut into the work piece, but some time passes before they occur.

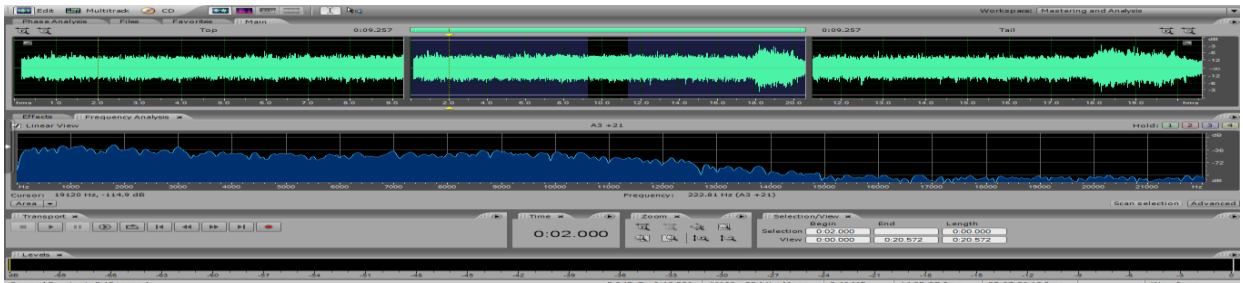


Fig. 2.2. Vibration spectrum image

Highlighting informative bands

It is known that various elements of the technological system and the cutting process itself “make noise” in different ways at different frequencies. Therefore, it is necessary to select a frequency band, the vibration amplitude in which depends only on the elements of the cutting mode and the amount of tool wear. To solve this problem, an experimental plan was built, in which the feed and frequency were varied within 0.18-1.5 min⁻¹, 250-2000 rpm, respectively. This was required to find the optimal conditions under which the cutter would wear out in 1-3 passes over the work piece surface. Such modes were $n = 2000$ rpm, $P_z = 1.44$ min⁻¹, $t = 0.5$ mm, and the spectra of the AI signal were constructed under conditions of shop noise and at steady-state cutting for each point of the experiment plan

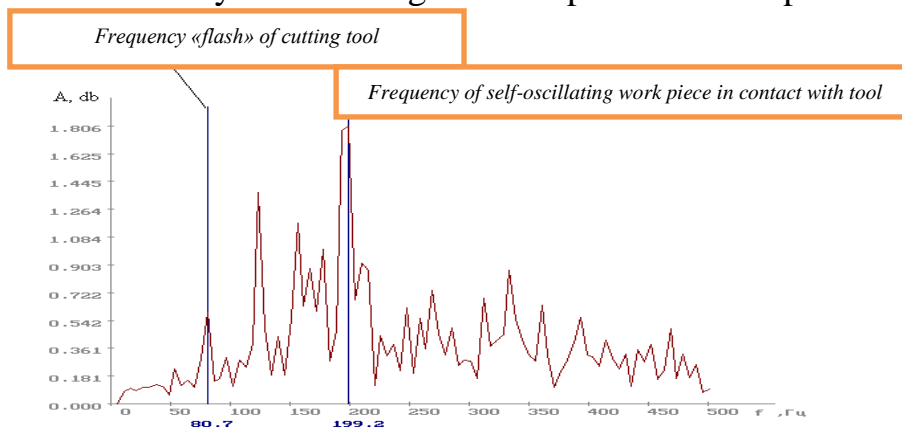


Fig. 2.3. Acoustic emission spectrum of the turning process

These spectra were superimposed on each other, as shown in Fig. 2.3 and the areas characterized by an increase in signal amplitude with changing tool wear were highlighted.

Results and discussion

As a result of the research carried out, it was found that when turning the work piece, there is only one wide informative frequency band - from 700 Hz to 1200

Hz - sensitive to changes in tool wear. The experimental results are shown in Tables 1, 2 and 3.

Table 1. Results of experiment with sharpened tool

Tests	Frequency of rotation of spindle n_p, min^{-1}	Instrument displacement towards work piece S, mm/round	Average value of Decibel, dB
1	250	0.18	54.5
2	315	0.23	55.1
3	400	0.29	56
4	500	0.36	57.5
5	1000	0.72	57.8
6	1600	1.15	60.5
7	2000	1.44	61.5

Table 2. Results of experiment with unsharpened tool

Tests	Frequency of rotation of spindle n_p, min^{-1}	Instrument displacement towards work piece S, mm/round	Average value of Decibel, dB
1	250	0.18	55.5
2	315	0.23	56.5
3	400	0.29	57.4
4	500	0.36	58
5	1000	0.72	58.5
6	1600	1.15	60.5
7	2000	1.44	62

Table 3. Results of experiment with worn out tool

Tests	Frequency of rotation of spindle n_p, min^{-1}	Instrument displacement towards work piece S, mm/round	Average value of Decibel, dB
1	250	0.18	57
2	315	0.23	57.8
3	400	0.29	58.2
4	500	0.36	59
5	1000	0.72	62
6	1600	1.15	65.5
7	2000	1.44	67

Note: The duller the tool and the more the feed and the spindle speed, you get a curved line, instead of a flat boring surface.

Conclusion

The results of this study can be used not only for practical technological applications, but also in the educational process for a significant increase in the level of training of specialists in the field of machining of materials by cutting.

References

1. Ostafiev V.A. Opredelenie parametrov processa deformacii pri rezke metallov [Determination of the parameters of the deformation process when cutting metals]. Higher school, 1969, 96 p. (Rus)
2. Vorontsov A.L., Sultan-Zade N.M., Albagachiev A.Yu. Development of a new cutting theory. Introduction. Bulletin of mechanical engineering, 2008, No. 1, pp. 57-67.
3. Starkov V.K. Stabil'nost' rezki i upravlenie kachestvom v avtomatizirovannom proizvodstve [Cutting stability and quality management in automated production]. Mashinostroenie, 1989, 296 p. (Rus)
4. Kufarev G. L. Struzhkoobrazovanie i obrabotka poverhnosti pri rezanii v nevole [Chip formation and surface finish during captive cutting]. Frunze: Mektep, 1970, 169 p. (Rus)
5. Silin S.S. Metod podobiya raskroya materialov. Mashinostroenie [Similarity method for cutting materials. Mechanical Engineering]. Moscow: Higher school, 1979, 152 p. (Rus)
6. Rosenberg A.M., Rosenberg O.A. Instrument stanki i tverdospлавnaya protyazhka dlya obrabotki gil'z i cilindrov [Machine tools, built-up cemented-carbide broach for machining sleeves and cylinders]. MASHGIZ, 1986, vol. 5, issue 8, pp. 19-20. (Rus)

РАЗРАБОТКА АКУСТИЧЕСКОГО МЕТОДА ДЛЯ ПРОГНОЗИРОВАНИЯ ИЗНОСА ТОКАРНЫХ РЕЗЦОВ

Ф. Д. Усман*, М. В. Соколов

Тамбовский государственный технический университет, г. Тамбов, Россия

**email: f.usman@futminna.edu.ng*

Аннотация. Разработана система прогнозирования акустическим методом износа инструмента при различных токарных обработках детали. В данной работе на основе анализа влияния условий механической обработки, закономерностей изнашивания и разрушения инструмента на основные характеристики процесса резания разработаны и приведены методики исследования работоспособности металлорежущего инструмента при ПТТ. В данной работе исследованы физические, химические и механические явления, происходящие на микроуровне, приводят к изменению свойств материала и на макроуровне, и это изменение в значительной степени непредсказуемо из-за случайного характера движения атомов и ничтожного, на первый взгляд, разброса первичных свойств изделий, предназначенных для одной и той же цели.

Ключевые слова: акустический метод, композитный материал, режущие инструменты, токарный процесс, вибрация, прогноз износа.

УДК 004
ББК 32.97

Information System for the Police Investigation Department

A. S. Aydarov*, K. G. Sadovnich

Tambov State Technical University, Tambov, Russia

*e-mail: aydarov09@yandex.ru

Abstract

The software and technical equipment of the police investigation department is considered. As a result of the analysis, the expediency of developing software for employees of the investigation department was revealed. The activities of employees while working with document flow, their requests and wishes regarding software were carefully studied. The developed system "Information system for the police investigation department" is presented.

Keywords: database, document flow, system.

To ensure error-free work, the investigative department works with a large number of different documents and forms that must be filled out. One of the main duties of this department is dealing with criminal cases under investigation. Employees are entrusted with responsibilities both for document management, tracking changes in existing legislation, and directly conducting the case for its disclosure. They have to fill out a large number of forms and protocols that are directly related to the course of the criminal investigation.

Fig. 1 lists all the responsibilities of the investigation department.



Fig. 1. Responsibilities of the investigation department

The functionality of the created software product is lower than that of similar products on the software market, but it is worth considering the rather "narrow" focus of the proposed product, since it was developed specifically for the needs of

the police investigation department, taking into account the wishes of the employees. It will allow you to automate the tasks of accounting, storing and organizing data on the registration of requests.

The advantages of this software include ease of use and clarity of the interface, since it has only the necessary tools that will allow the employee to quickly navigate during work.

The analysis showed that the program needs the ability to register the interrogation protocols of the suspect and witness, the data archive and the user database.

All functions are related to each other in the table, the content of one of them can be viewed in Fig. 2.

	Имя поля	Тип данных	
id		Счетчик	
mesto_sostavlenia		Короткий текст	Место составления
data		Дата и время	Дата составления
dopros_nachat		Дата и время	Допрос начат
dopros_okonchen		Дата и время	Допрос окончен
FIO_doznavatelja		Короткий текст	ФИО Дознавателя
in_pomeshenii		Короткий текст	В помещении
FIO		Короткий текст	ФИО подозреваемого
data_rojdenia		Дата и время	Дата рождения
mesto_rojdenia		Короткий текст	Место рождения
mesto_jitelstva		Короткий текст	Место жительства
grajdanstvo		Короткий текст	Гражданство
obrazovanie		Короткий текст	Образование
sp		Короткий текст	Семейное положение
mesto_raboti		Короткий текст	Место работы
nalichie_sydimosti		Короткий текст	Наличие судимости
seria_pasporta		Числовой	Серия паспорта
nomer_pasporta		Числовой	Номер паспорта
kem_vidan		Короткий текст	Кем выдан
infa		Короткий текст	Допрос

Fig. 2. Filling the table "Protocol of suspect interrogation"

After collecting the database in the form of tables, Deiphi created a system shell, represented by forms and a data module, which is designed to store database objects.

Buttons for registering protocols are needed to fill out the form and display the entered information in a form suitable for printing and further use in electronic form. The archive of protocols allows you to refer to already created protocols and search for them using filters and a search string. The database of department employees contains information about all department employees, as well as some information about them.

The main screen interface is shown in Fig. 3.

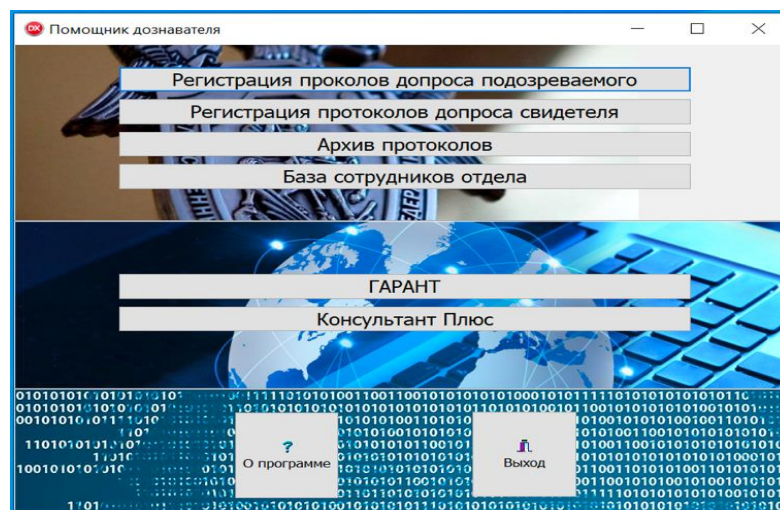


Fig. 3. Program interface

The developed information system makes it possible to relieve the staff of the department, relieve some of the load due to the workflow in handwritten form and speed up access to existing documents. Forms allow you to reduce the time for creating template documents and facilitate the transfer of information between employees, if necessary.

We believe that the developed system will speed up the work of the investigation department and reduce the costs of employees for routine and at the same time mandatory part of the work.

References

1. Volkov Yu.V., Kuznetsov P., Sokolov Yu.N. Pravovaya informatika. Teoriya. Informatizatsiya: uchebnik [Legal informatics. Theory. Informatization: textbook]. Ekaterinburg: Uralskoye gos. Izdatelstvo Yuridicheskoye akademii, 2007, 90 p. (Rus)
2. Rudakov. A.V. Tekhnologiya razrabotki programmnoy obespecheniya: uchebnik [Software Development Technology: textbook]. M.: Akademiya, 2017, 208 p. (Rus)
3. Gagarin. L.G., Kokoreva E.V., Vishnadul B. Tekhnologiya razrabotki programmnoy obespecheniya: uchebnik [Software development technology: textbook]. M.: Forum, INFRA-M, 2017, 400 p. (Rus)

ИНФОРМАЦИОННАЯ СИСТЕМА ДЛЯ СЛЕДСТВЕННОГО ОТДЕЛА ПОЛИЦИИ

А. С. Айдаров*, К. Г. Садовнич

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: aydarov09@yandex.ru

Аннотация. Рассмотрена программно-техническая оснащенность следственного отдела полиции. В результате продолжительного анализа была выявлена целесообразность разработки программного обеспечения для сотрудников следственного отдела. Была тщательно изучена деятельность сотрудников во время работы с документооборотом, их запросы и пожелания касаются программного обеспечения. Представлена разработанная система «Информационная система для следственного отдела полиции».

Ключевые слова: база данных, документооборот, система.

Développement des technologies vocales

M. Y. Bayez, Y. Ouammou

Université d'État technique de Tambov, Tambov, Russie
e-mail: bayez96@mail.ru, Youssefizix@gmail.com

Résumé

Le but de cet article est de donner un aperçu des progrès récents dans le domaine de la reconnaissance de la parole. De façon très générale, on peut dire que, ces dernières années, la comparaison entre les méthodes basées sur les connaissances étendues d'experts humains, avec les heuristiques correspondantes, et les méthodes auto-organisatrices, utilisant des bases de données de parole et des algorithmes d'apprentissage automatique, avec peu de connaissances explicites, a tourné à l'avantage de ces dernières, qui ont obtenu des résultats nettement meilleurs lors d'essais comparatifs d'évaluation.

Mots clés: traitement automatique, parole, système de reconnaissance, un vocabulaire, prononciation, différents locuteurs

Introduction

Ces trente dernières années ont été témoin d'une évolution impressionnante dans le développement du traitement automatique de la parole. D'un système de reconnaissance, le VIP100, premier à être commercialisé par Threshold Technology Inc. en 1972, qui était capable de reconnaître une centaine de mots isolés, après une phase d'apprentissage longue et fastidieuse, et qui avait un encombrement d'un mètre cube environ, on est passé à des systèmes adaptatifs, intégrés dans les postes de travail et reconnaissant un vocabulaire pratiquement illimité.

Les problèmes propres au traitement automatique de la parole

Plusieurs problèmes font que le traitement automatique de la parole est un domaine difficile, et non résolu actuellement

A. Il n'y a pas de séparateurs, de silences entre les mots, comparables aux blancs dans le langage écrit.

B. Chaque son élémentaire (appelé également phonème) est modifié par son contexte (proches): le phonème qui le précède, et celui qui lui succède. Cela est dû à la coarticulation: le fait que lorsqu'un phonème est prononcé, la prononciation du phonème suivant est préparée par un mouvement du conduit vocal. Cette cause donne à la parole un aspect "téléologique". D'autres modifications du signal correspondant à un phonème (mais de second ordre) seront dues au contexte plus large, comme la place du phonème dans la phrase.

C. Une très grande quantité de variabilité est présente dans la parole: variabilité intralocuteur, due au mode d'élocution (voix chantée, criée, murmurée, enrhumée, enrouée, sous stress, bégaiement); variabilité interlocuteur (timbres différents, voix masculines, féminines, voix d'enfants...); variabilité due au moyen d'acquisition du signal (type de microphone), ou à l'environnement (bruit, diaphonie).

D. Le même signal renferme différents types d'informations (les sons eux-mêmes, la structure syntaxique de la phrase, sa signification, mais aussi l'identité du locuteur, et son état émotionnel (oyeux, en colère...)). Il faudra que le système se focalise sur le type d'information qui correspond à la tâche qu'il a à accomplir.

Premiers résultats sur un problème simplifié

Après quelques espoirs trop optimistes sur la difficulté de la reconnaissance vocale, similaires aux premières sous-estimations de la difficulté de la traduction automatique, une saine réaction à la fin des années 60 a été de constater l'importance du problème dans sa généralité, et d'essayer de résoudre tout d'abord un problème plus simple en introduisant des hypothèses simplificatrices. Au lieu d'essayer de reconnaître n'importe qui prononçant n'importe quoi, de n'importe quelle façon, et en parole courante, un premier problème a été isolé: reconnaître seulement une personne, utilisant un petit vocabulaire (de l'ordre de 20 à 50 mots), en lui demandant d'observer des courtes pauses entre les mots. L'approche de base utilise deux phases: la phase d'apprentissage, et la phase de reconnaissance. Pendant la phase d'apprentissage, l'utilisateur prononce chacun des mots du vocabulaire.

Le signal correspondant est traité au niveau dit "acoustique" ou "paramétrique", et l'information résultante, également appelée "image acoustique", "spectrogramme de parole", "sonogramme", "reference" ou "forme de reference", qui représente habituellement le signal en trois dimensions (le temps, la fréquence et l'amplitude), est conservée en mémoire, avec son étiquette correspondante. Pendant la phase de reconnaissance, un traitement similaire est fait au niveau «acoustique». La forme correspondante est alors comparée avec toutes les formes de référence conservées en mémoire, en utilisant une distance appropriée. La référence pour laquelle la distance est la plus faible désigne le mot reconnu, et son étiquette peut alors être fournie comme un résultat. Si la distance est trop élevée, en fonction d'un seuil prédéfini, la décision de non-reconnaissance du mot prononcé est prise, qui permet ainsi de retenir des mots qui n'appartiennent pas au vocabulaire.

Conclusion

Disons en conclusion que cette approche a conduit aux premiers systèmes commercialisés ce qui est bien important pour la compréhension du problème analysé dans cet article.

Références

1. Alliance des Sciences et Technologies du Numérique (ALLISTENE). Éthique de la recherche en robotique. Rapport n°1 de la CERNA, Commission de réflexion sur l'Éthique de la Recherche en sciences et technologies du Numérique d'Allistene, 2014.
2. DeRenzi B., Dell N., Wacksman J., Lee S., Lesh N. Supporting Community Health Workers in India through Voice- and Web-Based Feedback. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). New York: ACM, 2017.
3. Dubois M., Bobillier-Chaumon M.E. L'acceptabilité des technologies: bilans et nouvelles perspectives. *Le travail humain*, 2009, 72(4), pp. 305.

РАЗВИТИЕ ГОЛОСОВЫХ ТЕХНОЛОГИЙ

М. Ю. Байез, Ю. Уамму

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: bayez96@mail.ru, Youssefizix@gmail.com

Аннотация. Цель статьи – дать обзор последних достижений в области распознавания речи. В целом, в последние годы методы, основанные на обширных знаниях экспертов с соответствующими эвристиками и методами самоорганизации, использующими речевые базы данных и алгоритмы машинного обучения, показали значительно лучшие результаты в тестовых испытаниях.

Ключевые слова: автоматическая обработка, речь, система распознавания, словарный запас, произношение, разные говорящие.

The Current State of Development of Computerized Process Control System for Rectified Ethyl Alcohol Production

A. A. Bronnikov*, A. A. Zobov

Tambov State Technical University, Tambov, Russia

e-mail: alexey199331@gmail.com

Abstract

The purpose of the study is to analyze a set of measures to ensure the elimination of the human factor in the manufacturing process. The relevance of the study consists in the elimination of the human factor in production, the implementation of automatic collection of data about the object and their provision in a convenient form.

Keywords: alcohol, computerized process control system, ethyl.

The production of ethyl alcohol is a continuous process; therefore the operator must constantly monitor the readings of the control devices, measure the pressure and temperature, and operate the valves to keep the production process in accordance with the set technological standards. Considering that all measuring and actuating devices are distributed throughout the facility, the operator has to constantly move around the workshop during the entire shift. Here we are faced with the human factor (overwork, inattention).

The process of distillation of alcohol is accompanied by the release of distillation by-products – the head fraction of ethyl alcohol, fusel oil and disposal of production waste. Rectified ethyl alcohol of the highest purification is used in various sectors: medical, food, paint and varnish and perfume industries.

At present, in the production of ethyl alcohol, the automation of the technological process does not meet modern requirements for the quality of control, signaling and control. The pneumatic control system of JSC “Biokhim”, which is currently used, is morally and physically outdated and requires replacement. All readings from the devices are taken manually every 10-15 minutes, compared with the previous readings, after which the necessary adjustments and regulation of technological parameters are made.

To control the equipmen, constant preparation of purified air is required, since the ingress of moisture and dust into the compressor leads to disruption of the pneumatic control system. Moisture causes corrosion of parts, and at low temperatures it freezes and forms plugs in pneumatic chambers and air ducts. Therefore, it becomes necessary to purge the system before and after work [1]. The efficiency of the pneumatic system depends on keeping the system clean and timely elimination of air leaks, which is not always possible in this complex technological process [2]. The use of only manual control of the technological process often leads to violation of technological regulations, deterioration in product quality, and the occurrence of pre-emergency and emergency situations. All these problems can be solved with the help of modern hardware and software automation using integrated enterprise management systems.

The main task of any production is to get the maximum profit from the work of the technological process, but this cannot be achieved on morally and physically outdated equipment. Therefore, for the effective functioning of the production process, it is necessary to create a computerized process control system [1].

The creation of an automated control system requires significant labor, material and financial resources. According to the technical and economic calculations of specialists, the cost of implementing an effective, reliable and full-scale computerized process control system can reach 5.1% of the total cost of automated technological equipment [1]. By achieving optimal loading of technological equipment, the productivity of the process will increase, the accident rate of equipment and erroneous actions of personnel will decrease, the cost of fuel and energy resources and production costs will decrease. Such a system will pay off within 2-5 years [1].

Taking into account the fact that outdated equipment will require large maintenance costs, since the number of failures and emergencies will increase every year, it is advisable to supply modern equipment, which will soon pay for itself and bring considerable income to the enterprise. When designing an automation system, it is necessary to take into account that the production is fire and explosive, and it is necessary to exclude or reduce to permissible limits the impact on workers of hazardous and harmful production factors, thereby improving working conditions [2].

The computerized process control system should perform the functions of a pre-emergency and emergency alarm system in order to prevent the release of harmful and toxic substances as well as waste from the production of rectified ethyl alcohol. This study will help reduce the presence of a human factor in production, reduce the number of rejects, and increase the quality and quantity of manufactured alcohol products.

References

1. Elizarov I.A., Frolov S.V., eds. *Tekhnicheskie sredstva avtomatizacii. Programno-tekhnicheskie komplekсы i kontrolyery* [Technical means of automation. Software and hardware systems and controllers]. Tambov, TSTU, 2003, 140 p. (Rus)

2. Fedorov I.N. *Spravochnik inzhenera po ASU TP. Proiektirovaniie I razrabotka* [Engineer's Handbook for ACS TP. Design and development]. M.: Infra-ingheneriia, 2008, 905 p. (Rus)

СОВРЕМЕННОЕ СОСТОЯНИЕ ВОПРОСА РАЗРАБОТКИ АСУ ТП ПРОИЗВОДСТВА СПИРТА ЭТИЛОВОГО РЕКТИФИКОВАННОГО

А. А. Бронников*, А. А. Зобов

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: alexey199331@gmail.com*

Аннотация. Целью данного исследования является анализ комплекса мероприятий по устранению человеческого фактора на производстве. Актуальность исследования состояния развития АСУ ТП объекта заключается, прежде всего, в устранении человеческого фактора при производстве, в реализации автоматического сбора данных об объекте и их предоставления в удобной форме.

Ключевые слова: АСУТП, спирт, этил.

The Alpha Algorithm for Intelligent Analysis of Mining Electronic Trading Platform

D. V. Dobrovolsky*, S. P. Vopilin, D. O. Rylyov

Tambov State Technical University, Tambov, Russia
**e-mail: danila.dobrovolskij@bk.ru*

Abstract

The purpose of the study is to create a model describing the business process of the electronic trading platform “Grain Chain” applying the basic Process Mining algorithm. The study will consider the collection of event logs in the electronic trading platform and the use of the Alpha algorithm to obtain a model based on event data. The relevance of the study lies in the fact that thanks to the resulting model performance, problems related to the performance of the information system can be found and removed.

Keywords: Alpha algorithm, business process, process mining, process modeling.

Introduction

This article considers the electronic trading platform “Grain Chain”. There are large amounts of data being used by this information system. Process mining is not just about collecting data, it is about analyzing processes. We are doing process mining to answer performance related questions and compliance related questions. Why are there certain performance bottlenecks in an information system? How can they be removed? Why do people use this information system deviation?

The goal of process mining is to turn event data into process model. Process mining techniques use event data to discover processes, check compliance, analyze bottlenecks, compare process variants, and suggest improvements.

Process modeling and analysis

The starting point for process mining is event data. The main business process of electronic trading platform is deals creating for selling and buying of grain crops. For example, there is a table 1, and every row in this table corresponds to an event. An event has different properties. The first property is a case id. In this case every record refers to deal handling. Thus, the case id refers to the deal number. The activity name refers to the activity with deal, for example, deal status change. And the timestamp in this case is the date of the activity with deal. There can be additional data like user name. This is example of the kind of event data that we would like to use for analysis. And we are focusing on the relationship between process models and event data.

Event logs from information system “Grain Chain” can be collected using Yandex.Metrika. Some types of events in this information system are deal proposal, price negotiations, deal confirmation, deal contracting, deal rejection, probe request, itinerary creating, itinerary confirmation, and itinerary rejection.

There is the Alpha algorithm used by process mining. From an event log we want to learn models that can have loops, parallel parts, choices, and the Alpha

algorithm is the algorithm being able to do that. We apply the Alpha algorithm and ignore the resources and other data elements. We only care about their ordering and do not use the case id or properties of the case. We only look at the order of activities within a particular case. Thus, we can convert such an event log to a multi-set of traces. And each trace is a sequence of activity names [1].

Table 1. Deal handling log example

No.	Activity	Timestamp	User
9901	propose a deal	22-11-2020@09.15	user 1
9902	propose a deal	22-11-2020@09.18	user 1
9901	confirm a deal	22-11-2020@09.49	user 2
9901	reject a deal	22-11-2020@10.41	user 2
9902	reject a deal	22-11-2020@11.08	user 3

The algorithm scans the traces (sequences in the event log) for ordering relations and builds the footprint matrix. Then, it converts the matrix into a Petri net. This algorithm uses rules for deriving models from event data. For example, there is temporal dependency: B follows A, but A never follows B, so B depends on A. The A and B are just arbitrary events. It could be “propose a deal” and “reject a deal” in an actual business process of information system “Grain Chain”. The Alpha algorithm consists of eight steps. First, it defines all events in the event log. Then it defines all possible start events. Third, it defines all possible end events. The fourth step is possible Sets A and B calculating. All events within A and within B should be independent of each other. All events in A should be causally related to events in B. Then it drops non-maximum sets. After that it creates places for all derived Sets and adds start + end state. Then it draws the connections. In the last step it returns the Petri net [2].

If we have a log, we want to automatically learn a process model that allows for the behavior that we have seen in the log. We can load collected event data into program “ProM”, after that we can automatically build a model using the Alpha algorithm. A model that can be produced by applying Alpha algorithm using event data from information system “Grain Chain” is shown on Fig. 1.

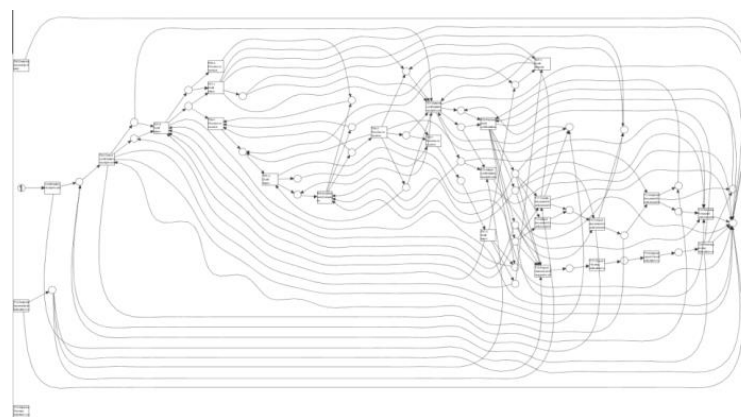


Fig.1. Model of deal creating using electronic trading platform

Conclusion

The model of electronic trading platform “Grain Chain” business process by applying basic algorithm of process mining was produced as a result of the study. Electronic trading platform event logs were collected using Yandex.Metrika, and then the Alpha algorithm was applied using event data. Thanks to the resulting model performance bottlenecks in the information system were found and removed.

Big Data is changing the way we do business, socialize and conduct research. In modern society, event data are collected about anything, at any time, and at any place. Process mining tools are able to analyze such data and can handle event logs with billions of events by exploiting modern IT infrastructures. Thus, process mining is a progressive technology in business process management for modern companies. It can quickly and efficiently optimize and improve business processes.

References

1. Van der Aalst W.M.P. Process Mining: Data science in action. URL: <https://www.coursera.org/learn/process-mining>. (Accessed 29.11.2020).
2. Van der Aalst W.M.P. Process Mining – Data science in action. Berlin, Springer-Verlag, 2016. 467 p.
3. Morozevich E.S., Panfilov I.A. Process mining kak instrument sovershenstvovaniya biznes-processov. [Process mining as a tool to improve business processes]. URL: <https://cyberleninka.ru/article/n/process-mining-kak-instrument-sovershenstvovaniya-biznes-protsessov/viewer>. (Accessed 30.11.2020). (Rus)
4. Shalyaeva I.M. Monitoring ekologicheskikh katastrof i ih posledstvij na osnove Internet-novostej. [Monitoring of environmental disasters and their consequences on the basis of Internet-news]. URL: <https://publications.hse.ru/mirror/pubs/share/folder/pqamolp6yt/direct/195908309> (Accessed 1.12.2020). (Rus)

ПРИМЕНЕНИЕ ALPHA-АЛГОРИТМА ДЛЯ ИНТЕЛЛЕКТУАЛЬНОГО АНАЛИЗА ПРОЦЕССОВ ЭЛЕКТРОННОЙ ТОРГОВОЙ ПЛАТФОРМЫ

Д. В. Добровольский*, С. П. Вопилин, Д. О. Рылёв

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: danila.dobrovolskij@bk.ru

Аннотация. Целью данного исследования является создание модели, которая описывает бизнес-процесс электронной торговой платформы «Grain Chain», с применением базового алгоритма Process Mining. В исследовании будет рассмотрен сбор журналов событий электронной торговой платформы и использование Alpha-алгоритма для получения модели на основе данных о событиях. Актуальность исследования заключается в том, что с использованием полученной модели могут быть обнаружены и устранены проблемы, связанные с производительностью информационной системы.

Ключевые слова: Alpha-алгоритм, бизнес-процесс, интеллектуальный анализ процессов, моделирование процессов.

A Device for Motor Activity Registration to Determine Yeast Hyperkinesia

D. P. Dolgov

Tambov State Technical University, Tambov, Russia
e-mail: Toveg2@yandex.ru

Abstract

The number of people suffering from tremulous hyperkinesia is constantly growing. The existing methods of diagnosis and assessment of the treatment are ineffective due to the specific conditions necessary for their correct operation. The aim of the work is to develop a device based on the accelerometry method for studying the condition of a patient with various neurological diseases. To analyze the parameters of motor activity and to assess the effectiveness of treatment in the future, special software was developed.

Keywords: accelerometry, actigraphy, epilepsy, motion detection sensor, neurological disorders, Parkinson's disease, tremor hyperkinesia.

Introduction

According to the World Health Organization (WHO), there is a high incidence of the class "Diseases of the nervous system" in the world. The incidence of diseases of the nervous system in the world and in Russia is growing steadily. Thus, about 50 million people in the world suffer from epilepsy, which, without the provision of the necessary treatment, progresses and leads to disability. The world prognosis for Parkinson's disease is also unfavorable - its incidence among the population, including in Russia, increased by 5.9% from 2010 to 2017 [1].

Problems

To analyze the effectiveness of treatment and dosage of medications for various neurological disorders, information is needed on the frequency and duration of attacks. To obtain qualitative and quantitative information about seizures, there are various instrumental methods, such as electroencephalography (EEG), video-EEG monitoring (VEEG), positron emission tomography (PET), and others. These methods are well known and common. All of them are quite informative, but at the same time have their disadvantages, namely: high cost, complexity of use at home, impossibility of constant monitoring of the patient, characteristic of all methods, and non-absolute verification of the process [2].

Proposed solution

The difference between the accelerometry method proposed by us in this work and the existing methods for diagnosing tremulous hyperkinesia is the availability, informational significance and ease of use of collecting information about the motor activity of the limbs during long-term monitoring. As with other extrapyramidal types of tremor, accelerometry is unique in the possibilities of subsequent metrological analysis.

The proposed solution includes the use of an accelerometer to record the total motor activity, the amount of registered activity, and the degree of motor activity. The obtained information about motor parameters during information processing of Parkinson's disease patterns and other neurological disorders allows for metrological analysis [3].

In order to collect information, process it later, find out the metrological features of motor activity in General and tremor in particular, as well as aggregate analysis of all registered patterns in Parkinson's disease, we offer a device for registering the movements of the hands with subsequent data processing using special software. The block diagram of the device is shown below in figure 1.

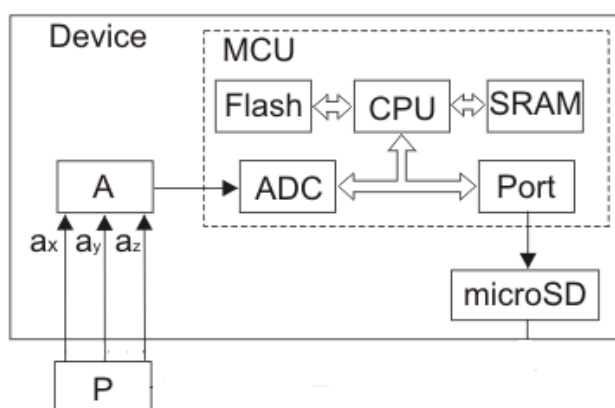


Fig. 1. Block diagram of the device

Later, using the developed software, the obtained data were processed and presented for analysis in the form of values, graphs and histograms (Fig 2). The following parameters were evaluated [3]:

Motor activity – is activity determined by the percentage of the ratio of the number of files with significant motor activity to the total number of files, in%;

Jerk – is a module of the highest rate of acceleration change, the value obtained during data recording, g/s is used.

The number of events – is the total number of movements during the entire study period.

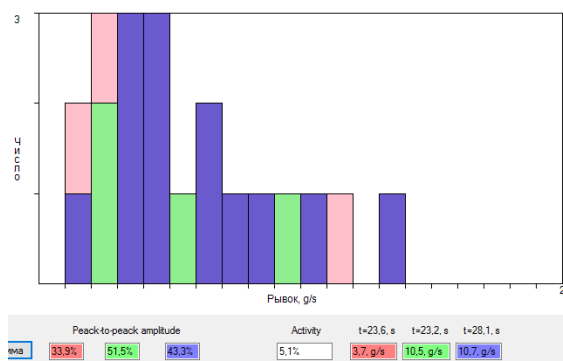


Fig. 2. Screenshot of the program for determining the parameters of motor activity

Conclusion

Traditional methods of diagnosing the state of the human body are ineffective for long-term monitoring. The accelerometry method, having slightly different information content from other known instrumental methods, is well suited for long-term monitoring due to its versatility and accessibility [4].

The developed device for registration of motor activity allows revealing the potential of the accelerometer sensor fully. It demonstrates the possibility of its use for diagnostics and assessment of the effectiveness of treatment of tremulous hyperkinesia.

References

1. Ilarioshkin S.N. Ivanova-Smolenskaya I.V. Drozhatel'nye giperkinezy [Shivering hyperkinesia]. M.: Atmosphere, 2011, pp. 246-256. (Rus)
2. Gorbunov A.V., Egorov S.A., Egorov A.S. Patent 168584 Russian Federation. [Device for recording human motor activity]. (Rus)
3. Gorbunov A.V., Egorov S.A., Egorov A.S. Patent 2640138 Russian Federation. [A method for the diagnosis of epilepsy and a device for its implementation]. (Rus)
4. Gorbunov A.V., Dolgov E.P. [The capabilities of the accelerometer in Parkinson's disease]. VI International Scientific and Practical Conference "Virtual simulation, prototyping and industrial design". Tambov: TSTU, 2019, pp. 250-255. (Rus)

УСТРОЙСТВО ДЛЯ РЕГИСТРАЦИИ ДВИГАТЕЛЬНОЙ АКТИВНОСТИ ДЛЯ ОПРЕДЕЛЕНИЯ ДРОЖАТЕЛЬНЫХ ГИПЕРКИНЕЗОВ

Е. П. Долгов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: Toveg2@yandex.ru

Аннотация. Количество людей, страдающих дрожательными гиперкинезами, постоянно растёт. Существующие методы диагностики и оценки эффективности лечения малоэффективны вследствие специфических условий, необходимых для их корректной работы. Цель работы – разработать устройство на основе метода акселерометрии для исследования состояния пациента с различными неврологическими заболеваниями. Для анализа параметров двигательной активности и в возможности в будущем оценивать эффективность лечения было разработано специальное программное обеспечение.

Ключевые слова: Акселерометрия, актиграфия, болезнь Паркинсона, датчик регистрации движения, дрожательные гиперкинезы, неврологические расстройства, эпилепсия.

Information Technologies for Blind Users

O. V. Dubrovina

Tambov State Technical University, Tambov, Russia
e-mail: prepov@rambler.ru

Abstract

The article analyzes information technologies used by visually impaired and blind users while working with a computer. The software and hardware as well as the necessary skills and abilities allowing such people to work at a computer were identified. The article describes the main screen access programs and the principle of operation of users with vision problems using them. The paper presents common speech synthesizers that read the text aloud by screen readers. Aspects of the application of a braille display or braille line and printing of text in braille were considered. The general principle of operation of a user with serious visual impairments and options for convenient display of information was described.

Keywords: tflomeans, relief-point output, screen reader, braille display, braille line.

Introduction

The standard computer interface is aimed at sighted people and is based on visually perceived forms of information. The ability to work at a computer for the blind is provided by a complex of software and hardware tools that convert visual information into tactile and auditory information.

The main computer tool is a screen access program that transfers information between a blind user and a computer. This is due to the output of information using sound and the bas-relief output.

Hardware and software speech synthesizers perform voice output of information. They are programs that convert digital information into speech, which is read by screen readers. Important parameters of speech synthesizers are the quality of speech, the speed of reaction to the control and the maximum possible playback speed.

To display the bas-point type of computer information, a special device called a braille display is used. It is a string containing up to eighty-eight-point modules on which text information is displayed in Braille. The work of a blind person with a braille display can be imagined as viewing the contents of the monitor through a small window, which displays all the information on the screen [1].

Analysis of computer technologies for the blind

Most braille displays can not only display computer information, but also transmit user control to the computer. Each display module is equipped with a special button. By pressing it, information about the position displayed by this module on the screen is sent to the computer and can be interpreted by software (for example, pressing a mouse button, causing the carriage to move or activate the corresponding menu item).

There are several types of screen readers. In this article, we are going to consider the most common. Screen reader JAWS for Windows by Freedom Scientific is the world's most popular data access software, with multi-touch and

gesture support, easy installation, and support for all Windows application standards. JAWS 8.0 and later versions have built-in speech synthesizer [3].

The second most popular is the free NVDA screen reader for Windows operating systems, which allows blind and visually impaired users to work at a computer without additional financial costs for specialized software. NVDA interacts with the user through speech synthesis and braille output, and provides access to various features of the Windows operating system.

In Russia, the most popular speech synthesizers are SpeakingMause, Digalo and Sakrament. It is rather difficult to determine which one is better. Because, SpeakingMause shows good responsiveness to commands and high phonetic intelligibility, and Digalo provides a more comfortable perception, but reacts slower to control. To ensure comfortable working conditions, several synthesizers are often installed on a computer and one of them should be multipurpose.

The solution to the problem of the information flow organizing in accordance with the available storage media is assigned to the screen access program. In other words, the purpose of the screen access program is to create an information model of the working situation based on the bas-point output on the braille display and / or speech messages of the synthesizer. That would provide the blind operator with the opportunity to make decisions for targeted impact on it, and then control the effectiveness of this impact.

When working at a computer, a blind user uses a conventional keyboard. All work is based on knowledge of the ten-finger printing method and a set of Windows control commands. There is also a braille keyboard. This is a device that allows entering text characters in 6- or 8-point braille. Each braille keyboard has at least 6 dot keys, a space key and, depending on the model, additional service keys. Their main disadvantage is cost.

Specialized notebooks for the visually impaired, as a rule, have such keyboards and can be used in conjunction with a computer. A standard computer keyboard is required for complete control over your computer. There are also computer programs that allow entering 6-point Braille text using a standard computer keyboard. The cost of such programs is significantly lower than the cost of a specialized braille keyboard.

Special printers are used to output information for printing. They allow converting flat-printed text into Braille. Modern braille printers allow printing texts made in any text editor. Graphic output to a braille printer is used most often for printing plans, diagrams, graphs, etc. Of course, the visual capabilities and resolution of bas-point graphics are significantly inferior to the usual ones.

Typing a text for a blind person is a difficult task. Speech recognition programs are designed to solve this problem. Dragon Systems' Naturally Speaking and IBM's ViaVoice allow dictating text to a computer without pauses between words. Unfortunately, these products are unable to process fast speech. In addition, the resulting text needs editing. There is a need to use a braille display and keyboard.

The most important source of differences between work processes based on a standard (visual) and non-visual interface is the fundamental difference in

information models on the basis of which they are built. In the standard version, a complete picture of the working situation can be provided by an image on the screen. When a blind user is working, the working situation information model is synthesized on the basis of a series of sequential local messages of the screen access program by means of logical thinking, in the same way as with the help of spatial thinking a number of local perceptions are formed into a single image of space. This model has no material carrier, existing only in the operator's imagination [2].

Conclusion

Each of the considered tools, used by the blind to work at a computer, has its own advantages. The braille display greatly facilitates work that requires detailed and accurate perception of information (editing, reading foreign language texts, etc.). The use of a speech synthesizer provides a higher speed of obtaining information in comparison with reading on a braille display. Therefore, speech access is more efficient, for example, when familiarizing with large amounts of information. In addition, the speech output makes it possible to control the correctness of actions by ear, without looking up from the keyboard.

It can be concluded that the most effective way for a blind user to work at a computer is the combined use of a speech synthesizer and a braille display, which allows combining the advantages of both of these tools.

References

1. Shvetsov V.I., Roshchina M.A. Komp'yuternye tiflotekhnologii v social'noj integracii lic s glubokimi narusheniyami zreniya: Uchebnoe posobie [Computer typhlotechologies in the social integration of persons with profound visual impairments: Textbook]. Nizhny Novgorod: NNSU, 2007, 154 p. (Rus)
2. Shchvetsov V.I., Roshchina M.A. Pedagogicheskoe soprovozhdenie razvitiya i primeneniya komp'yuternyh tekhnologij kak sredstva social'noj integracii lic s glubokimi narusheniyami zreniya [Pedagogical support for the development and application of computer technologies as a means of social integration of persons with profound visual impairments]. Bulletin of Lobachevsky Nizhny Novgorod University. Series of Innovations in Education. Nizhny Novgorod: NNSU, 2012, 4(1), pp. 76-82. (Rus)
3. Computer technologies for the blind and visually impaired [Electronic resource]. URL: <http://www.tiflocomp.ru/>

ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ ДЛЯ НЕЗРЯЧИХ ПОЛЬЗОВАТЕЛЕЙ

О. В. Дубровина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: prepov@rambler.ru

Аннотация. В статье проведен анализ информационных технологий, применяемых слабовидящими и незрячими пользователя в работе с компьютерной техникой. Определены программные и технические средства и необходимые навыки, и умения, позволяющие таким людям работать за компьютером. Описаны основные используемые программы экранного доступа и принцип работы пользователей с проблемами зрения при помощи их. Приведены распространённые синтезаторы речи, озвучивающие текст, читаемый программами экранного доступа. Рассмотрены аспекты применения брайлевского дисплея или брайлевской строки и вывода на печать текста шрифтом Брайля. Описан общий принцип работы пользователя с серьезными нарушениями зрения и варианты удобного вывода информации.

Ключевые слова: тифлосредства, рельефно-точечный вывод, программа экранного доступа, брайлевский дисплей, брайлевская строка.

The Information System of the Human Resources Department for a Penal Settlement

M. V. Filimonova*, L. A. Tyuterev

Tambov State Technical University, Tambov, Russia

*e-mail: marifilimonova96385@gmail.com

Abstract

The software and technical equipment of the human resources department in the penal settlement is considered. As a result, it is advisable to develop an information system for working with data on the staff of the correctional institution. To develop this system, the activities of the human resources staff on hiring, dismissing, personnel accounting and drawing up documentation were studied in detail. A data flow diagram has been created that reflects the result of the analysis of the activities of the human resources department. The system “Automated information system of the human resources department” developed on the basis of diagrams and tables is presented.

Keywords: penal settlements, database, HR department, HR staff, system.

The main structural unit for personnel management in any correctional institution, including a penal settlement, is the HR department. The goal of the HR department is to achieve the goals of the institution by providing the organization with the necessary personnel and effectively using the potential of employees. The HR staffs are entrusted with the functions of hiring, dismissing, recording personnel, improving qualifications and retraining personnel, issuing and calculating vacations, drawing up a staffing table and various types of documentation.

Fig. 1 presents a functional model of the activity of the HR department of a penal settlement.

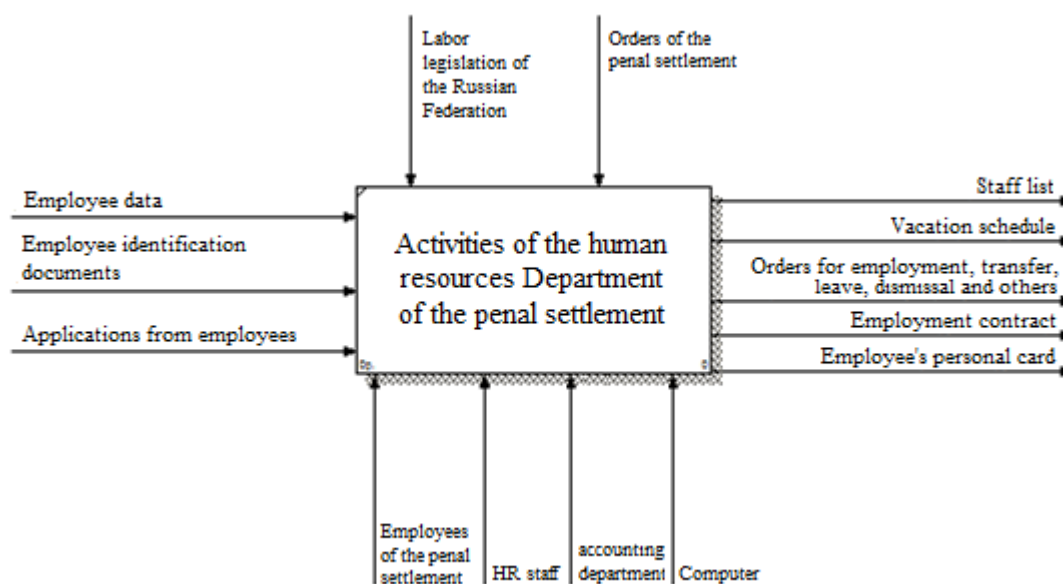


Fig. 1. Human resources department of a penal settlement

The information systems market abounds in a variety of HR solutions that improve the productivity and quality of employees in a department. Each such software system has a lot of advantages, but the analysis showed that their implementation in the HR department of the penal settlement is impractical, since some of the functions of these programs will simply not be in demand in this institution due to the not so large staff. In addition, these systems have a significant cost of implementation and support. Therefore, we consider it expedient to develop an information system with the necessary set of functions, designed to automate the activities of employees of the HR staff in a penal settlement.

The analysis of the activities of the HR department employees in the penal settlement showed that the database of the developed information system should consist of the following objects: “Education”, “Reward”, “Marital status”, “Department”, “Position”, “Military rank”, “Personal card”, “Order T1”, “Order T5”, “Order T6”, “Order T8” and “Employment contract”. All objects are interconnected and are represented by tables.

After the database in Delphi, a system shell was created, represented by 17 forms and one data module, which is designed to store database objects and SQL queries and provide direct user interaction with the database.

Figure 2 presents the interface of the main form of the program. The tabs of the main menu “Organization”, “Reference books”, “Documents” and “Exit” are designed to go to the corresponding forms and program exit. The button “Personal file” allows the user to view detailed information about a specific employee and edit data about him. The form also provides the ability to search for an employee by full name.

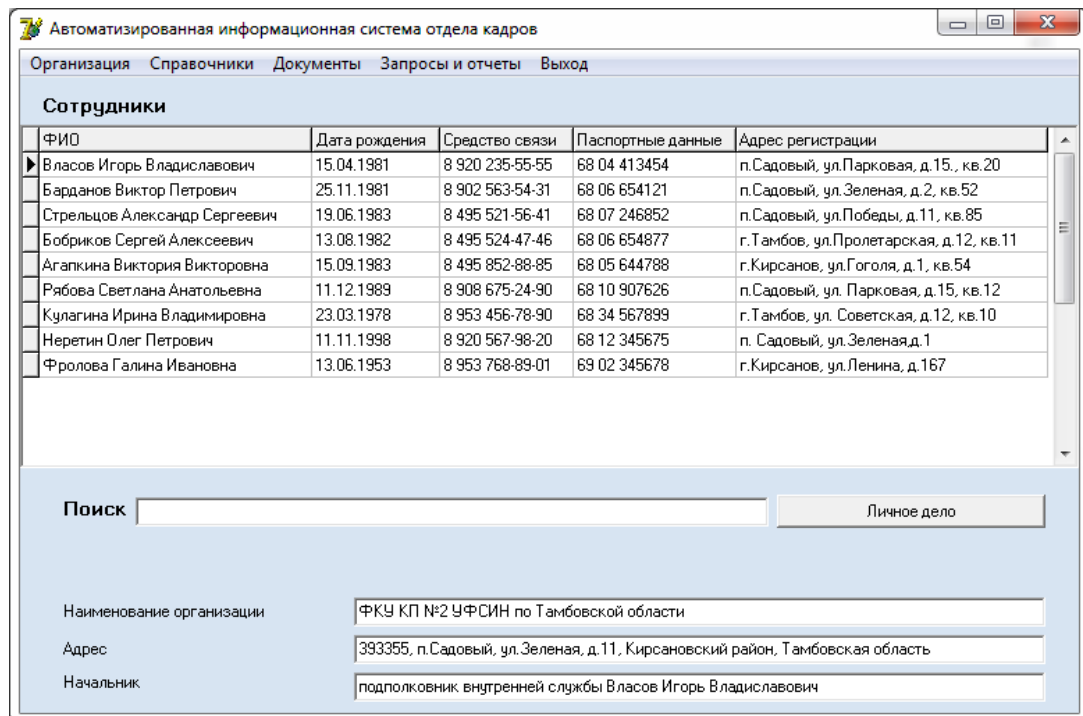


Fig. 2. The main form

The developed information system is designed to automate the process of filling out documentation for employees of the penal settlement, storing, processing, searching for information, as well as exporting it to Unified Forms. In addition, the system allows you to automate the filling of the required data forms of reports and requests, among which one can single out the “Staffing table” and “Vacation schedule”. This helps to save time for HR staff, as well as avoid possible mistakes in work.

We believe that the product should free the human resources staff from routine unproductive labor, reducing the processing time and ensure high efficiency of obtaining the required information.

References

1. Gagarina L.G., Teplova Ya.O., Rumyantseva E.L., Gagarinoy L.G. *Informatsionnyye tekhnologii: ucheb. posobie* [Information technology: a tutorial]. M.: ID FORUM, NITS INFRA-M, 2015, 320 p. (Rus)

2. Lisyak V.V. *Razrabotka informatsionnykh sistem: ucheb. posobiye* [Development of information systems: a tutorial]. URL: <http://www.iprbookshop.ru/95818.html>. (Accessed: 05.12.2020). (Rus)

3. Nazarov S.V. *Arkhitektura i proyektirovaniye programmnykh sistem: monografiya* [Architecture and design of software systems: monograph]. M.: INFRA-M, 2018, 374 p. (Rus)

4. Nemtinov V.A., Nemtinova Yu.V. On an Approach to Designing a Decision-Making System for State Environmental Examination // *Journal of Computer and Systems Sciences International*. 2005. T. 44. № 3. С. 389-398.

ИНФОРМАЦИОННАЯ СИСТЕМА ОТДЕЛА КАДРОВ ДЛЯ КОЛОНИИ-ПОСЕЛЕНИЯ

М. В. Филимонова*, Л. А. Тютерев

Тамбовский государственный технический университет, Тамбов, Россия
**e-mail: marifilimonova96385@gmail.com*

Аннотация. Рассмотрена программно-техническая оснащенность отдела кадров в колонии-поселения. В результате выявлена целесообразность разработки информационной системы для работы с данными о сотрудниках исправительного учреждения. Для разработки данной системы была подробно изучена деятельность сотрудников отдела кадров по приему, увольнению, учету персонала и составлению различной документации. Создана диаграмма потоков данных, отражающая результат анализа деятельности отдела кадров. Представлена разработанная на основе диаграммы и таблиц система «Автоматизированная информационная система отдела кадров».

Ключевые слова: база данных, колония-поселение, отдел кадров, система, сотрудники отдела кадров.

The Application of SVD to Initialize Weights of the Neural Network

I. I. Khrushchev*, D. V. Neretin, D. A. Klinkov

Tambov State Technical University, Tambov, Russia

*e-mail: ilya68rus01@gmail.com

Abstract

The average time spent on building a neural network with a high convergence rate is quite large. The aim of this article is to reduce the time spent on building a neural network. To solve this problem, an approach based on predicting the values of the weight coefficients is used. If, at the stage of building a neural network, we set weights close to those that will be achieved as a result of training, then the training time will be reduced. Using SVD allows determining the importance of attributes of the input dataset relative to others, while using individual numbers as weights can improve the convergence rate of the neural network.

Keywords: artificial neural networks, neural network weights, SVD.

Currently, you can observe the rapid development of various methods of machine learning, and, in particular, artificial neural networks (ANN), this direction is one of the most promising, which is confirmed by the decree of the President of the Russian Federation “On the development of artificial intelligence in Russian Federation”, within the framework of which the national strategy for the development of artificial intelligence for the period up to 2030 was approved.

Thus, the construction and analysis of artificial neural networks is an urgent task. At the same time, there are few tools for automating computational experiments with neural networks, and they are difficult to master. Because of this, the average time spent on building a neural network with a high convergence rate is quite large.

One of the approaches for increasing the convergence of artificial neural networks is to predict the values of the weight coefficients. If, at the stage of constructing the ANN, set weights close to those that will be achieved as a result of training, then the training time will be reduced.

Thus, the aim of the work is to reduce the labor and time spent on setting up computational experiments to increase the convergence of artificial neural networks, modernized by means of predictors of weight coefficients.

The principle of ANN operation is simple: a vector of input values arrives at the input layer, then these values are sent to the next neuron, and multiplied by the vector of weights of connections between neurons. After that, the products of weights and values are summed up in the neuron to which they enter, and the specified activation function is applied to this sum. Mathematically, this can be written as follows:

$$y = f \left(\sum_{i=1}^k x_i * w_i \right),$$

where y is the output value of the neuron; x_i is a value coming to the i -th input; w_i is a weighting coefficient of the i -th connection; k is a number of neuron inputs; f is a selected activation function.

Based on this, we can conclude that the weights of the neural network have a huge impact on the training time of the neural network. Indeed, training a neural network consists in selecting the correct weighting factors, at which the required result will be achieved.

Representation of a real $m \times n$ matrix A in the form:

$$A = U * S * V,$$

where S is an $m \times n$ diagonal matrix with a diagonal of non-increasing singular numbers s_1, s_2, \dots, s_k , and U and V are orthogonal $m \times m$ and $n \times n$ matrices, respectively, is called a singular value decomposition of the matrix A or SVD decomposition [2].

The matrix S is of particular interest, since the elements of this matrix show how important each of the attributes is relative to the others. This fact is of interest, since the initial method of specifying the ANN weights strongly affects the learning rate and the result.

The hypothesis under study is that if you set the initial value of the weights of the first hidden layer based on the normalized diagonal elements of the matrix S (singular numbers), you can speed up the learning process of the ANN. This hypothesis is based on the idea that as a result of the proposed initialization of the weights of the first hidden layer, the neural network at the beginning of training will tend to divide the sample into a priori created clusters.

To solve the classification problem using the ANN, a training data set is required, which consists of an array of input data X , dimension $m \times n$, and a column vector of output values Y , dimension $m \times 1$, which contains g classes. For the successful application of SVD decomposition, it is required to apply the classification and thereby divide the original array X into g arrays.

$$X = (X^1, X^2, \dots, X^g).$$

The classification is applied so that in each resulting array X^i , $i = (\overline{1, g})$ there are data characterizing the i -th class, which will allow us to determine the importance of each attribute for this class more accurately. The next step is to highlight hidden subclasses, for this, clustering is used, as a clustering algorithm, we will use K-means.

As a result of clustering, the data arrays corresponding to each class can be divided into k more arrays:

$$X^1 = (X_1^1, X_2^1, \dots, X_k^1), X^2 = (X_1^2, X_2^2, \dots, X_k^2), X^g = (X_1^g, X_2^g, \dots, X_k^g).$$

Clustering allows you to determine the dependencies between the attributes of arrays by identifying their cluster structure. The next stage is to apply SVD and find singular numbers for each array X_j^i , where: $i = [1, \dots, g]$; $j = [1, \dots, k]$. As a result, we get k matrices S_j^i for each class and combine them into one matrix:

$$S^1 = (S_1^1, S_2^1, \dots, S_k^1), S^g = (S_1^g, S_2^g, \dots, S_k^g), S = (S^1, S^2, \dots, S^g).$$

As a result, the resulting matrix S can be set as a matrix of weight coefficients, for the ANN with n inputs and $g * k$ neurons in the first hidden layer. However, to apply

singular numbers in the ANN, the vectors S_j^i should be normalized. Each element of the S matrix will show how important the corresponding input neuron is for predicting the outcome.

We experiment with different architectures and methods of initializing the weight coefficients, write down the accuracy metric values in a table. The experimental results are presented in Table 1.

Table 1. Results of the experiments

Experiment number	ANN with one hidden layer			ANN with two hidden layers		
	<i>SVD</i>	<i>He normal</i>	<i>Lecun normal</i>	<i>SVD</i>	<i>He normal</i>	<i>Lecun normal</i>
1	0.748	0.755	0.767	0.766	0.767	0.774
2	0.855	0.869	0.863	0.860	0.868	0.877
3	0.834	0.839	0.839	0.846	0.858	0.858
4	0.922	0.925	0.926	0.928	0.925	0.929
5	0.818	0.825	0.838	0.855	0.868	0.869
6	0.841	0.842	0.848	0.855	0.870	0.870
7	0.835	0.826	0.838	0.850	0.848	0.860
8	0.893	0.893	0.902	0.920	0.906	0.921
9	0.807	0.817	0.823	0.827	0.849	0.857
10	0.853	0.865	0.867	0.875	0.888	0.896

Based on the results of the experiments, it can be seen that the ANN with two hidden layers and the method of initializing the weights coefficients *Lecun normal* has the best indicators. However, the SVD-based initializer performs close to the best, and the difference between the average accuracy is only 0.02.

Based on all that has been said previously, we can conclude that the method of initializing weight coefficients based on SVD can be used to train the ANN, since the trained ANN classifies the data quite accurately, however, it is impossible to judge the increase in the convergence rate of the ANN at this stage of the experiments.

References

1. Verzhbitskiy V.M. Vychislitel'naya lineynaya algebra [Computational Linear Algebra]. M.: Higher School, 2009, 351 p. (Rus)

ПРИМЕНЕНИЕ SVD ДЛЯ ИНИЦИАЛИЗАЦИИ ВЕСОВЫХ КОЭФФИЦИЕНТОВ НЕЙРОННОЙ СЕТИ

И. И. Хрущев, Д. В. Неретин, Д. А. Клинков

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ilya68rus01@gmail.com

Аннотация. Средние временные затраты, на построение нейронной сети с высокой скоростью сходимости, довольно велики. Для решения этой проблемы применяется подход, основанный на прогнозировании значений весовых коэффициентов. Если на этапе построения нейронной сети задать веса близкие к тем, что будут достигнуты в результате обучения, то время обучения сократится. Применение SVD позволяет определить важность атрибутов входного набора данных, относительно других, а использование сингулярных чисел в качестве весовых коэффициентов способно улучшить скорость сходимости нейронной сети.

Ключевые слова: веса нейронной сети, искусственные нейронные сети, SVD.

Road Traffic Regulation Using Machine Learning Technologies

V. A. Khvorov *, S. A. Odintsov, D. E. Semyonov

Tambov State Technical University, Tambov, Russia
*e-mail: vadimhvorovhnz@mail.ru

Abstract

This paper discusses the way to regulate road traffic by embedding adaptive traffic lights into the road infrastructure, which can analyze the situation on the road and make decisions about changing the signal using machine learning technologies.

Keywords: intersection control, machine learning, neural network.

Introduction

There are several ways to ensure efficient vehicle traffic on road infrastructure. The first is to expand transport capacity and build better road systems. However, this solution is time and resource consuming. The second is to work with the existing infrastructure by improving systems that have a significant impact on traffic flow, such as traffic lights.

Therefore, it becomes necessary to optimize, first of all, already existing systems for regulating traffic flows.

Literature review

Previous works have been done to dynamically control adaptive traffic lights. But due to the limited computing power and simulation tools, early studies focus on solving the problem by fuzzy logic [1], linear programming [2], etc. In these studies, road traffic is simulated with many restrictions and cannot be applied in real life. There are two significant limitations to these studies.

First, most of them test their models at a simple cross-shaped intersection with through traffic. Secondly, none of the previous studies considered the work of traffic lights in an endless loop.

This paper describes the creation of a system that can regulate an intersection of any complexity at any time interval.

System description

To develop such a system, we need “eyes” to monitor the number of vehicles in real time, and “brain” to make decisions about changing traffic light signals.

Instead of “eyes” there will be a camera that will transmit video with the situation at the intersection, and an algorithm for recognizing vehicles.

Instead of a "brain" - a neural network using reinforcement learning.

Vehicle recognition

When solving the problem of vehicle recognition, the most promising approach is the use of computer vision through a digital video camera. One of the most successful methods in this area is the Viola-Jones method [3]. Using the Viola-Jones method, the problem of object recognition is successfully solved using the

criteria that the input stage of the method is trained with. This allows us to create an algorithm for our study.

Neural network

Reinforcement learning is one of the categories of machine learning algorithms that are different from supervised learning and unsupervised learning. He interacts with the environment to receive rewards for his actions. Its goal is to make decisions that maximize numerical rewards over the long term. During the learning process, the agent takes an action and the environment returns a numerical reward based on the action and current state.

The simplest reinforcement learning model consists of:

- S : the possible state space s is a specific state ($s \in S$);
- A : the possible action space a is an action ($a \in A$);
- R : the reward space $r_{s,a}$ means the reward in taking action a at state s ;

1) State. In our system, the vehicle recognition algorithm is responsible for determining the state.

2) Action. The action space is determined by choosing the duration of each phase in the next cycle. But if the duration varies greatly between two cycles, the system can become unstable. Therefore, the minimum allowable phase duration is set to 20 seconds.

3) Reward. Reward is the element that distinguishes reinforcement learning from other learning algorithms. The role of reward is to provide feedback to the reinforcement learning model about the performance of previous activities. In our system, the main goal is to improve the efficiency of the intersection. The main indicator of efficiency is the waiting time for vehicles. Thus, we define reward as the change in cumulative waiting time between two adjacent cycles.

Let i_t denote the observed vehicle from the starting time to the starting time point of the t^{th} cycle and N_t denote the corresponding total number of vehicles till the t^{th} cycle. The waiting time of vehicle i till t^{th} cycle is denoted by $w_{i_t,t}$, ($1 \leq i_t \leq N_t$). The reward in t^{th} cycle is defined by the following equation,

$$r_t = W_t - W_{t+1}, \text{ where}$$

$$W_t = \sum_{i_t=1}^{N_t} w_{i_t,t}$$

It means the reward is equal to the increment in cumulative waiting time between before taking the action and after the action. If the reward becomes larger than before, the waiting time increases less than before. Considering the delay is non-decreasing with time, the overall reward is always non-positive.

Results

We will compare the performance of the proposed model with scenarios when the traffic light times are planned in advance. At intersections with traditional traffic lights, the operators plan the signals in advance and they do not change

anymore. The assessment is carried out in SUMO [4], which provides real-time simulation of road traffic at the micro level.

The intersection consists of two perpendicular roads shown in Fig. 1. The area of the entire intersection is 300 x 300 m.

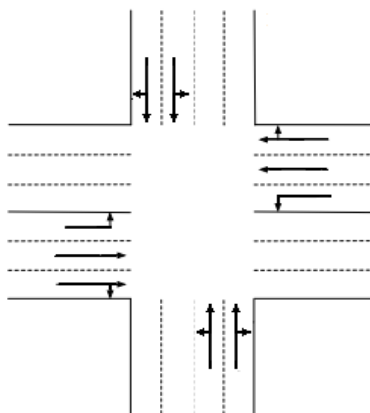


Fig. 1. Intersection view

Vehicles arrive at each lane according to a specific random process. The average speed of vehicles appearing on a vertical road in each lane is the same and amounts to 1/10 per second. On a horizontal road, the speed of cars appearing on the through-traffic lane is 2/10 per second, and the speed of appearing on the lanes from which a turn is possible is 1/10 per second.

The model is trained iteratively. The number of iterations is 1500. One iteration is an episode with traffic for one hour. The reward accumulates throughout the entire training episode. The goal of our network is to maximize the reward in one-hour episode by changing the duration of the traffic signals.

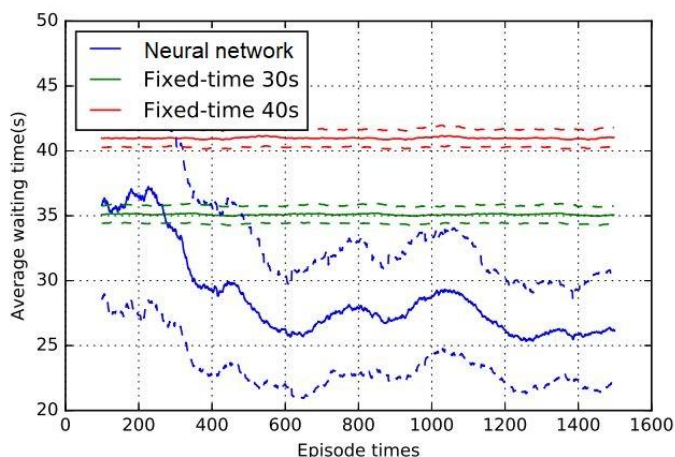


Fig. 2. Simulation results

The performance in our system is compared to fixed signal traffic lights. We record the duration of traffic lights at 30 seconds and 40 seconds. The simulation results are shown in Fig. 2.

The blue line shows the results of our model, while the green and red lines show the results of the fixed time traffic light. The dotted lines are the corresponding confidence intervals for the lines of the corresponding color.

Conclusion

The traffic control system presented in this article can learn to reduce waiting time from about 35 seconds to 26 seconds after 1200 iterations, at least 25.7% less than the other two strategies. This shows that our model can significantly improve the average waiting time for vehicles at intersections.

References

1. Chiu S., Chand S. Adaptive traffic signal control using fuzzy logic. The First IEEE Regional Conference on Aerospace Control Systems, April 1993, pp. 1371–1376.
2. De Schutter B. Optimal traffic light control for a single intersection. American Control Conference, vol. 3, June 1999, pp. 2195–2199.
3. Viola P., Jones M.J., Snow D. Detecting pedestrians using patterns of motion and appearance. Proceedings of the 9th International Conference on Computer Vision (ICCV'03), 2003, pp. 734–741.
4. Krajzewicz D., Erdmann J., Behrisch M., Bieker L. Recent development and applications of sumo-simulation of urban mobility. International Journal on Advances in Systems and Measurements, 2012, No. 3-4, pp. 128–138.
5. Nemtinov V., Nemtinova Yu., Borisenko A., Mokrozub V. Information Support of Decision Making in Urban Passenger Transport Management // Transport Problems. 2017. T. 12. № 4. pp. 83-90.

РЕГУЛИРОВАНИЯ ДОРОЖНОГО ДВИЖЕНИЯ С ИСПОЛЬЗОВАНИЕМ ТЕХНОЛОГИЙ МАШИННОГО ОБУЧЕНИЯ

В. А. Хворов*, С. А. Одинцов, Д. Э. Семёнов

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: vадimhvorovhnz@mail.ru

Аннотация. В данной статье рассматривается способ регулирования дорожного трафика путём встраивания в дорожную инфраструктуру адаптивных светофоров, которые могут анализировать ситуацию на дороге и принимать решения о смене сигнала с помощью технологий машинного обучения.

Ключевые слова: регулирования перекрестков, машинное обучение, нейронная сеть.

Dynamics of Information Conflict

E. V. Koshelev, A. D. Lomov, D. YU. Tulupov

Tambov State Technical University, Tambov, Russia

e-mail: lyutsian-zzz@yandex.ru, alekslomyarius@gmail.com, tulupovden@yandex.ru

Abstract

The aim of the paper is to represent in formula form such concepts as dynamics of the information conflict, state of the supersystem, and resource allocation of the supersystem. These concepts were not presented in the form of formulas before. The presentation of information conflicts proposed in the article can be used for educational purposes, as well as for modeling and analyzing complex information systems.

Keywords: conflict, information conflict, resource allocation, state of the supersystem.

Like any social phenomenon, conflict can be viewed as a process that takes place over time. A conflict has certain periods and steps, during which it arises, develops, and ends. The dynamics of a conflict is the course of development, changes in the conflict under the influence of its internal mechanisms and external factors.

In [3], the information conflict is described as follows: «Any state, stage and level of IS development is characterized by conflicts that may be internal, caused by a number of reasons (for example, mismatching of the technical base and software, insufficient training of personnel, etc.), as well as external, caused by the actions of competitors. It should be noted that external conflicts are "man-made" and represent a set of actions aimed at IS in order to obtain a certain gain (economic, technological, etc.).

The main goal of the conflict is to establish control over the information resources of the databases, software, computer equipment, peripheral equipment, telecommunications, etc. In turn, the following goals can be attributed to the tactical and strategic objectives of the conflict:

- to destroy elements of the IS infrastructure using methods and means of information impact, including means of destruction, distortion and theft of information, overcoming protection mechanisms and information security systems, restricting or prohibiting access to legitimate users, disorganization of work, etc.;
- to exercise hidden control (monitoring) over the use of information resources of IS [Author's translation].

Based on the above, we can conclude it is convenient to represent an information conflict as a confrontation between two supersystems. The allocation of resources of the parties discussed in the article is of interest.

We denote X is the vector of the conflict state, U and V are the control strategies of the opponents, F is the vector function, then the dynamics of the conflict is described in general form:

$$\dot{X} = F(X, U, V, t) \quad (1)$$

Target functional systems on the interval (0, T) are:

$$Z_A = F_A(X, U, V, t), Z_n = F_n(X, U, V, t), \quad (2)$$

where $U \subset u, V \subset v$.

Efficiency criteria of the systems in the course of a supersystem are:
 $\max K_A(Z_A, T), \max K_B(Z_B, T)$.

The equations of state of the supersystem A are:

$${}^A \dot{X}_K^i = - \sum_{j=1}^{N^p} L_p^j \hat{X}_p^j B V_p^{i,j,k} {}^A X_K^i f({}^A X_K^i)$$

$${}^A \dot{X}_p = {}^A \dot{X}_K - \sum_{j=1}^{N^c} L_c^j \hat{X}_c^j B V_c^{i,j,k} {}^A X_p^i f({}^A X_p^i)$$

(3)

$${}^A \dot{X}_{np} = {}^A \dot{X}_o - \sum_{j=1}^{N^n} L_n^j \hat{X}_n^j B V_n^{i,j,k} {}^A X_{np}^i f({}^A X_{np}^i) + \sum_{j=1}^{N^y} L_y^j \hat{X}_y^j B V_y^{i,j,k} {}^A X_{np}^i f({}^A X_{np}^i) \quad (4)$$

$${}^A \dot{X}_o = {}^A \dot{X}_p - \sum_{j=1}^{N^{cy}} L_{np}^j \hat{X}_{cy}^j B V_{cy}^{i,j,k} {}^A X_o^i f({}^A X_o^i)$$

where ${}^k X_o^i, {}^k X_p^i, {}^k X_o^i, {}^k X_{np}^i$ is the number of subsystem elements S_k^i

in the states S_o, S_p, S_H, S_{np} respectively;

${}^k X_o^i, {}^k X_p^i, {}^k X_H^i, {}^k X_{np}^i$ are time derivatives;

N^p, N^c, N^H, N^y is the number of reconnaissance, communications, suppression and destruction subsystems;

$V_k^{i,j,m}$ is the share of the subsystem resource S_k^i allocated against the subsystem S_k^j and satisfying the condition:

$$\sum_{i=1}^5 \cdot \sum_{m=1}^{N^k} V_k^{jim} \leq 1, L_s^i = \sum_{j=1}^{N_s} \lambda_s^{ij} \hat{X}_s^{ij} f(X_q^i) \quad (5)$$

where N^k is the number of subsystems in the system S_k ;

λ_s^{ij} is the performance of the subsystem, S_s^j , $f(X_q^i)$ that makes sense if there will be no more transitions on the interval $(t, t + \Delta t)$.

Thus, such concepts as dynamics of information conflict, state of the supersystem, and distribution of resources of the supersystem were presented in the form of convenient formulas. The representation of such concepts as the dynamics of information conflict, the state of the supersystem, and the distribution of resources of the supersystem in the form of formulas can be used for training purposes, as well as for modeling complex information systems. Thus, the goal was achieved.

References

1. Gromov Yu.Yu., Ivanovskij M.A. Razrabotka metodiki ocenivaniya effektivnosti sistemy obespecheniya informacionnoj bezopasnosti korporacii [Development of a methodology for evaluating the effectiveness of the Corporation's information security system]. Voronezh: Voronezh State University, 2011, 255 p. (Rus)
2. Gromov Yu.Yu., Ivanovskij M.A., Didrih V.E., Ivanova O.G., Martem'yanov Yu.F., Starozhilov O.G. Metody analiza informacionnyh sistem [Methods of information systems analysis]. Tambov, Novelistic, 2012, 219 p. (Rus)
3. Ohrimenko S.A. Konflikty v informacionnyh sistemah [Conflicts in information systems]. URL: <http://security.ase.md/publ/ru/pubru13.html>. (Accessed 27.10.2020). (Rus)
4. Nemtinov V., Zazulya A., Kapustin V., Nemtinova Y. Analysis of Decision-Making Options in Complex Technical System Design // Journal of Physics: Conference Series. 2019. T. 1278. № 1. p. 012018.

ДИНАМИКА ИНФОРМАЦИОННОГО КОНФЛИКТА

Е. В. Кошелев, А. Д. Ломов, Д. Ю. Тулупов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: lyutsian-zzz@yandex.ru, alekslomyarius@gmail.com, tulupovden@yandex.ru

Аннотация. Целью данной статьи является представление в формульном виде таких понятий как, динамики информационного конфликта, состояния суперсистемы, распределение ресурсов суперсистемы. Эти понятия раньше не были представлены в виде формул. Предлагаемое в статье представление информационных конфликтов может быть использовано в учебных целях, а также при моделировании и анализе сложных информационных систем.

Ключевые слова: конфликт, информационный конфликт, распределение ресурсов, состояние суперсистемы.

The Subsystem for Selecting a Class of Information System Resource Allocation Tasks

E. V. Koshelev, V. A. Milshina

Tambov State Technical University, Tambov, Russia
e-mail: lyutsian-zzz@yandex.ru, lera.milshina@yandex.ru

Abstract

The aim of this paper is to develop a neuro-fuzzy classifier for selecting the class of tasks to be solved in the distribution of information resources in information systems that are affected by negative impacts. For achieving this goal negative external impacts on information systems are analyzed and a tree of negative impacts is selected, classes of system adaptation problems are highlighted, unclear classification rules have been developed. The subject raised in this article is relevant, since no ready-made solutions were found, and the problem with negative impacts and lack of information resources is becoming more acute every year.

Keywords: class of problems to be solved, negative external influences (NEI), fuzzy classification rules, fuzzy classifier.

The effectiveness (organizational, social, technical, economic, etc.) of any system, including information, depends on the correct distribution of internal and external resources. As in any field, the work of information systems (IS) does not take place in ideal conditions. This means that the IS operates under external influences, which are usually negative in nature.

Negative external influences (NEIs) lead to unstable functioning of the IS. To counteract this influence, it is possible to redistribute elements and resources within the IS by solving optimization problems, the formulation of which is presented in [1, 2]. The type or class of such tasks is selected through the analysis. In [3] the analysis of impacts on the information system is made and the tree of these influences is proposed; these will be used in this paper when constructing neuro classifier class of tasks.

This threat tree divides all NEIs into three groups: false and erroneous information, functional damage, and connection failure. Each group is divided into subgroups. False and erroneous information is divided into: redirection of information requests for the purpose of issuing false or unnecessary information, distribution of false information, penetration into IS elements for the purpose of posting false information. Functional impairment is divided into: malfunction of IS unauthorized analysis of the structure of IS and its characteristics in order to identify vulnerabilities, scan data transmission protocols and unauthorized network traffic analysis, unauthorized access to information resources to access them from the face of the staff of the subject access, unauthorized access to information resources to control system functions. Disconnecting the connection is divided into: disabling the information-logical interaction of elements, redirecting data packets.

NEIs are designated as $V = \{V_1, V_2, \dots, V_{N_V}\}$, where V_i is a specific type of external influence on IS, N_V is the number of types of negative external influences (in this case $N_V = 10$).

Each type of negative impact is described by a set of parameters that can relate to deterministic or random variables. Thus, the negative impact of one type is described by a certain number of deterministic variables, as well as by a certain number of random variables. Each type of impact is characterized by three parameters, so $V_i = \{v_{i,1}, v_{i,2}, v_{i,3}\}$, where $v_{i,j}$ is the amount of information related to j class, for type i exposure.

Depending on the type of parameters that characterize the entire set of negative impacts that affect the functioning of the IS, the appropriate class of system adaptation tasks is selected. These classes include: problems in which all parameters are deterministic values (K_1); problems where parameters are deterministic or random variables (K_2); problems where the parameters are fuzzy variables (K_3).

The amount of information related to the j class for the i type of impact will be expressed in three fuzzy values – “small”, “medium”, and “large”.

Since 10 types of external negative impacts were considered for the classifier, and the amount of information related to one of the three classes varies between three fuzzy values (“small”, “medium” and “large”), the classifier should have 30 inputs – $v_{1,1}, v_{1,2}, v_{1,3}, v_{2,1}, v_{2,2}, \dots, v_{10,3}$.

A fragment of the fuzzy rules of the neuro-fuzzy classifier is presented below.

1. *If ($v_{1,1}$ is small) and ($v_{1,2}$ is small) and ($v_{1,3}$ is small) and ($v_{2,1}$ is small) and ($v_{2,2}$ is small) and ($v_{2,3}$ is small) and ($v_{3,1}$ is small) and ($v_{3,2}$ is small) and ($v_{3,3}$ is small) and ($v_{4,1}$ is small) and ($v_{5,2}$ is small) and ($v_{5,3}$ is small) and ($v_{6,1}$ is small) and ($v_{6,2}$ is small) and ($v_{6,3}$ is small) and ($v_{7,1}$ is small) and ($v_{7,2}$ is small) and ($v_{7,3}$ is small) and ($v_{8,1}$ is small) and ($v_{8,2}$ is small) and ($v_{8,3}$ is small) and ($v_{9,1}$ is small) and ($v_{9,2}$ is small) and ($v_{9,3}$ is small) and ($v_{10,1}$ is small) and ($v_{10,2}$ is small) and ($v_{10,3}$ is small) then (Class is K_3)*

...

30. *If ($v_{1,1}$ is small) and ($v_{1,2}$ is small) and ($v_{2,1}$ is small) and ($v_{2,2}$ is small) and ($v_{2,3}$ is medium) and ($v_{3,1}$ is small) and ($v_{3,2}$ is small) and ($v_{3,3}$ is medium) and ($v_{4,1}$ is small) and ($v_{4,2}$ is small) and ($v_{4,3}$ is large) and ($v_{5,1}$ is small) and ($v_{5,2}$ is small) and ($v_{5,3}$ is large) and ($v_{6,1}$ is small) and ($v_{6,2}$ is small) and ($v_{6,3}$ is large) and ($v_{7,1}$ is small) and ($v_{7,2}$ is small) and ($v_{7,3}$ is large) and ($v_{8,1}$ is small) and ($v_{8,2}$ is small) and ($v_{8,3}$ is large) and ($v_{9,1}$ is small) and ($v_{9,2}$ is small) and ($v_{9,3}$ is large) and ($v_{10,1}$ is small) and ($v_{10,2}$ is small) and ($v_{10,3}$ is large) then (Class is K_3)*

A tree of negative external influences that affect the information system was selected, three classes of information system adaptation tasks were identified, and fuzzy classification rules were drawn up. This fuzzy classifier can be used in any

information systems that may have a negative external impact. Therefore, the goal has been achieved.

References

1. Minin Yu.V., Eliseev A.I., Said B.M.G., Minina E.N. Razmeshchenie uzlov setevoy informacionnoj sistemy s topologiej "derevo" [Placement of nodes of a network information system with the "tree" topology]. Tambov, 2015, 200 p. (Rus)

2. Gromov Yu.Yu., Minin Yu.V., Habib Alrammahi A.A., Sari F.A. Probabilistic and Fuzzy Models of the Optimal Allocation of Resources of a Network Information System. Lipetsk, 2019, pp. 353-358.

3. Gromov Yu.Yu., Minin Yu.V., Eliseev A.I., Habib Alrammahi A.A., Sari F.A. Overall Score of Information System Performance and Selection of Synthesis Problem. Lipetsk, 2019, pp. 377-382.

ПОДСИСТЕМА ВЫБОРА КЛАССА ЗАДАЧ РАСПРЕДЕЛЕНИЯ РЕСУРСОВ ИНФОРМАЦИОННЫХ СИСТЕМ

Е. В. Кошелев, В. А. Мильшина

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: lyutsian-zzz@yandex.ru, lera.milshina@yandex.ru

Аннотация. Целью данной статьи является разработка нейронечёткого классификатора выбора класса решаемых задач при распределении информационных ресурсов в информационных системах, на которые воздействуют негативные воздействия. Для достижения данной цели проанализированы негативные внешние воздействия, действующие на информационные системы, и выбрано дерево негативных воздействий, выделены классы задач адаптации системы, разработаны нечёткие правила классификации. Поднимаемая тема в данной статье является актуальной, так как готовых решений найдено не было, а проблема с негативными воздействиями и нехваткой информационных ресурсов с каждым годом становится всё острее.

Ключевые слова: класс решаемых задач, негативные внешние воздействия (НВВ), нечёткие правила классификации, нечёткий классификатор.

Digital Technologies in an Intelligent Information-Measuring System of Thermophysical Properties of Solid Materials

A. V. Kupriyanov

Tambov State Technical University, Tambov, Russia
e-mail: artem.kupriyanov.2012@mail.ru

Abstract

The paper considers the possibility of using digital technologies in an intelligent information-measuring system of thermophysical properties of solid materials. Their advantages, as well as directions for eliminating technical imperfections are considered.

Keywords: intelligent information-measuring system, digital technologies, thermophysical properties.

One of the directions of technology development at present is the introduction of digital technologies into various systems, including intelligent information and measurement systems. Digital technologies are technologies based on the representation of signals in discrete bands of analog levels, rather than as a continuous spectrum. The need to use digital technologies lies in their advantage over analog technologies, which includes noise immunity, ease of storing information, and others.

But there are also disadvantages, such as high-power consumption, which can cause high heating of the components. In this case, additional cooling is required. The use of digital technologies can improve the functionality of the system, as well as improve performance, without having to re-equip the hardware.

Intelligent information-measuring system (IIMS) carries out multichannel measurements of material properties with high accuracy, collection of information from measuring sensors (thermocouples), temperature control, automation of research and testing, calibration and verification of sensors, control of environmental parameters in production processes.

Intelligent IIS has a knowledge base that includes various data [1-2]. In this case, these are the parameters of thermophysical properties of solid materials, such as thermal conductivity, specific heat, thermal diffusivity, density, and others.

Measurements, decision-making, management and processing of information, obtaining results occur in digital form [3]. The principle of operation of the IIMS is as follows. The central processor sends a signal to the heat treatment unit to heat the test material. After that, the sensors read the necessary information for further processing. At the next stage, an analog signal is generated from the measuring sensors, namely a frequency-pulse signal, which is fed to an analog-to-digital converter, from the output of which a digital signal is sent to the central processor (Fig. 1). The central processor uses special software to process the digital signal

based on the use of information from the knowledge base. Then the signal goes to the output device (Fig. 2.).

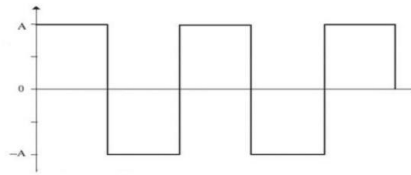


Fig. 1. Digital form of the generated signal

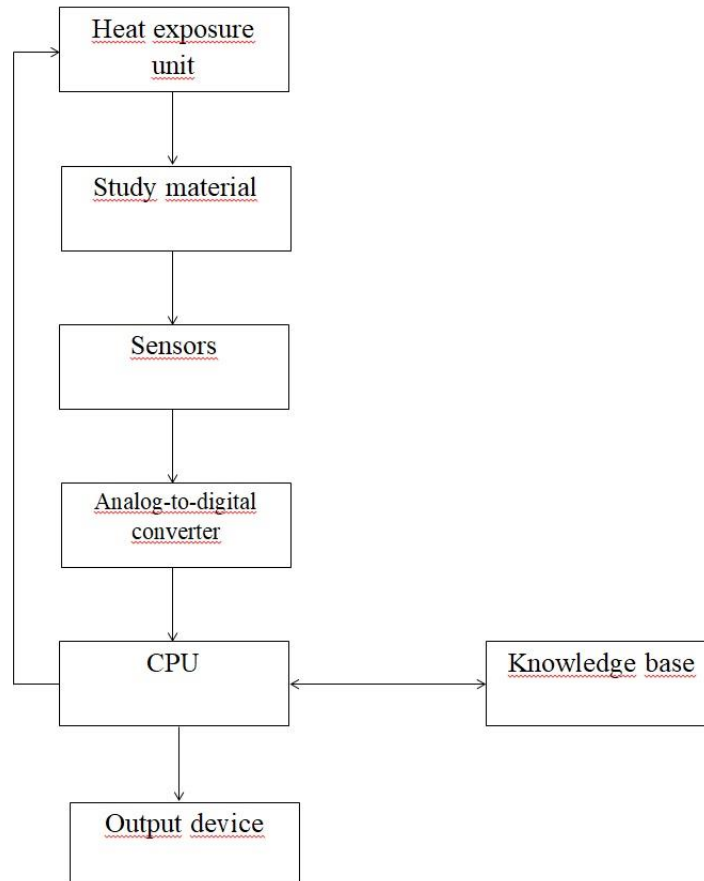


Fig. 2. Structural diagram of IIMS for determining the TFS of materials

The software makes it possible to carry out the primary mathematical processing of information according to the specified formulas, view, at the choice of the operator, the measured analog and discrete signals at the pace of the experiment. In addition, the transfer of measurement results to the local network of the enterprise in the process of measuring the parameters of material properties, intelligent decision-making procedures in IIMS, replenishment of information in the knowledge base of the system, processing of the obtained data arrays using specialized software packages for solving problems of forecasting, identification and management measurements of material properties. The measurement results are transferred to a computer, they are stored, viewed, analyzed, and the results obtained are printed in the form of tables indicating the time and date of

measurements, the type of material and the values of the parameters of material properties [2-4]. The software must include software for error detection and correction.

In the future, the software should be constantly updated to expand the functionality of the IIMS for determining the TPS of materials, increasing its efficiency and accuracy as a result of the use of digital technologies for processing measurement information.

The use of digital technologies greatly simplifies the work associated with measuring the thermophysical properties of solid materials. Modern software allows you to expand the range of tasks set by the user.

References

1. Selivanova Z. M., Khoan T. A. A Systematic method of improving the accuracy of an information and measuring system for determining the thermophysical properties of materials under the effect of destabilizing factors. *Measurement Techniques*, 2017, 60(5), pp. 473-480.

2. Selivanova Z.M., Kurenkov D.S., Hoang T.A. Simulation of the thermophysical experiment with remote control to determine the quality properties of the object. *Journal of Physics: Conference Series*, 2020, vol. 1553(1), 012026.

3. Selivanova Z.M. *Intellectualizatsiya informatsionno-izmeritel'nykh sistem nerazrushayushchego kontrolya teplofizicheskikh svoystv tverdykh materialov* [Intellectualization of information-measuring systems for non-destructive testing of thermophysical properties of solid materials] Moscow: Mechanical Engineering Publishing House - 1, 2006, pp. 30-31. (Rus)

4. Selivanova Z.M., Kurenkov D.S. *Intellectual'naya informatsionno-izmeritel'naya sistema distantsionnogo kontrolya kachestvennykh parametrov teploizolyatsionnykh materialov v usloviyakh vozdeystviya destabiliziruyushchikh faktorov* [Intelligent information-measuring system for remote control of quality parameters of heat-insulating materials under the influence of destabilizing factors]. *Bulletin of the Tambov State Technical University*, 2020, 26(1), pp. 6-19, doi: 10.17277 / vestnik.2020.01.pp.006-019. (Rus)

5. Egorov S., Nemtinov V., Egorov E., Nemtinova Y. Development of an Online Application for Determination of Thermo-Physical Properties of Substances // *Journal of Physics: Conference Series*. 2019. p. 012016.

ПРИМЕНЕНИЕ ЦИФРОВЫХ ТЕХНОЛОГИЙ В ИНТЕЛЛЕКТУАЛЬНОЙ ИНФОРМАЦИОННО-ИЗМЕРИТЕЛЬНОЙ СИСТЕМЕ ТЕПЛОФИЗИЧЕСКИХ СВОЙСТВ ТВЕРДЫХ МАТЕРИАЛОВ

А. В. Куприянов

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: artem.kupriyanov.2012@mail.ru

Аннотация. Рассмотрена возможность применения цифровых технологий в интеллектуальной информационно-измерительной системе теплофизических свойств (ИИИС ТФС) твердых материалов, их преимущества, а также направления устранения технического несовершенства.

Ключевые слова: интеллектуальная информационно-измерительная система, цифровые технологии, теплофизические свойства.

Constant Earnings on Online-Casinos While Automating User Actions

N. F. Mazaev

Tambov State Technical University, Tambov, Russia

e-mail: mazaevit@gmail.com

Abstract

The article discusses the possibility of making money on online casinos such as “roulette” or “double”. The user’s risks and methods of their neutralization are studied. A strategy is created for reducing the chance of losing to a minimum.

Keywords: automation of actions, making money at casinos, online casinos.

A huge number of players from different cities and countries lose large amounts of money in online casinos. The study aims to investigate whether it is possible to increase the chance of winning in online casinos by careful preparation and thorough analysis of the algorithm of winning.

The main risks of an ordinary user are to lose their entire balance on an online casino. Also, users waste time that they spend playing on an online casino site.

Before starting this study, a certain online casino site with the type of roulette or double game was selected. In the beginning, all statistics were collected by hand, that is, each dropped value was recorded personally. Soon it was decided that such a waste of time was unreasonable and a program was created to automatically collect information of interest. With the help of this program, 2,500,000 dropped values were collected, which served as a good basis for the analysis.

During the analysis of the obtained values, the following facts were revealed:

- It is better to play at one odds (we chose “green” - x50)
- It is important to know the maximum “distance” between the drops of this coefficient (in our case - 350)
- Each next bet with its winnings should pay off the amount of the previous ones, bringing profit

The last conclusion was the most important in our study:

X_n is a bet

X_s is the sum of previous bets from X_1 to X_n

k is the coefficient on which the bet was made

m is the difference between the received winnings and the number of previous bets (profit)

$$(X_n * k) - X_s = m$$

When this law was formulated, on its basis, we compiled a table of rates that the user must make in order not to lose. The table turned out to be 350 values, which is equal to the maximum difference between the dropouts of the coefficients of interest to us. Here we are faced with another problem: the number of bets

turned out to be too large, and the profit obtained by using such a table is too small. We returned to the analysis of the previously collected data and noticed that the first 100 fallouts after the “green” fall is very rare, so we came to the conclusion that they can be excluded. As a result, we got a table for 250 bets (Fig. 1. Table with casino bets) and the resulting bet amount turned out to be acceptable.

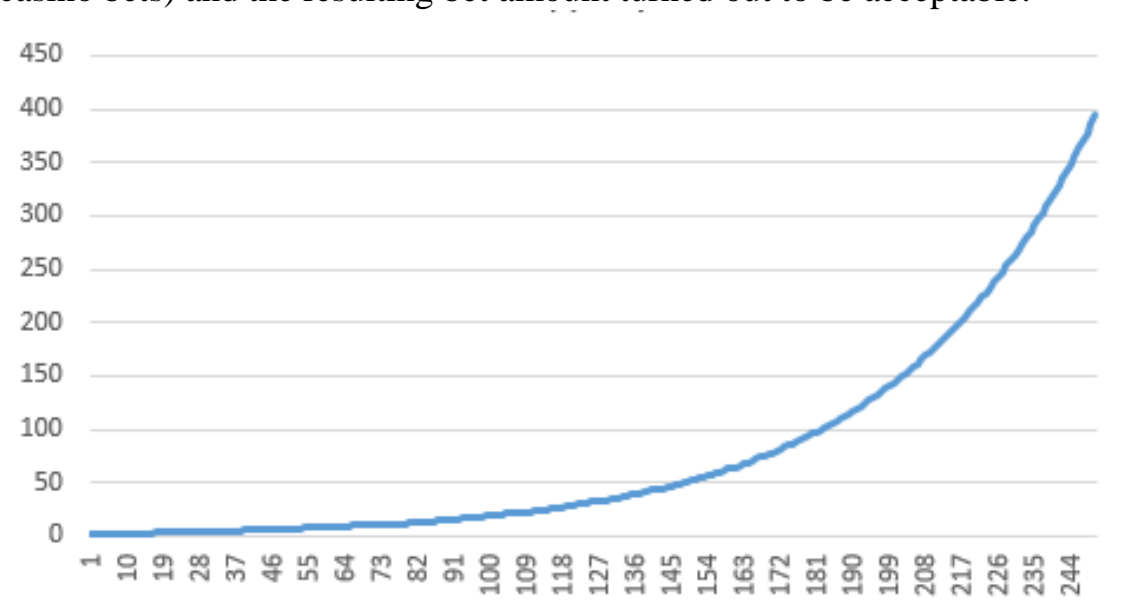


Fig. 1. Table with casino bets

As a result, we got the following game strategy:

1. After falling out “green”, the user waits for a series of 100 so that "green" does not fall out
2. After the first condition is met, the user begins to place bets on the table we created
3. After the “green” has dropped out, return to the first point (repeat until the user decides to stop)

After creating this strategy, we saw that the time that the user spends will be huge. To determine the required series (100 values), the user must spend $100 * 30$ seconds, that is, 50 minutes. After that, make another maximum of 250 bets, that is, $250 * 30 - 125$ minutes. As a result, it turns out that the user needs to spend from 50 to 175 minutes in order to win. Based on this data, it was decided to create a special program for performing automatic actions that emulate the user's work. To create this program, the following data was required:

- The time for which the site generates and shows a new value
- Arrangement of buttons and input lines to emulate user actions
- Rates table

Taking into account all these data, the necessary program was developed and created. In automatic mode, it executed the betting strategy we had created earlier, and the user could go about his business at that time. One of the options for using this program: during the day, the user is engaged in his business on a personal

computer, and in the evening, when he goes to bed, launches this program, which allows him to earn money on an online casino in a fully automatic mode.

The main risk of this strategy is that if you make a mistake with the series, the entire balance will be lost, since the bet will not pay back the amount of the previous ones and the user will lose money.

You can earn money on online casinos such as “roulette” or “double”, provided that:

- the necessary factors that are unique for each online casino have been analyzed;
- a strategy that takes into account all previously obtained data has been created;
- the user strictly adheres to the previously created strategy.

References

1. Svetlov M.B. Strategiya stavok na sport “Martingail” [The “Martingale” sports betting strategy]. URL: <https://bookmaker-ratings.ru/wiki/martingeyl.html> (Accessed 20.01.2014). (Rus)

ПОСТОЯННЫЙ ЗАРАБОТОК НА ОНЛАЙН-КАЗИНО ПРИ АВТОМАТИЗАЦИИ ДЕЙСТВИЙ ПОЛЬЗОВАТЕЛЯ

Н. Ф. Мазаев

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: mazaevit@gmail.com

Аннотация. В статье рассматривается возможность заработка на онлайн-казино типа «рулетка» или «дабл». Изучаются риски пользователя и методы их нейтрализации. Создается стратегия, уменьшающая шанс проиграть до минимума.

Ключевые слова: автоматизация действий, заработок на казино, казино-онлайн.

Sécurité des réseaux de communication GSM

D. D. Melnikova

Université technique d'état de Tambov, Tambov, Russie
e-mail: melnikowa.dasha2017@yandex.ru

Résumé

Cet article présente les méthodes de la protection des données d'utilisateur sur un réseau GSM (Global System for Mobile). Ce sujet est aujourd'hui très actuel puisque le cryptage des données est examiné dans le cadre de la sécurité des opérateurs et r cipientis. Nous consid rons tous les moyens de la protection des donn es lors de la connexion de l'abonn  au r seau de l'op rateur.

Mots cl s: la s curit  des r seaux de communication, la s curit  de GSM, le cryptage des donn es, l'authentification, la carte SIM.

Dans la norme GSM, les donn es analogiques sont converties en donn es num riques et transmises par des  metteurs num riques. La transmission de donn es num riques fournit le niveau de s curit  n cessaire sur les r seaux GSM. La s curit  globale des communications cellulaires GSM comprend les domaines techniques, organisationnels et juridiques.

Pour assurer la protection des utilisateurs, ces trois  l ments doivent  tre en  troite collaboration. Sous le concept de "s curit " dans la norme GSM, nous comprenons la protection du syst me contre l'acc s non autoris  pour assurer le secret des n gociations des abonn s. En premier lieu l'ensemble des algorithmes fournit la s curit  technique qui sont utilis s pour organiser la connexion de l'abonn  avec le r seau de l'op rateur GSM. Au c ur de la s curit  GSM se trouvent trois algorithmes qui sont secrets. C'est un algorithme d'authentification, un algorithme de chiffrement de cl  pour une session de communication et un algorithme de cryptage du signal pendant la session de communication.

Pour assurer le secret, chaque abonn  re oit un num ro international temporaire d'utilisateur (TMSI), qui n'est pas pertinent que dans la zone de l'abonn . Lorsque vous d placez un abonn  vers une autre zone, un nouveau TMSI lui est attribu . Le centre d'authentification (AUC) est responsable de toute la s curit  sur le r seau GSM. L'authenticit  de l'appelant est une carte SIM. Elle contient toutes les informations sur l'abonn . Les mesures de s curit  sur le r seau GSM sont appliqu es pour emp cher l'acc s non autoris  aux donn es des abonn s mobiles.

Les actes illicites portent g n ralement sur deux aspects principaux:

1. Les actions visent   obtenir l'acc s aux donn es transmises de l'abonn , qu'il s'agisse de donn es vocales ou de donn es textuelles; pour obtenir des informations sur les donn es ferm es de l'abonn . Il est n cessaire de disposer d'un  quipement assez complexe permettant d'acc der   l' quipement de l'abonn  de mani re   ce que l'abonn  ne le sache pas lui-m me. Un tel  quipement est c teux et n'est pas disponible pour tout le monde.

De m me, il convient de noter que l'acc s   des donn es priv es est l galement ill gal et est consid r  comme un acte frauduleux. La r alisation de

telles opérations pour obtenir des données personnelles de l'abonné ne peut être effectuée que dans les cas liés aux lois du pays concret. C'est-à-dire que, à la base d'une ordonnance du procureur ou d'un tribunal entièrement légal, l'opérateur a le droit de fournir les informations personnelles de l'abonné à des tiers lorsque cela est nécessaire.

2. Les actions visent à obtenir un accès gratuit au réseau de communication.

Cette situation est beaucoup plus simple que la précédente. On pourrait obtenir un accès gratuit au réseau de communication via le téléphone de quelqu'un d'autre, aussi stupide que cela puisse paraître. Les appareils téléphoniques peuvent être volés ou perdus, de sorte que l'accès à la carte SIM devient complètement ouvert.

Dans de tels cas, il est conseillé aux opérateurs de bloquer immédiatement les cartes SIM avec des verrous temporaires qui empêcheront d'autres personnes d'utiliser votre téléphone comme prévu. Ces verrous interdisent toute action, qu'il s'agisse d'un appel vocal ou d'un message texte. Par la suite, on pourrait restaurer la même carte SIM avec toutes les données, et le verrouillage de la connexion sera immédiatement supprimé, ce qui permettrait d'utiliser la connexion comme avant.

Alors, on conclut que les mécanismes sélectionnés sur le réseau GSM pour assurer le secret, ainsi que les méthodes de leur mise en œuvre, ont identifié les principaux éléments de l'information transmise et les voies de transmission sur lesquelles le cryptage devrait être effectué. Dans cette norme, il n'y a pas de recommandations strictes pour la formation de groupes d'abonnés fermés. Dans l'organisation des systèmes de la communication, il y a une certaine liberté dans l'application des aspects de la sécurité. Ce qui est très important c'est que la norme GSM génère les clés d'authentification et les numéros d'appel internationaux correspondants.

Références

1. Schneier B. Cryptographie Appliquée. Éditions Triumph, 2002.
2. Davydov S. Sécurité des réseaux de communication GSM [ressource Électronique]. Disponible à partir de: [http://www.comprice.ru/articles/detail.php?ID P. renumedian, 41090](http://www.comprice.ru/articles/detail.php?ID_P_revenumedian,41090) (Accédé le 16 décembre 2020).
3. Alexeyev G. Sécurité dans la norme de communication cellulaire GSM [ressource Électronique]. – Disponible à partir de: [http://re.mipt.ru/infsec/2003/essay/2003_GSM_ Security_ _ Alekseev.pdf](http://re.mipt.ru/infsec/2003/essay/2003_GSM_Security_ _Alekseev.pdf) (Accédé le 16 décembre 2020).

БЕЗОПАСНОСТЬ СЕТЕЙ СВЯЗИ СТАНДАРТА GSM

Д. Д. Мельникова

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: melnikowa.dasha2017@yandex.ru

Аннотация. Эта статья представляет собой методы защиты данных пользователей в сети GSM (Global System for Mobile). Затронутая тема сегодня очень актуальна, поскольку шифрование данных рассматривается в контексте безопасности оператора и реципиента. Рассматриваются все средства защиты данных в процессе соединения абонента с сетью оператора.

Ключевые слова: безопасность сетей связи, безопасность GSM, шифрование данных, аутентификация, SIM-карта.

Adaptive Video Data Transmission Control in Agricultural Information Systems

M. S. Nikolykin, O. A. Sokolinskaya, V. G. Mokrozub

Tambov State Technical University, Tambov, Russia
e-mail: chlppyone@mail.ru

Abstract

The article discusses an approach to the construction of adaptive information systems for the agricultural sector, and also puts forward the problem of data transmission in a changing environment (slow internet connection speed, low-power hardware). To solve this problem, an optimization problem is posed and a method for solving it is briefly described.

Keywords: adaptation algorithm; data transmission; information system.

Introduction

An adaptive automated system is a system that can automatically change its functioning algorithms or its own structure in order to achieve and maintain an optimal state when changing environmental factors.

The problem of developing systems that are convenient and adapted to the requirements of users has existed for a long time, since in this matter there are contradictions between the view of the developers and the subjective wishes of end users. The business processes of organizations are in constant development, which requires appropriate modification of systems, including its functional characteristics. Automation of this process in the future will significantly reduce time and material costs in the development and modernization of such systems.

The use of adaptation algorithms is relevant and is used in automated systems focused on various fields of activity. They have found active application in the field of agriculture, for example, in the construction of smart greenhouses or in the design of intelligent agricultural machinery.

Methods of research

The main tasks in agriculture information systems that can be solved using adaptive algorithms are monitoring the object, in the case of building smart greenhouses, as well as remote control and monitoring of agricultural equipment. Thus, the typical architecture of such a system can be as shown in Figure 1.

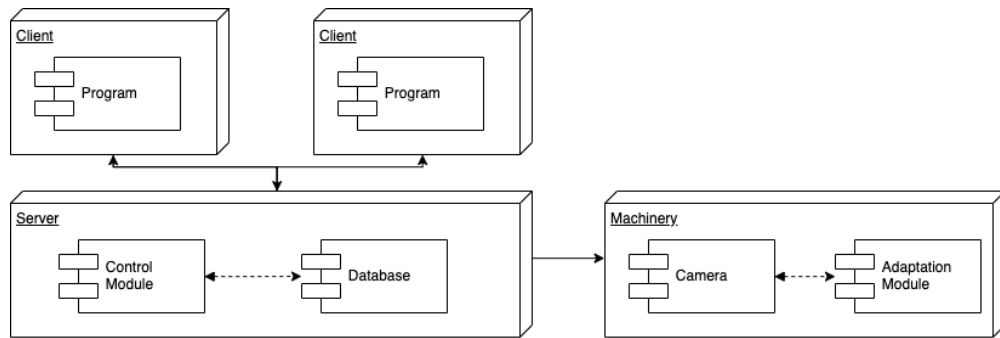


Fig.1. Typical adaptive system architecture

An external factor in the case of the presented architecture is the speed of the Internet connection, since in the field, the bandwidth of the channel for transmitting full-size video may not be enough, and therefore, it becomes necessary to transmit a video stream of such quality that would satisfy the data transmission channel.

In addition to the speed of the Internet connection, it is also worth considering the power of the control device, which is directly involved in the process of decoding and transmitting the video stream to an intermediate server for its subsequent storage and distribution to client applications. Depending on the configuration of the control device, the speed and ability to decode video in general may vary [1]. So, for example, a 4K video stream with a maximum bit rate can simply kill the device, so adapting the characteristics of the video stream for optimal decoding to the current characteristics of the control device is also relevant [2]. To do this, you can set the optimization problem:

It is necessary to find the values of the video quality parameters (r, f, b, d) at which the value of the objective function of the video stream quality K tends to the maximum:

$$K \rightarrow \max, \quad (1)$$

$$K = r \cdot f \cdot b, \quad (2)$$

With restrictions:

$$N(K) \leq 70\%, \quad (3)$$

$$S(f, d) \leq I, \quad (4)$$

Where r is the video stream resolution (height * width), f is the frame rate of the video stream, b is the bitrate of the video stream; the quality of the video stream, defined as the product of the main characteristics of the video stream, N is the load on the central processor of the control device, S is the size of one frame of the video stream, I is the bandwidth of the data transmission channel.

In order to solve this problem, before starting the video decoding process, it is necessary to conduct a series of tests (benchmarks) in order to find out the characteristics of the device and the current speed of the Internet connection, then, based on the data obtained and checking for compliance with the restrictions, calculate the optimal characteristics for its decoding and transmission [3]. The solution to the

optimization problem is performed by the exhaustive search method, since the values of the main indicators of the video stream vary in the range of small sets.

Conclusion

The method described above was tested on the basis of the Digital Engineering Center of the Tambov State Technical University within the framework of the project of an intelligent platform-tractor. This algorithm allowed, in conditions of a poor Internet connection and a low-power control device, to minimize video transmission delays and reduce the load on the device itself, which will allow in the future to launch several more processes of processing any information on it.

Further research will be related to the approbation of the obtained software and the posed optimization problem in practice when finding the best video stream parameters in agriculture information systems

References

1. Rao A. Network characteristics of video streaming traffic. Proceedings of the Seventh Conference on emerging Networking Experiments and Technologies, 2011, pp. 1-12.

2. Seong C., Hong S., Lim K. A. Machine Learning-based Adaptive Video Streaming Algorithm in Dynamic Network Environments. International Information Institute (Tokyo), 2017, vol 20, No. 9A, pp. 6369-6376.

3. Seeliger R., Silhavy D., Arbanowski S. Dynamic ad-insertion and content orchestration workflows through manifest manipulation in HLS and MPEG-DASH. IEEE Conference on Communications and Network Security (CNS), 2017. pp. 450-455.

4. Nemtinov V., Zazulya A., Kapustin V., Nemtinova Y. Analysis of Decision-Making Options in Complex Technical System Design // Journal of Physics: Conference Series. 2019. T. 1278. № 1. pp. 012018.

АДАПТИВНОЕ УПРАВЛЕНИЕ ПЕРЕДАЧЕЙ ВИДЕОДАНЫХ В СЕЛЬСКОХОЗЯЙСТВЕННЫХ ИНФОРМАЦИОННЫХ СИСТЕМАХ

М. С. Николюкин, О. А. Соколинская, В. Г. Мокрозуб

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: ch1ppuone@mail.ru

Аннотация. В статье рассмотрен подход к построению адаптивных информационных систем для сельскохозяйственного сектора, а также выдвинута проблема передачи данных в условиях изменяющейся внешней среды (медленная скорость Интернет-соединения, маломощное «железо»). Для решения поставленной проблемы поставлена задача оптимизации и кратко описан способ ее решения.

Ключевые слова: алгоритм адаптации; информационная система; передача данных.

The Information System for the Juvenile Inspector

V. D. Pilyugina*, A. A. Varfolomeeva

Tambov State Technical University, Tambov, Russia

*e-mail: pilyugina.viktorya2011@yandex.ru

Abstract

The paper focuses on the need for an automated workplace for a juvenile inspector. In order to develop this system, the work of the inspector in dealing with complaints and enquiries on juvenile offences is analysed in detail. Data flow diagrams are created to present the inspector's work analysis. An automated information system, the "Juvenile Inspector's Automated Workplace," is developed to account for minors, their parents or legal representatives.

Keywords: database, juvenile inspector, minors.

Working with information is a time-consuming and long-term process. Automation with dedicated information systems is a means to improve productivity and quality. The underdeveloped functionality of existing information systems does not allow minimizing the labor costs in processing, analyzing and systematizing data. This article analyzes the specifics of the juvenile inspector's work of and describes the automated workplace.

Fig. 1 presents a diagram of the data flows during the activities of a juvenile inspector.

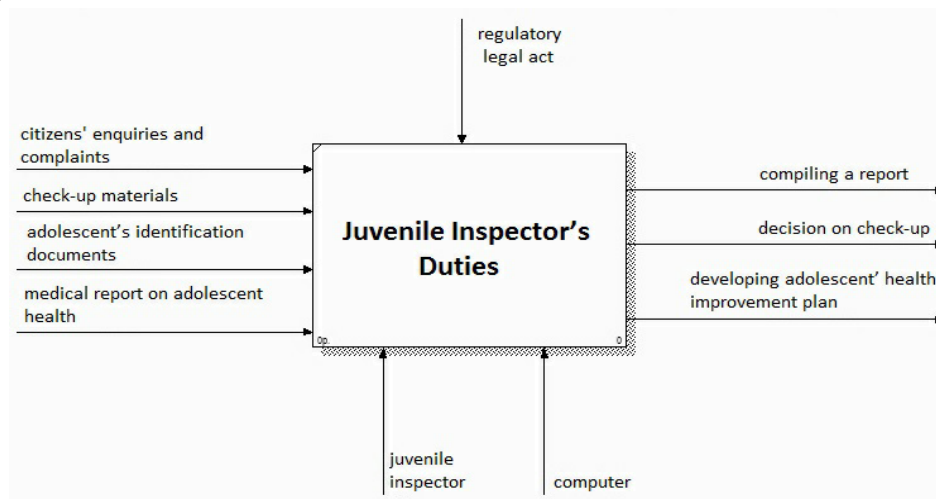


Fig. 1. Activities of the juvenile inspector

One of the ways to increase the productivity and quality of work with information is automation using special information systems.

However, the analysis of the software used by the juvenile inspector showed that today there are no automated information systems designed to work with data on registered minors, so we consider it expedient to develop such a system.

To develop this system, the activity of the inspector on the acceptance of applications, complaints and other information about the illegal acts of minors was analyzed in detail. The result of the analysis is presented in the data flow diagram (Fig. 2).

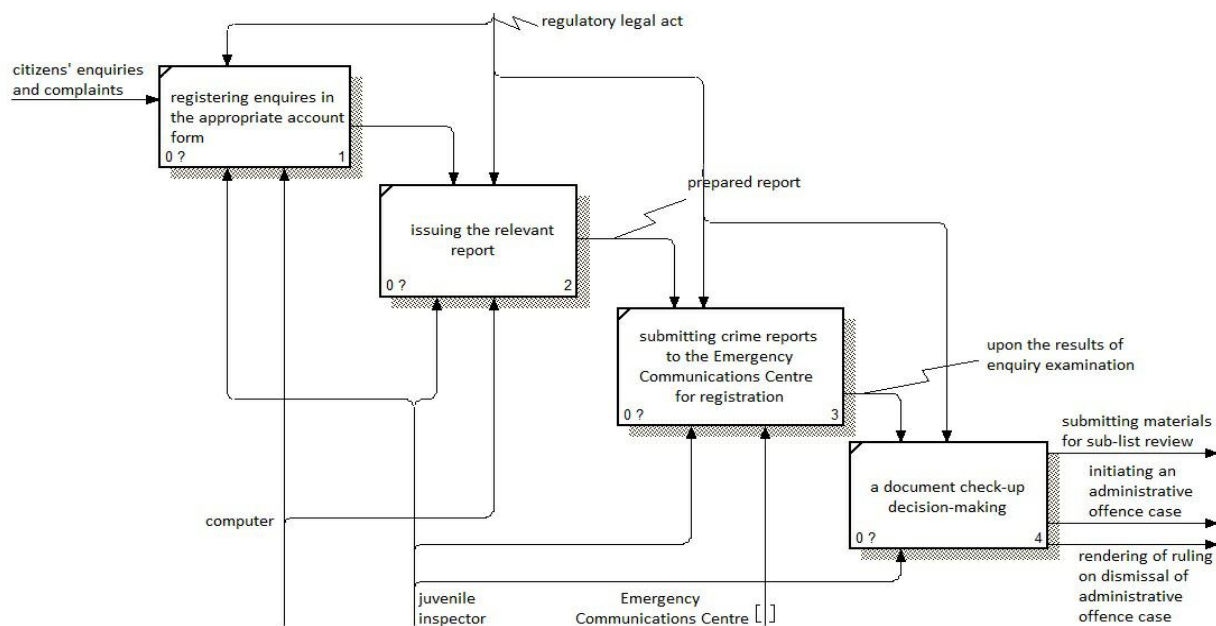


Fig. 2. Data flow diagrams for handling applications, complaints and other information about illegal acts of minors

The analysis of the activities of the inspector for juvenile affairs showed that the database of the information system under study consists of the following units: “Minors”, “Executed representatives”, “Educational institutions” and “Offences”.

For the inspector's work, the interface of the proposed system "Workstation for the juvenile inspector" is represented by four forms and one data module. Data module is used for storing database objects and provides direct user interaction with the database.

Fig. 3 shows the main window of the system. The buttons “Legal representatives”, “Offences” and “Place of study” presented in this window are intended to go to the corresponding tables.

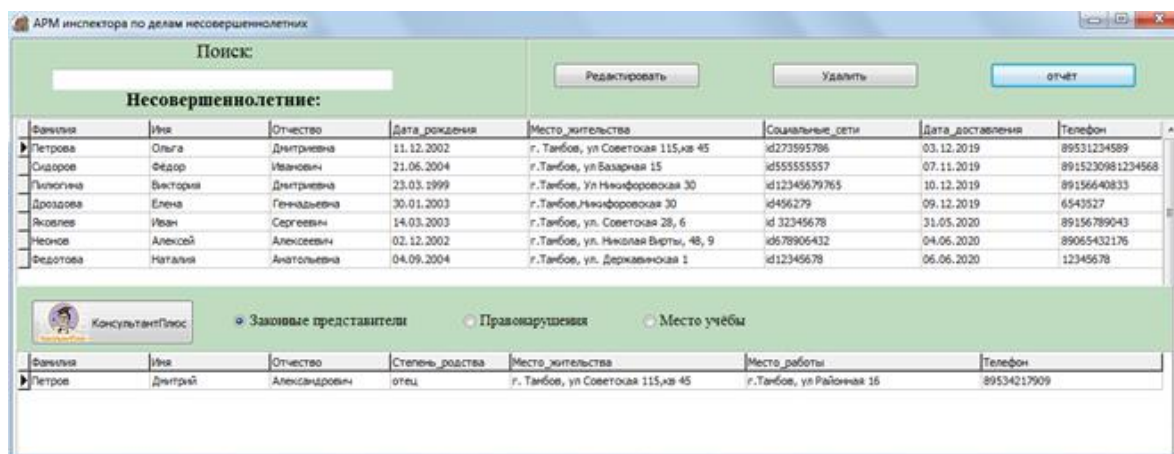


Fig. 3. The main form of the information system “Workstation for the juvenile inspector”

The developed automated information system “Workstation for the juvenile inspector” is designed to keep track of minors, their parents or legal representatives. The input lists used in the system allow reducing the time for entering information into the system, to avoid unnecessary input errors. The use of the system significantly speeds up the search for the necessary information, preparation of the necessary reports. In addition, the “export data to Microsoft Word” function simplifies the registration process for new faces. Also, the necessary and convenient functions of the system for the inspector are “information about the teenager's social networks” and a link to the ConsultantPlus.

The developed system comes in useful for the juvenile inspector and saves from routine paperwork.

References

1. Bezhencev A.A. Administrativnaya deyatel'nost' organov vnutrennih del po preduprezhdeniyu pravonarushenij nesovershennoletnih: monografiya [Administrative activities of internal affairs bodies for the prevention of juvenile delinquency: monograph]. M.: YUNITI-DANA, 2015, 255 p. (Rus)

2. Suponina E.A. O nekotoryh polnomochiyah sotrudnikov PDN po razresheniyu zayavlenij i soobshchenij grazhdan o protivopravnyh deyaniyah, sovershennyh nesovershennoletnimi, libo o proisshestviyah s uchastiem podrostkov [On some powers of PDN employees to resolve statements and messages from citizens about illegal acts committed by minors, or about accidents involving teenagers]. Novainfo, 2016, 51(2), pp. 153-156. (Rus)

3. SHimanovskij V.V. Processual'nye osobennosti rassledovaniya prestuplenij nesovershennoletnih: ucheb. posobie [Procedural features of the investigation of juvenile crimes: textbook]. Volgograd, 2014, 95p. (Rus)

ИНФОРМАЦИОННАЯ СИСТЕМА ДЛЯ ИНСПЕКТОРА ПО ДЕЛАМ НЕСОВЕРШЕННОЛЕТНИХ

В. Д. Пилюгина*, А. А. Варфоломеева

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: pilyugina.viktorya2011@yandex.ru

Аннотация. Рассмотрено состояние обеспеченности информационными технологиями инспектора подразделения по делам несовершеннолетних. В результате выявлена целесообразность разработки информационной системы для работы с данными о несовершеннолетних, стоящих на учёте. Для разработки данной системы была подробно проанализирована деятельность инспектора по принятию заявлений, жалоб и прочей информации о противоправных деяниях несовершеннолетних. Созданы диаграммы потоков данных, отражающие результат анализа деятельности инспектора. Представлена разработанная на основе диаграмм автоматизированная информационная система «АРМ инспектора по делам несовершеннолетних», предназначена для учета несовершеннолетних, их родителей или законных представителей.

Ключевые слова: база данных, инспектор по делам несовершеннолетних, подростки, система.

Face Recognition in Control Systems

N. I. Pokhvalenskii*, A. A. Krokhin

Tambov State Technical University, Tambov, Russia

*e-mail: nikitastotch@gmail.com

Abstract

The paper investigates the influence of the orientation of a person's face in space on the operation of the ViolaJones face detection algorithm. The aim of this work is to develop a method for finalizing the face detection algorithm so that it allows a larger range of face rotation angles in the input image.

Keywords: face recognition, improving the algorithm, ViolaJones.

In this paper, we will consider the problem of face detection, which does not include matching a face with a known image from the database. The solution to the problem of face detection is especially important when using video surveillance systems (such as CCTV) and in security complexes. Due to the growing computing power of personal computers and mobile devices, face detection is gaining popularity as a way of organizing human-machine interaction. Today, the field of application of face detection algorithms is dynamically developing. These algorithms are used in various embedded systems, and the conditions of use of these systems cause significant differences in the quality of images. Real-time processing requirements make it impossible to post-process images or engage an operator for; therefore, it is important to develop image defect-resistant algorithms that are computationally efficient. Thus, the problem of face detection is one of the priorities in the development of machine learning and computer vision algorithms.

The purpose of this article is to develop and implement an algorithm with improved robustness to image rotation. A prerequisite for determining the direction of research is the analysis of the existing algorithm in order to obtain accurate numerical values of the ranges of the rotation angle, as well as performance (by performance we mean the time required to detect faces in test images. Since the absolute performance depends on many factors, such as configuration hardware and software, we will be interested in relative performance, i.e. the values obtained when running different algorithms on the same machine in an identical runtime environment).

To implement the tasks described above, the following steps were performed. - Search for publicly available databases of images of faces taken at different angles of rotation. The INRIA institute image database was selected - Writing an application for automatic preparation of images for use at the stage of statistics collection. The preparation includes the following steps: - Obtaining archives of images from the relevant websites - Bringing data from various databases to a single catalog format - Converting images from various formats to the required one. This task was solved by means of the Qt library, which is also used to display an image on the screen. - Implementation of a program for collecting statistics on face detection algorithms. The program automatically executes algorithms using test images as input data and generates a report.

Viola-Jones algorithm implementation. The final stage is the implementation of head-rotation-resistant face detection algorithms. It consists of implementing the two approaches to increasing resilience described earlier. The first stage implements an algorithm that processes the image with the camera in order to compensate for the change in head position. Thus, most face detection algorithms can operate over a wider range of acceptable angles without modifying the original algorithm. The second stage is the development and implementation of an algorithm that uses a set of rotation-invariant features to search for faces.

The algorithm uses a feature base to detect objects. The base can be generated from all possible combinations of Haar-Like features by filtering out "weak" classifiers that give an error of the second kind, that is, they mistakenly do not find an object in the image. One of the ways to get the base using the AdaBoost algorithm is described in [1].

In this work, the base generation stage is not used and only the stage of object detection is implemented using a ready-made set of features. A cascade of features consists of several stages. Each stage includes a set of features. In the representation used in the cascade from the OpenCV project, features are split into monochromatic rectangles, each of which is assigned a positive or negative weight.

During the execution of the algorithm, a $W_h * W_w$ pixel "window" moves along the image horizontally and vertically. The initial window size is chosen equal to the window size recorded in the cascade classifier. The size of the window increases with each step. There are two ways to increase the window size. The first is to calculate the scaling factor and adjust the coordinates of the rectangles inside the features. The second is to scale the original image itself. In this work, the first method is used, since it is computationally simpler for software implementation of image scaling. In this case, the window size at each iteration is multiplied by the scaling factor `ITER_SCALE`. The window is shifted horizontally by `w_step_x` pixels, and `w_step_y` pixels vertically. These variables are calculated as follows:

$$w_step_y = \max(1, \min(4, W_h / 10))$$

$$w_step_x = \max(1, \min(4, W_w / 10))$$

The normalization factor is calculated for the window

$$win_norm = \frac{1.0}{W_h * W_w}$$

Inside the window, the sum of the pixel brightness `w_sum` and the sum of the squares of the pixel brightness `w_ssq` are calculated using the integral representation of the images. The mathematical expectation of the pixel brightness mean, variance `var` and standard deviation are calculated.

$$mean = w_sum * win_norm$$

$$var = (w_ssq * win_norm) - mean^2$$

$$stddev = \begin{cases} \sqrt{var} & \text{если } var \geq 0 \\ 1.0 & \text{иначе} \end{cases}$$

For optimization, the threshold constant `STDDEV_MIN` is introduced, if the standard deviation of `stddev` is less than this value, this "window" is skipped. This is done in order to exclude areas of low brightness, where there is no guarantee of finding the object. For each stage from the cascade, the accumulated coefficient `sum_stage` is calculated and compared with the critical value recorded in the cascade. In the event that the value is less than the critical one, the stage is considered not completed, and processing is interrupted for the current window. If all stages have worked correctly, it is considered that an object (face) has been detected in the current window. Also introduced a check that the standard deviation is greater than `STDDEV_FACE`, this allows you to adjust the response threshold. For each feature from the cascade, the normalized value $sum_feature * win_norm$ is calculated and compared with the normalized critical value recorded in the cascade $feature \rightarrow threshold * stddev$. If the value is less than critical, the value from the left subtree of the feature is added to the value of the stage, otherwise from the right one. The `sum_feature` value is calculated as the sum of the brightness of the pixels that fall into the rectangular area inside the feature, multiplied by the area weight. The area coordinates are multiplied by `win_scale`.

Modified Viola-Jones algorithm. This chapter proposes the refinement of the Viola-Jones algorithm to increase its resistance to face turns around the vertical axis. The modified algorithm consists of three stages.

Color segmentation. The following conditions are used to highlight areas of the image that contain skin, where `R`, `G`, `B` are colors in the range `[0; 255]`: $\{to R > = 1.2 * G \ G < = 8 * B \ G > = 0.9 * B \ R < = 2.8 * G\}$. These coefficients were selected based on the analysis of the results presented in the work devoted to the detection of skin areas in conditions of different illumination [2]. After the selection of areas, adjacent pixels classified as "skin" are combined into clusters. Each cluster is bounded by a rectangular area. A face search is performed inside each rectangular area (the second and third stages of the algorithm). Areas less than 5 percent of the height / width of the image are then filtered (by comparing the area of the image and the area of the area)

Choice of a classifier. In each of the areas potentially containing a face, which were detected at the previous step of the algorithm, the search for parts of the face is performed using cascades of features trained to search for this part. The eyes are searched. Cascades are used to detect the left and right eyes. If one eye is found, a face search is performed using the face profile cascade (side view). When two eyes are found, the mouth is searched for in the image. In case a mouth is detected, the center points of the rectangular regions that delimit the eyes and mouth are calculated. The distances D_{right} and D_{left} from the center of the right and left eyes to the center of the mouth are calculated. The real distance between the eyes D_{eyes} and the "expected" distance $D_{expected}$ are calculated. The "expected" distance is the distance that should be between the centers of the eyes in an image of a face looking directly into the camera. It is assumed that the image was only rotated about 17 vertical axis and the horizontal distance between the parts of the face was

not disturbed. In this case, $D_{expected} = D_{left} * D_{right} / 1.254 / 2$. This coefficient was selected as an average value by analyzing 10 images from the database. The horizontal scaling of the image is performed with the coefficient $D_{expected} / D_{eyes}$. If a face was not detected using the “profile” cascade, or a scaled image was obtained after the “eye” classifiers, a virtual image of the face is built containing an approximation of the original image before rotation (third stage of the algorithm).

Rotation compensation. At this stage, a “virtual image” is built, which is an approximation of the face image before rotation around the horizontal axis. For this, a face image is taken, which is a two-dimensional projection of the face onto the camera plane. We consider this image as a plane in three-dimensional space, assigning the coordinate $Z = 0$. We will rotate this plane around the vertical axis with a step of 5 degrees in the range from -30 to +30 degrees inclusive. It is assumed that the combination of rotation and scaling in the previous step will make the image more similar to the one that we would get if the face is directed towards the camera and the face detection algorithm should allow for a larger range of face rotation angles.

In the course of this work, all the expected results were achieved: - A technique for testing face detection algorithms for resistance to Affine transformations was described - An analysis of the behavior of the ViolaJones face detection algorithm was performed - An analysis of the behavior of the modified face detection algorithm was carried out. Despite the fact that the modified algorithm only slightly increased the percentage of image recognition at the boundaries of the interval of acceptable rotation angles for the Viola-Jones algorithm, the introduction of image segmentation based on skin color reduced the number of false positives of the algorithm and reduced the execution time of the algorithm due to the fact that only part of the image is processed.

References

1. Jones M., Viola P. Robust Real-Time Face Detection. URL: International Journal of Computer Vision, 2001, 57(2), pp. 137-154. URL: <http://www.vision.caltech.edu/html-files/EE148-2005-Spring/pprs/viola04ijcv.pdf>
2. A novel approach for human face detection from color images under complex background. URL: <http://visgraph.cs.ust.hk/biometrics/Papers/Face/pr2001-10-1.pdf>

РАСПОЗНАВАНИЕ ЛИЦ В СИСТЕМАХ КОНТРОЛЯ

Н. И. Похваленский*, А. А. Крохин

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: nikistotch@gmail.com

Аннотация. Исследовано влияние ориентации лица человека в пространстве на работу алгоритма обнаружения лиц ViolaJones. Целью работы является улучшение алгоритма обнаружения лиц для допуска большего диапазона углов поворота лица во входном изображении.

Ключевые слова: метод Виолы – Джонса, распознавание лиц, улучшение алгоритма.

The Information System for the Bailiff

K. G. Sadovnich*, A. S. Aydarov

Tambov State Technical University, Tambov, Russia

*e-mail: kirill4886@yandex.ru

Abstract

The article discusses the need to create an information system for the bailiff. To create the system, the activities of the bailiff on the inventory of debtors' property were analyzed in detail. A data flow diagram was created, reflecting the result of the analysis of the bailiff's activities. The system "Automated information system for bailiff" was developed and presented.

Keywords: database, bailiff, Federal Bailiff Service.

One of the main duties of the bailiff as the only person dealing with compulsory execution of judicial acts and acts of other bodies is the function of an inventory of the debtor's property. This process of working with information is time consuming and time consuming.

Fig. 1 shows a diagram of the data flows that circulate during the activities of the bailiff.

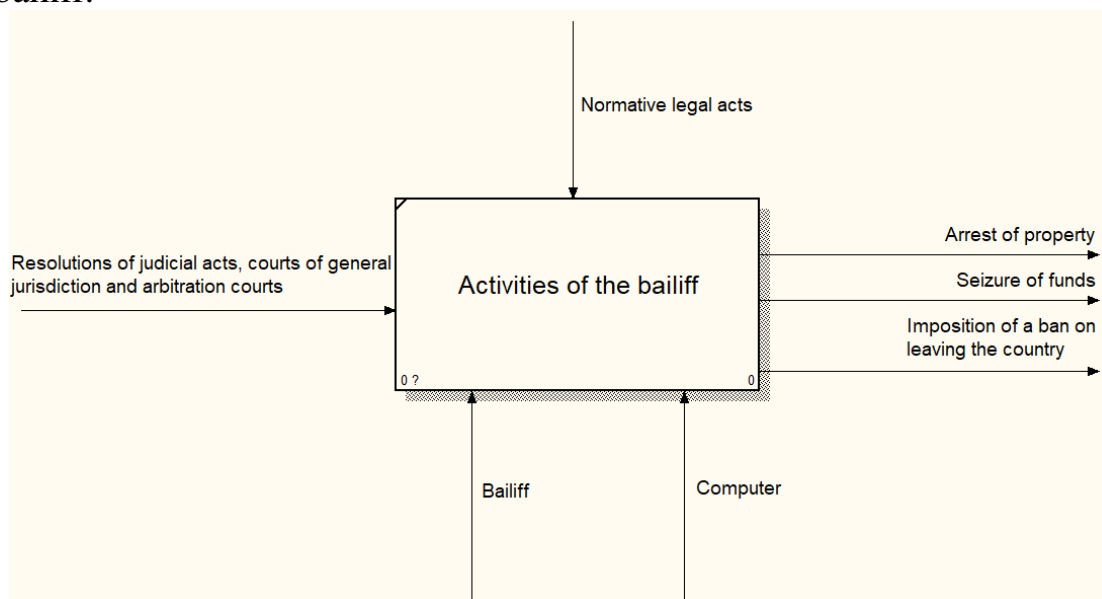


Fig. 1. Activities of the bailiff-executor

One of the means to increase the productivity and quality of work with information is automation using special information systems.

However, at present, a bailiff carries out the procedure for the seizure of property manually using paper media. This process takes a lot of time, since after the arrest the employee must independently enter all the data on the property in the AIS Federal Bailiff Service. Therefore, we consider it expedient to propose to develop an automated information system for recording seized property that will automate this type of activity.

The analysis of the activities of the bailiff showed that the database of the developed information system should consist of the following objects: "Enforcement proceedings" (contains data on enforcement proceedings), "Items" (contains data on seized property), "People" (contains data on debtors), "Users" (contains login information).

All objects are connected with each other and representatives, the diagram of which can be seen in Fig. 2.

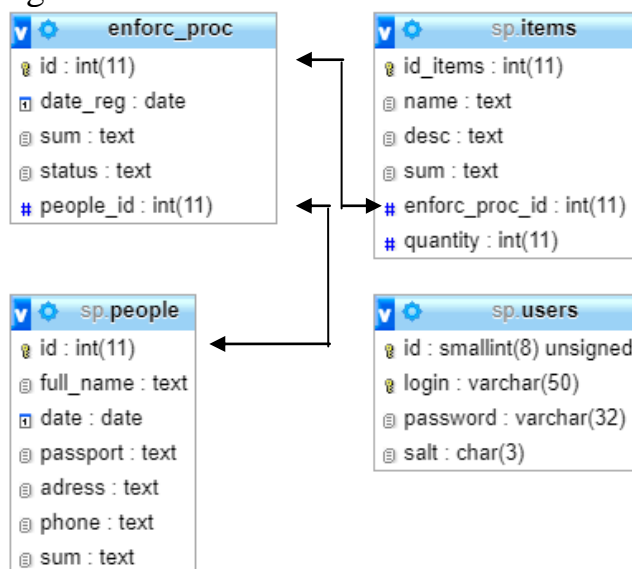


Fig. 2. Data diagram

After the database, using HTML and CSS, an interface is created, using PHP, a handler for the main functions of the system is written.

Figure 3 shows the interface of the main page of the system. The table contains a list of debtors who need to carry out a property inventory Using the input field and the "Search" button, you can find the required debtor by name, address or phone number. The link with the debtor's number allows you to view detailed information about the person and the list of enforcement proceedings initiated against him.

Deptor

List deptor

#	Full name	Date of Birth	Passport	Address	Phone	Operations
6819-22	Malinova Yulia Viktorovna	08.08.1992	6155 984894	Tambov, st. Michurinskaya, 12, apt. 3	7(123)434-1324	🔗 🗑️
6819-6	Ivanov Ivan Ivanovich	06.12.1990	5959 959595	Tambov, st. Chicherina, 12, apt. 42	7(925)903-0331	🔗 🗑️
6819-5	Krenkov Dmitriy Andreevich	01.11.1960	9595 959595	Tambov, st. Svobodnaya, 15 apt. 3	7(892)123-1626	🔗 🗑️
6819-4	Sidorov Maxim Alexandrovich	12.05.1985	9598 798798	Tambov, st. Chichkanova, 5, apt. 8	7(898)891-4949	🔗 🗑️
6819-3	Petrov Petr Petrovich	07.08.1974	6812 595988	Tambov, st. Magistralnaya, 40, apt. 7	7(848)958-9898	🔗 🗑️
6819-2	Dmitriev Anton Mikhailovich	05.12.1985	9848 125619	Tambov, st. Sovetskaya d.156, apt. 8	7(812)912-9599	🔗 🗑️
6819-1	Petrov Ivan Alexandrovich	08.12.1991	6959 598459	Tambov, st. Magistralnaya, 5, apt. 7	7(123)546-9876	🔗 🗑️

Add deptor

Fig. 3. Main page

The developed information system makes it possible to automate the work of the bailiff-executor for the inventory and accounting of the seized property, provides quick input and editing of data, as well as convenient operation on all devices.

We believe that the product should free staff from routine and unproductive work, reducing processing time and prompt input of the necessary information.

References

1. Gureeva V.A. *Nastol'naya kniga sudebnogo pristava-ispolnitelya: ucheb. posobiye* [Handbook of the bailiff-executor: a tutorial]. M.: Statut, 2017, 1056 p. (Rus)
2. Nazarov S.V. *Arkhitektura i proyektirovaniye programmnykh sistem: monografiya* [Architecture and design of software systems: monograph]. M.: INFRA-M, 2018, 374 p. (Rus)
3. Kostkina O.O. *nekotorykh problemakh ispolnitel'nogo proizvodstva: ucheb. posobiye* [On some problems of enforcement proceedings: a tutorial]. M.: Jurist, 2012, 117 p. (Rus).
4. Nemtinov V., Krasnyanskiy M., Borisenko A., Nemtinova Y., Karpushkin S. *Mathematical Software For E-Learning Systems in Mechanical Engineering*. International Multidisciplinary Scientific GeoConference SGEM. 2015. vol. 1. № 2. p. 191

ИНФОРМАЦИОННАЯ СИСТЕМА ДЛЯ СУДЕБНОГО ПРИСТАВА-ИСПОЛНИТЕЛЯ

К. Г. Садовнич*, А. С. Айдаров

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: kirill4886@yandex.ru

Аннотация. В статье рассмотрена необходимость создания информационной системы для судебного пристава-исполнителя. Для создания системы детально проанализирована деятельность судебного пристава-исполнителя по описи имущества должников. Создана диаграмма потоков данных, отражающая результат анализа деятельности пристава. Представлена разработанная на основе диаграммы и таблиц система «Автоматизированная информационная система для судебного пристава-исполнителя».

Ключевые слова: база данных, судебный пристав-исполнитель, Федеральная служба судебных приставов.

Building a Dynamic Network Model of the Wireless Access Control System Operation

A. A. Tikhomirova

Tambov State Technical University, Tambov, Russia
e-mail: tihomirowaalina@yandex.ru

Abstract

The possibility of using a smartphone with installed special software as an identifier in the access control and management system is considered. A formal description of the control and management system for access via a wireless channel is given. The modeling of the process of opening the barrier device in the developed system of control and management of access via a wireless channel using the apparatus of Petri nets is carried out. The analysis of the properties of the constructed dynamic network model is carried out.

Keywords: access control and management system, authentication server, dynamic network model, identifier, Petri net, wireless channel.

Introduction

Today, more and more organizations and companies consider ensuring security, in particular, the organization of access control using access control and management systems (ACMS), one of the most important aspects of their work. Current systems, for example, those based on RFID (Radio-frequency identification) cards, smart cards and magnetic cards require the costs of issuing personal identifiers (ID). Also, they are inconvenient for users who need to store many different identifiers. Other systems, for example, based on human biometric characteristics of a person, are expensive, and some of them are unusable in an aggressive environment.

The access control system based on smartphones with installed special software, which includes a hardware-software complex for controlling barrier devices via a wireless channel, can solve these problems.

Building of a dynamic network model

The purpose of this work is to construct a dynamic network model of the barrier device in the access control and management system via a wireless channel. This type of access control and management systems is based on the transmitting of a user ID to a reader over a wireless channel. As an identifier, can be used some code, a login-password pair, or a special token. As a wireless channel, the constructed ACMS will use the Bluetooth wireless data transmission technology, which has a number of advantages over other existing technologies (for example, Wi-Fi, NFC (Near Field Communication), mobile Internet), such as:

- the ability to transfer data between devices at a distance of up to 100 meters;
- small size of modern modules supporting low power consumption protocol with built-in encryption (AES) [1];
- widespread use (in 2018, 100% of smartphones and tablets sold support Bluetooth).

The advantages of a system based on smartphones with installed special software include:

- no need to issue individual identification devices, for example, such as RFID cards (therefore, no costs for their issuance);
- ease of issuing temporary passes;
- the ability to use biometric systems built into some modern smartphones for two-factor identification;
- the ability to use multiple accounts by one person.

These advantages allow you to use your smartphone as an identifier and make it possible to start designing a system based on a Bluetooth wireless channel.

We consider the algorithm of interaction between the components of the developed access control and management system.

Access to the ACMS is based on verification of the access token issued to the user by the authentication server based on their username and password. The token contains the user's permissions and identification number. The controller compares the user's permissions from the token with the required ones and makes a decision about access. The token, username, and password are transmitted and received via the Bluetooth channel between the user's smartphone and the controller. The scheme of the developed ACMS is shown in Fig. 1.

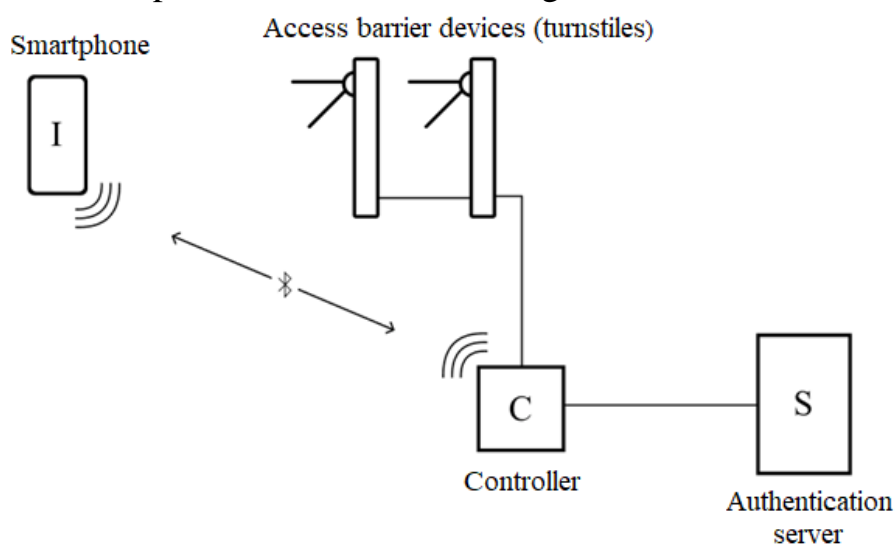


Fig. 1. Block diagram of the developed access control and management system

The access token is made according to the JSON Web Token standard. This standard describes access tokens based on the JSON format. The token consists of three parts: header, payload, and signature.

The token is created by the authentication server, signed with a secret key, and sent to the user's smartphone, who then uses this token to confirm his identity.

The authentication server uses a relational database as the user data storage. It can be described using the ER-diagram in the notation of Gordon Everest. This diagram is shown in Fig. 2.

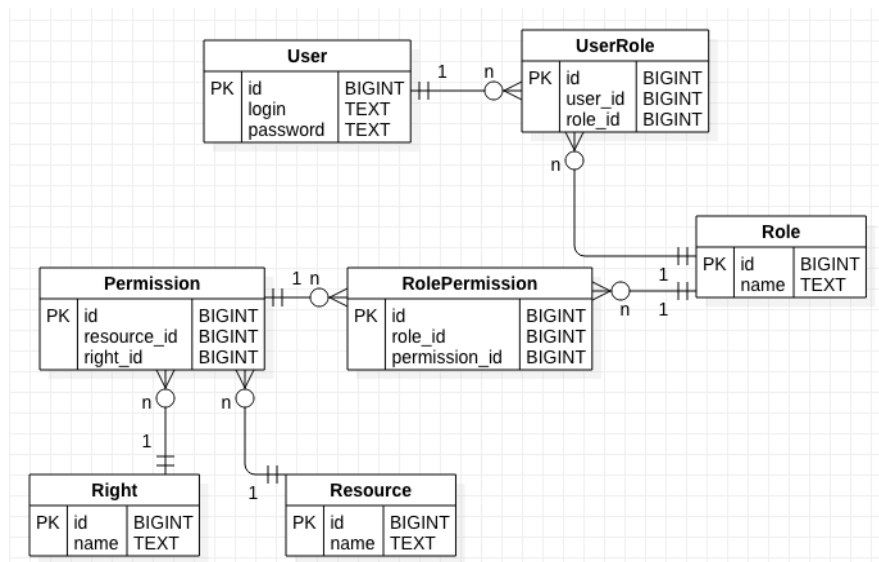


Fig. 2. ER-database diagram

You can edit, create, and delete users using the administration panel built into the authentication server.

For the subsequent transition to the software and hardware implementation of the prototype (pilot project) of the described system, we will build its model of operation control using the apparatus of Petri nets.

A Petri net is defined as a five $\langle P, T, I, O, \mu \rangle$, where P and T are finite sets of places and transitions, I and O are sets of input and output functions, and μ is a set of state markings [2]. Input and output functions are related to transitions and places. The input function I maps the transition t_j to a set of positions $I(t_j)$, called the input places of the transition. The output function O maps the transition t_j to the set of positions $O(t_j)$, called the output places of the transition [3].

The Petri net is executed by triggering transitions. A transition is triggered by removing marks from its input places and generating new marks at its output places. A transition can only be triggered when it is allowed. A transition is called allowed if each of its input places has a number of marks at least equal to the number of arcs from places to the transition. Formally, the operation of a Petri net is described by a set of launch sequences and a set of implemented markings.

Modeling in Petri nets is carried out at the event level. It is determined what actions take place in the system, what states preceded these actions and what states the system will assume after performing actions. Analysis of the results can tell about the states in which the system was or was not, which states are not reachable.

Let's simulate the process of opening the barrier device in the developed access control and management system via a wireless channel using the apparatus of Petri nets. The designation of the elements of this net is as follows:

– finite set of places:

$$P = \{p_0, p_1, p_2, p_3, p_4, p_5, p_6, p_7, p_8, p_9, p_{10}, p_{11}, p_{12}, p_{13}, p_{14}, p_{15}\};$$

– finite set of transitions:

$$T = \{t_0, t_1, t_2, t_3, t_4, t_5, t_6, t_7, t_8, t_9, t_{10}, t_{11}, t_{12}, t_{13}, t_{14}, t_{15}\};$$

– set of the input places of the transition:

$I = \{I(t_0), I(t_1), I(t_2), I(t_3), I(t_4), I(t_5), I(t_6), I(t_7), I(t_8), I(t_9), I(t_{10}), I(t_{11}), I(t_{12}), I(t_{13}), I(t_{14}), I(t_{15})\};$

$I(t_0) = \{p_0\}, I(t_1) = \{p_2\}, I(t_2) = \{p_3\}, I(t_3) = \{p_4\}, I(t_4) = \{p_5\}, I(t_5) = \{p_6\}, I(t_6) = \{p_7\}, I(t_7) = \{p_8\}, I(t_8) = \{p_1\}, I(t_9) = \{p_9\}, I(t_{10}) = \{p_{10}\}, I(t_{11}) = \{p_{11}\}, I(t_{12}) = \{p_{12}\}, I(t_{13}) = \{p_{13}\}, I(t_{14}) = \{p_{14}\}, I(t_{15}) = \{p_{15}\};$

– set of the output places of the transition:

$O = \{O(t_0), O(t_1), O(t_2), O(t_3), O(t_4), O(t_5), O(t_6), O(t_7), O(t_8), O(t_9), O(t_{10}), O(t_{11}), O(t_{12}), O(t_{13}), O(t_{14}), O(t_{15})\};$

$O(t_0) = \{p_2\}, O(t_1) = \{p_3\}, O(t_2) = \{p_4, p_6\}, O(t_3) = \{p_5\}, O(t_4) = \{p_0\}, O(t_5) = \{p_7\}, O(t_6) = \{p_8\}, O(t_7) = \{p_1\}, O(t_8) = \{p_9\}, O(t_9) = \{p_{10}, p_{14}, p_{15}\}, O(t_{10}) = \{p_{11}, p_{13}\}, O(t_{11}) = \{p_{12}\}, O(t_{12}) = \{p_1\}, O(t_{13}) = \{p_1\}, O(t_{14}) = \{p_1\}, O(t_{15}) = \{p_1\};$

– initial marking:

$\mu_0 = \{1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0\}.$

The content of the places of the Petri net that simulates the process of opening the barrier device in the developed system is presented in table 1.

Table 1

Place designation	Description
p_0	User without access token
p_1	User with access token
p_2	The controller received the username and password
p_3	The server received the username and password
p_4	The server did not find any matches in the user database
p_5	The controller received an error message
p_6	The server found the user in the database
p_7	The server generated a user access token
p_8	The controller received an access token from the server
p_9	The controller received an access token from the user
p_{10}	The token was successfully verified by the controller
p_{11}	The token contains the required permissions
p_{12}	The barrier device is open
p_{13}	The token does not contain required permissions
p_{14}	The token has expired
p_{15}	The token has an invalid signature

The content of the transitions of the Petri net that simulates the process of opening the barrier device in the developed system is presented in Table 2.

Table 2

Transition designation	Description
t_0	Sending the username and password to the controller
t_1	Sending your username and password to the server
t_2	Search for a user in the database
t_3	Sending an error message to the controller
t_4	Sending an error message to the user
t_5	Generating a user access token
t_6	Passing an access token from the server to the controller
t_7	Passing the access token to the user

Transition designation	Description
t_8	Passing an access token from the user to the controller
t_9	Access token verification
t_{10}	Access token permissions check
t_{11}	Opening the barrier device
t_{12}	Sending a message about successful opening to the user
t_{13}	Sending an error message to the user
t_{14}	Sending an error message to the user
t_{15}	Sending an error message to the user

A Petri net that simulates the process of opening the barrier device in the developed system is shown in figure 3.

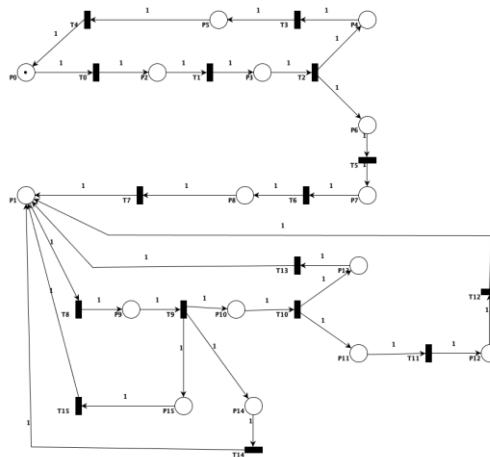


Fig. 3. The Petri net simulating opening the barrier device in the developed system

We analyze the constructed Petri net. The analysis consists in studying the main properties of Petri nets: safeness, boundedness, persistence, reachability and liveness. Let's introduce a definition of each of these properties and, based on them, give a characteristic of the constructed model.

A place $p_i \in P$ is said to be safe in a given initial marking μ if during the operation of this network more than one token (marker) never appears in this place p_i , that is, $\mu(p_i) \leq 1$. A Petri net is called safe if all its positions are safe [4].

From this definition, we can conclude that the Petri net, which simulates the process of opening a barrier device in the developed, is safe, because there is no accumulation of markers in the places of this network.

A place $p_i \in P$ is said to be bounded in the given initial marking μ if during the operation of this network more than k markers will never appear in this place p_i , that is, $\mu(p_i) \leq k$. A Petri net is called bounded if all its positions are bounded [4].

The Petri net that simulates the process of opening the barrier device in the developed system is bounded with a value of $k = 1$, because the number of marks in each place will never exceed the value of $k = 1$.

A Petri net is said to be persistent if the following condition is met for any of its transitions $t_i \in T$: the state of excitation of this transition cannot be removed by triggering any other transition. If the network has alternative transitions, it is unstable [4].

In the network that simulates the process of opening the barrier device in the developed system, there are alternative transitions, such as transitions t_2 , t_9 , t_{10} , therefore, this network is unstable.

The marking μ' is said to be reachable from some marking μ , if for a given model of the Petri net it is possible to specify such a sequence of transitions that transforms marking μ into marking μ' [4].

The Petri net shown in figure 3 is reachable, since there is no deadlock transition in it. A transition $t_i \in T$ is said to be live in a given initial marking μ if, for any marking μ' that is reachable from μ , one can specify a chain of transitions firing, that leads to the excitation of the transition t_i . A Petri net is said to be live in the given initial marking μ if all its transitions are live [4].

A Petri net that simulates the process of opening the barrier device in the developed system is live, because all its transitions are live, states are reachable at the initial marking, and you can specify a chain of transitions firing that will lead to a particular state.

Conclusion

The constructed dynamic network model of the wireless access control and management system has a mathematically rigorous description that allows you to analyze the interaction of three subjects of information relations, namely the user, the controller and the authentication server. This model allows you to go to the hardware and software implementation of the prototype of the access control and management system via a wireless channel.

References

1. Bluetooth Security 101. URL: <https://www.bluetooth.com/blog/bluetooth-security-101/>.
2. Kotov V.Ye. Seti Petri [Petri nets]. M.: Nauka, 1984, 160 p. (Rus)
3. Piterson Dzh. Teoriya setey Petri i modelirovaniye sistem [Petri net theory and system modeling]. M.: Mir, 1984, 264 p. (Rus)
4. Rad'ko, N.M. Risk-modeli informatsionno-telekommunikatsionnykh sistem pri realizatsii ugroz udalennogo i neposredstvennogo dostupa [Risk models of information and telecommunication systems in the implementation of threats of remote and direct access]. M. Radiosoft, 2010, 232 p. (Rus)

ПОСТРОЕНИЕ ДИНАМИЧЕСКОЙ СЕТЕВОЙ МОДЕЛИ ФУНКЦИОНИРОВАНИЯ СИСТЕМЫ КОНТРОЛЯ И УПРАВЛЕНИЯ ДОСТУПОМ ПО БЕСПРОВОДНОМУ КАНАЛУ

А. А. Тихомирова

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: tihomirowaalina@yandex.ru

Аннотация. Рассмотрена возможность использования смартфона с установленным специальным программным обеспечением в качестве идентификатора в системе контроля и управления доступом. Приведено формальное описание системы контроля и управления доступом по беспроводному каналу. Проведено моделирование процесса открытия преграждающего устройства в разрабатываемой системе контроля и управления доступом по беспроводному каналу с помощью аппарата сетей Петри. Осуществлён анализ свойств построенной динамической сетевой модели.

Ключевые слова: система контроля и управления доступом, беспроводной канал, идентификатор, сервер аутентификации, динамическая сетевая модель, сеть Петри.

The Information System for Acceptance and Processing of Applications for Conviction (Non-Conviction) Records

L. A. Tyuterev*, M. V. Filimonova

Tambov State Technical University, Tambov, Russia

*e-mail: lvtrv@gmail.com

Abstract

Employees of the Information Center of the Russian Ministry of Internal Affairs face the problems of collecting, storing, searching, processing and using information. Proceeding from this, an automated workstation equipped with all the necessary elements for the best performance of its professional tasks has been created. To develop this system, the activities of an employee of the Information Center were analyzed in detail. A data flow diagram was created, reflecting the result of the analysis of the employee's routine. The automated information system "Workstation of an employee for acceptance and processing of applications for conviction /non-conviction) records" was developed and described.

Keywords: workstation, Information Center, employee.

Introduction

The work of the Information Center employee involves collecting, processing, systematizing and storing information. The main challenge is caused by a large number of information sources, the growing volume of information processing and the time required to carry out this processing, the repetition of the receiving and sending cycles in the specified time periods, the need to ensure the protection and confidentiality of information.

Figure 1 shows a data flow diagram of the Information Center employee's routine.

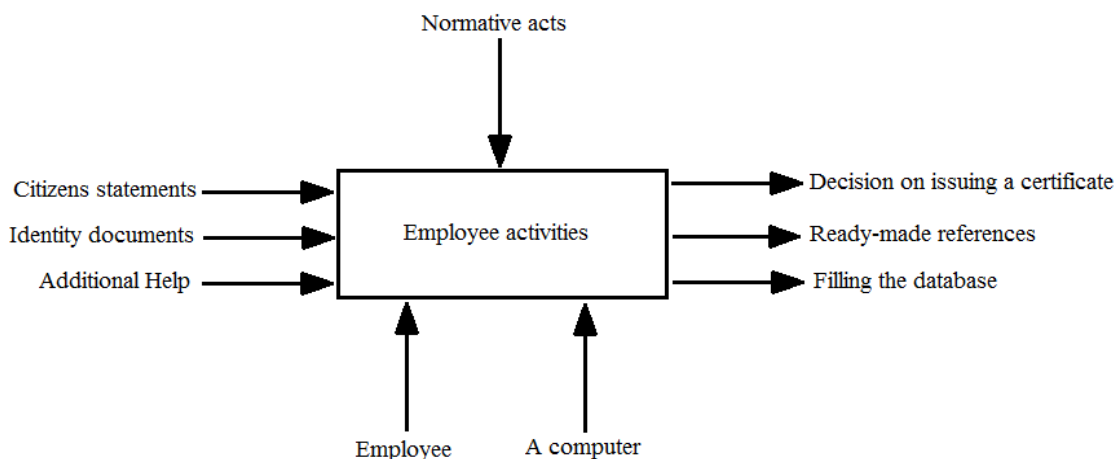


Fig. 1. Information center employee's routine

One of the ways to increase employee productivity is automation using special information systems.

Based on the technical means of the Information Center, we can conclude that the Information Center of the Ministry of Internal Affairs does not have a convenient tool for receiving and processing a statement on the presence (absence)

of a criminal record. To solve this problem, it is worth developing new software. Since the development of full software can take a long time, a demo version of the program will be introduced first, which will determine the following: user-friendliness of the interface for work, “stress resistance” of the program, collecting feedback from users, making changes to the functionality.

The advantages of this software include ease of use and clarity of the interface, since the program has only the necessary tools that allow the employee to quickly navigate during work.

System development “Information System for Acceptance and Processing of Applications for Conviction (Non-Conviction) Records”

The development of an information system begins with the creation of a database. To create a database, you need to analyze the data, which will determine which objects will be included in the database structure and what data will be stored in it.

Based on this data, a database is created with the name BD, it will include two tables. The main table will be the “Arx” (Archive) table. It contains fields that are responsible for the applicant's data, such as name, passport data, and so on. An additional table for accounting for the statement is the “Sot” table (Employees). It contains fields responsible for employee data, such as name, position and rank.

For an employee's work, the interface of this program consists of seven forms. The main form of the program is a navigation window (Fig. 2).

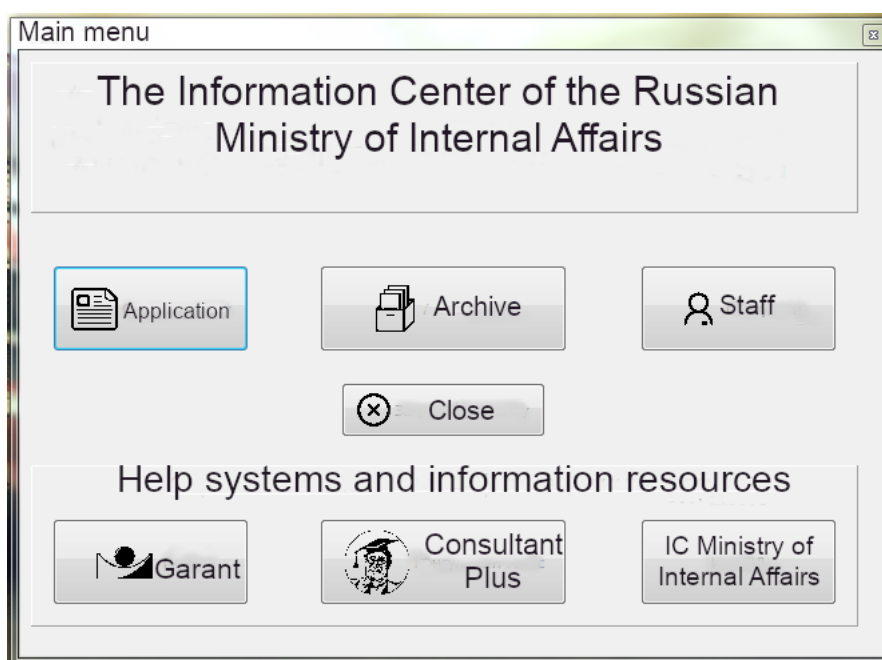


Fig. 2. The main menu of the program

The developed information system allows speeding up the acceptance and processing of data related to the statement of conviction (non-conviction) records.

Input masks implemented in the system will help to avoid errors. The archive of applications allows you to reduce the time for finding the necessary information and preparing reports.

Conclusion

Also, the transition to the information systems “Garant”, “Consultant Plus” and the main site of the Information Center facilitate the job of the employee. The software has the necessary tools that will allow the employee to quickly navigate during work, which will help get rid of routine paperwork.

References

1. Akopov G.L., Gude S.V., Shevchuk P.S. Pravovaya informatika: ucheb. posobiye [Legal informatics: textbook]. Rostov-na-Donu: Rostovskiy yuridicheskiy institut MVD Rossii, 2006, 149 p. (Rus)
2. Burtseva Ye.V., Seleznev A., Chernyshov V. Informatsionnyye tekhnologii v yurisprudentsii: uchebnyk [Information technology in jurisprudence: textbook]. Tambov: TSTU, 2012, 104 p. (Rus)
3. Nemtinov V., Krasnyanskiy M., Borisenko A., Nemtinova Y., Karpushkin S. Mathematical Software for E-Learning Systems in Mechanical Engineering // International Multidisciplinary Scientific GeoConference SGEM. 2015. T. 1. № 2. p. 191

ИНФОРМАЦИОННАЯ СИСТЕМА ДЛЯ ПРИЕМА И ОБРАБОТКИ ЗАЯВЛЕНИЙ О НАЛИЧИИ (ОТСУТСТВИИ) СУДИМОСТЕЙ

Л. А. Тютюрев*, М. В. Филимонова

Тамбовский государственный технический университет, Тамбов, Россия

* e-mail: lvtrv@gmail.com

Аннотация. Сотрудники Информационного Центра УМВД РФ каждый день сталкиваются с проблемами сбора, хранения, поиска, обработки и использования информации. Исходя из этого создается автоматизированное рабочее место, которое оснащено всеми необходимыми элементами для лучшего выполнения своих профессиональных задач. Для разработки данной системы была подробно проанализирована деятельность сотрудника Информационного центра. Создана диаграмма потоков данных, отражающие результат анализа деятельности сотрудника. Представлена разработанная на основе диаграмм автоматизированная информационная система «АРМ сотрудника для приёма и обработки заявления о наличии (отсутствии) судимостей».

Ключевые слова: сотрудник, Информационный Центр, автоматизированное рабочее место.

Information Technologies for the Center of Social Services

A. A. Varfolomeeva*, V. D. Pilyugina

Tambov State Technical University, Tambov, Russia

*e-mail: varfolomeevaniura@yandex.ru

Abstract

The paper aims to provide theoretical substantiation of the need to develop an information system for the Center for Social Services in the city of Uvarovo and the Uvarovsky District. The work of such centers is associated with the receipt, storage and processing of information. Information technologies based on modern computers used to increase the efficiency of this activity are analyzed.

Keywords: database, information system, senior citizens, social worker, social services.

The analysis of the activities of the Center for Social Services in the city of Uvarovo and the Uvarovsky District showed that the work of such centers is associated with the receipt, storage and processing of information. Employees receive requests on a wide range of social issues, including financial aid, social perks, and other payments. To improve the efficiency of the center, information technologies based on modern computers are used.

Thus, a study of the software and hardware available in the Center for Social Services for the Population of Uvarovo and the Uvarovsky District showed that the workplace of each employee is provided with a personal computer and the necessary software. The Center uses the following information systems:

- “Register of citizens receiving state social support”. This program is designed to work with requests, documents, personal data. The program also contains all the information about cash payments. All information about personal data is protected in accordance with the legislation of the Russian Federation;
- “Recreation of Children”. The purpose of the program is to arrange vouchers for summer camps and sanatoriums for children;
- “State Social Assistance”, designed to work with applications for the provision of payments for the category of citizens "poor" and store information about payments;
- “Compensation payments”, designed to maintain applications for compensation, compensation for harm, as well as storing information about payments;
- Information systems are used to work with child benefits: “Monthly children's benefits”, “Benefits for caring for children up to 1.5 years old”, “One-time benefit”. The programs are combined into one software package, in which the choice with which database to work. This software is used to work with processing applications, storing data about the applicant, their family income and payments of benefits.

In addition to the above information systems, there are also “Healthy

generation”, “Monthly allowance for the third and subsequent child”, “Benefits for children of military personnel undergoing military service”, “Provision of social support measures for families with many children” (used by an employee who works with families with many children).

The department for work with senior citizens uses the information system “Register of Citizens Receiving State Social Support”.

It should be noted that the analysis of the information system “Register of Citizens Receiving State Social Support” made it possible to reveal its drawback – the inability for specialists working with senior citizens to register their daily work. They have to keep records of their actions on paper. In order to solve this problem, we propose to develop an information system that automates the accounting of social workers' services and the preparation of the necessary reports. The data from this system can be automatically transferred to the general information system of the Center for Social Services, which will facilitate this activity.

The study of the functions of a social worker made it possible to determine the requirements for the proposed system. To account for the services of social workers and prepare the necessary reports, the system must perform the following functions: 1) input, storage and deletion of information about citizens; 2) quick search for information about the specified citizen; 3) input, storage and deletion of information on the provision of social services (special masks will be used in the form for quick input, which will allow you to quickly and efficiently fill in the table); 4) automated creation of an individual schedule for the provision of social services (special masks will be used in the form for quick input, all data can be transferred to a Microsoft Word document for further printing under the signature); 5) automated creation of a report on the provision of social services (all data can be transferred to a Microsoft Word document for further printing under the signature).

Based on the results of the analysis of the functions necessary for the automation, an information system was created that allows automating the work of a social worker in accounting for the provided social services at home.

The program window shown in picture 1, allows you not only to edit the data, but also to view all the information necessary about the services performed.

The screenshot shows a software window titled "редактирование данных" (data editing). It contains two main sections for data entry. The first section, "личные данные о гражданах" (personal data of citizens), includes input fields for "ф.и.о." (full name), "дата рождения" (date of birth), "место жительства" (place of residence), "категория" (category), and "номер телефона" (phone number), along with a "сохранить" (save) button. The second section, "предоставление социальных услуг" (provision of social services), includes dropdown menus for "получатель социальных услуг" (recipient of social services), "социальный работник" (social worker), and "месяц предоставления услуг" (month of service provision), as well as input fields for "время прихода" (arrival time), "время ухода" (departure time), "дата посещения" (date of visit, with a calendar icon), "вид услуги" (type of service), and "денежные распоряжения" (financial arrangements). A "сохранить" (save) button and a "назад" (back) button are also present in this section.

Fig. 1. Data editing form

Testing of this program by a social worker has shown its ease of use, since the system provides quick data entry and editing due to the applied input masks and reference books. In addition, the data is automatically filled in related fields of different tables, which allows you to quickly and clearly generate the required report.

We believe that this system will help make it easier for a social worker to maintain the necessary records.

References

1. Abrosimova M.Ye. Sotsial'naya rabota s invalidami v XXI veke: (regional'nyy aspekt) [Social work with disabled people in the XXI century: (regional aspect)]. Izvestiya Saratovskogo universiteta (Ser.: Sotsiologiya, Politologiya), 2011, 11(1), pp. 47-50. (Rus)
2. Topchiy L. Sotsial'noye obsluzhivaniye naseleniya. Tsennosti, teoriya, praktika [Social services for the population. Values, theory, practice]. M.: RGSU, 2012, 332 p. (Rus)
3. Rak I.P., Platonkin A.V., Terekhov A.V. Osnovy razrabotki informatsionnykh sistem: ucheb. posobiye [Basics of information systems development: textbook]. Tambov: TSTU, 2017, 98 p. URL: <http://www.iprbookshop.ru/85939.html> (Accessed 12 October 2020). (Rus)
4. Nemtinov V., Krasnyanskiy M., Borisenko A., Nemtinova Y., Karpushkin S. Mathematical Software for E-Learning Systems in Mechanical Engineering // International Multidisciplinary Scientific GeoConference SGEM. 2015. T. 1. № 2. p. 191

ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ В ДЕЯТЕЛЬНОСТИ СПЕЦИАЛИСТОВ СФЕРЫ СОЦИАЛЬНЫХ УСЛУГ

А. А. Варфоломеева*, В. Д. Пилюгина

Тамбовский государственный технический университет, Тамбов, Россия

* *e-mail*: varfolomeevaniura@yandex.ru

Аннотация. Анализ деятельности Центра социальных услуг города Уварово и Уваровского района показал, что работа таких центров связана с получением, хранением и обработкой информации. Анализируются информационные технологии на базе современных компьютеров, используемые для повышения эффективности данной деятельности.

Ключевые слова: база данных, информационные системы, пожилые граждане, социальный работник, социальные услуги.

Assessment of the Possibility of Developing an Integrated System for Detection and Recognition of Aviation Objects

A. E. Zaytsev

Tambov State Technical University, Tambov, Russia

e-mail: praviypalecnogi@rambler.ru

Abstract

The article deals with the problem of detection and recognition of aviation objects. The parameters according to which the system analyzes the object are presented. The features of the database organization and information interaction of the system elements are considered. A qualitative assessment of the system parameters has been carried out.

Keywords: aviation objects, database, detection, drones, expert system, recognition.

In the conditions of hostilities, prompt decision-making is required, therefore, to increase the efficiency of control, information systems with the capabilities of decision support systems that assess the electronic situation are required.

To increase the speed of decision making in combat conditions, detection systems are needed for detected objects [1]. The complex of the system should include the means allowing to carry out research of the target in radio, video, IR, sound ranges.

For target detection, means of passive radio reconnaissance and radar are used. They are used to determine the size of objects, height, azimuth, speed. For the emitting object, radio detection is used: interception of messages, determination of the types of modulation used for encryption. For passive objects, video information, heat signature, sound metering are collected.

For optical recognition, you can apply the method of enumerating the type of object at different angles, scales, displacements, etc. The second approach is to find the outline of an object and examine its properties (connectivity, presence of corners, etc.). Another approach is to use an artificial neural network. This method requires a large number of examples of a recognition problem (with correct answers), or a special neural network structure that takes into account the specifics of this problem.

The collected data must be processed by an expert system in real time. To identify the detected objects, a knowledge base should be used, which is a set of tactical and technical characteristics of objects, for example:

- dimensions;
- equipment installed on board;
- the appearance of the object;
- thermal signature;
- types of modulation used for encryption of transmitted data; etc.

In addition, the knowledge base is formed by sets of rules that allow solving the problem of recognition and identification of detected objects by processing data.

The database management system is built using IMDB (In-memoryDatabase) located in RAM. It stands out against the background of systems that use the disk storage mechanism. In-memory databases are faster than persistent storage-optimized databases because access to them is slower than memory access, and internal optimization algorithms are simpler and execute fewer central processing unit (CPU) instructions.

Accessing data from memory eliminates the time it takes to search for it, making it faster and more predictable than using a disk drive. Since RAM is volatile, a pre-logged non-volatile device is used to ensure the integrity of the database during sudden reboots [2].

The system should be able to duplicate and replace, if it is impossible to use one of the data collection tools. The system should have test modes and report faults to the user. The system should include a combined-arms radar identification system "friend or foe". The system operates in automatic and semi-automatic modes: detection is performed in the specified zones with the possibility of their reconfiguration. Data about objects is transmitted to the server, processed and displayed on the operator's workstation. Workstation remotely interacts with the server via Ethernet LAN [3].

When solving problems, heuristic and approximate methods are the main ones. Such methods do not require extensive background information. The methods used can be divided into computational methods, control methods and decision theory methods. The computational methods of the system include decision-making technology, which is used in the selection of suitable object models. This group also includes methods for comparing the received input data about an object with those available in the knowledge base.

For control, the method of differential evolution is used, which belongs to the class of stochastic optimization methods, and is also built on the basis of genetic algorithms with minor modifications.

The methods of choice theory and decision making are used to form the output data model. The output data is an expert opinion containing the designation of the recognized object, the probability of the object's definition accuracy, as well as a set of characteristics inherent in the object. Such systems are relevant for military airfields, military units, border posts. Along with global positioning systems, mobile rapid deployment systems are no less relevant. It is also appropriate to talk not only about the tracking and recognition of large aircraft, but also about civil unmanned aerial vehicles.

There is a high need to control the territory of secure industrial facilities, military units, as well as places of mass visits of people (stadiums, concerts, etc.), in order to prevent violations of secrecy regimes, unauthorized collection of data,

as well as terrorist attacks. The creation of small detection and recognition systems with the ability to quickly deploy to monitor the situation and alert is urgent.

Such systems are based on a combination of acoustic data, analysis of the video stream and data from IR sensors, data on the presence of a Wi-Fi signal and a signal at typical frequencies of the control channel. Drones are distinguished from conventional planes and birds. After detection, the drone is monitored by video and its actions are analyzed. The detection range of such a system is about 500 meters. It is also possible to trace the source of the control signal.

The analysis shows the stability of the system in terms of failures and fault tolerance, which indicates reliability. The use of the IMDB system ensures the speed of interaction with the database [4]. Duplication systems increase the resource of the system. This recognition system will increase the speed of decision-making and the success of the suppression tasks, due to the precise determination of the forces and means that must be countered.

References

1. Karpov I.G. Radiotekhnicheskiye sistemy peredachi informatsii [radio-technical information transmission systems]: uchebnik . Tambov: TVVAIURE (VI), 2008. 447 p. (Rus)
2. Nacional'naya biblioteka im. N.E. Baumana Bauman National Library [electronniy resurs]. URL: [http://ru.bmstu.wiki/IMDB_\(In-memory_Database\)](http://ru.bmstu.wiki/IMDB_(In-memory_Database)). (Rus)
3. Smirnova E.V., Kozik P.V. Tekhnologii sovremennyh setey Ethernet. Metody commutatsii i upravleniya potokami dannykh [Modern Ethernet networks technologies. Methods of switching and data flow control]: ucheb. posobie. SPb.: BHV-Peterburg, 2012, 272 p. (Rus)
4. Shklyar V.N. Nadejnost' sistem upravleniya [Reliability of control systems]: ucheb. posobie. Tomsk: Izd-vo Tomskogo politekhnicheskogo universiteta, 2009, 126 p. (Rus)

ОЦЕНКА ВОЗМОЖНОСТИ РАЗРАБОТКИ КОМПЛЕКСНОЙ СИСТЕМЫ ОБНАРУЖЕНИЯ И РАСПОЗНАВАНИЯ ОБЪЕКТОВ АВИАЦИИ

А. Е. Зайцев

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: praviypalecnogi@rambler.ru

Аннотация. Рассмотрены проблемы обнаружения и распознавания объектов авиации. Представлены параметры, согласно которым система анализирует объект. Изучены особенности организации базы данных и информационного взаимодействия элементов системы. Проведена качественная оценка параметров системы.

Ключевые слова: авиационные объекты, база данных, дроны, обнаружение, распознавание, экспертная система.

УДК 69.051

ББК 30.2

Conditions for Construction and Installation Works on the Design of Urban Developments

G.V. Betin*, M.Y. Tarapon, G.V. Zelenin

Tambov State Technical University, Tambov, Russia

*e-mail: *betin.georgy@yandex.ru*

Abstract

The article discusses the main factors influencing the choice of design technological solutions and organizational forms of management during the reconstruction of objects of varying complexity. Organizational and technological documentation should be developed taking into account progressive methods of construction and installation work, local conditions, universal means of mechanization to ensure production efficiency and reduce costs.

Keywords: building, reconstruction, cramped conditions, construction and installation work.

Changes in direction are currently taking place in housing construction, along with the typical development of new districts a tendency has emerged to increase the density of development in historically established districts. At the same time, new tasks appear in the reconstruction of districts in the conditions of historically established buildings: to maximize the density of buildings, but at the same time preserving the existing norms of urban planning; to carry out the reconstruction of residential buildings in such a way as to fulfill the social task - targeted relocation of families from houses to be reconstructed or demolished into houses that are being built in this microdistrict in the course of new development.

Reconstruction objects are subdivided according to the nature of the planned construction and installation works and the degree of their complexity: simple, complex and especially complex [1]. This feature must be used in the development of design solutions for the expedient implementation of the reconstruction of an object or complex, to determine the conditions for the production of construction and installation works and a preliminary cost estimate, as well as to select organizational forms of management of reconstruction or construction.

Reconstruction management includes the following:

- development and justification of the project concept, assessment of its economic or social significance;
- execution of a feasibility study for a reconstruction project and development of a business plan for the project;
- development of estimates and project budget;
- ensuring effective control and regulation, as well as managing changes that are inevitable during project implementation;
- assessment of the duration and structure of the project.

The implementation of repair and construction work in reconstructed buildings, especially in the conditions of the existing development, is a rather complex process, which makes it difficult to carry out work using progressive methods using optimal engineering solutions, modern methods of organizing production and is characterized by a number of features.

The following factors will have a significant impact on the production of repair and construction work in dense urban development: traffic and pedestrian traffic in the immediate vicinity of the work site; limited storage conditions or the impossibility of storing materials at the construction site to provide workers with materials; the network of existing underground communications, subject to suspension or re-laying, carried out during the period of work; limiting the swing of the booms of assembly cranes to ensure the safety requirements [2].

The cramped conditions of the existing urban development presuppose the presence of spatial obstacles at the construction site and the adjacent territory, restrictions on the width, length, height and depth of the dimensions of the working area and underground space, the location of construction machines and vehicle passages, an increased degree of construction, environmental, material risk and, accordingly, enhanced safety measures for workers in the construction industry and the living population [3].

Organizational and technological rules for the reconstruction of objects in the cramped conditions of the existing urban development, regardless of their purpose and belonging, are developed in the construction organization project, which provides for measures to ensure the safety of existing facilities, reduce construction, environmental and material risks, but in practice, the implementation of design and estimate documentation is hampered by the lack of a methodological base.

In the conditions of the cramped construction site, it is also difficult to choose rational options for the mechanization of construction and installation work [4].

In these conditions, it is necessary to carry out the following measures:

- limitation of the service area by the outreach of the crane hook in the installation area - the outreach is limited by the contour of the building being erected, and the unloading and storage area is limited by the line of limitation of the crane service area;

- limiting the height of lifting loads. In the area of unloading vehicles and warehousing, the height of lifting of goods from the ground level should not exceed 3.5 m. In the installation area, the lifting height of loads should be no more than 2.3 meters higher than the level of the installation horizon or obstacles in the way;

- limiting the speed of rotation of the crane boom towards the border of the working area and the speed of movement of goods in the mounting area to the minimum when the distance from the moved load to the border of the zone is less than 7m.

When using cranes, neighboring buildings and structures in which there are people, transport or pedestrian roads can get into dangerous zones, the project necessarily provides solutions (measures) to ensure the safety of people.

A significant factor restraining the implementation of works related to the reconstruction is the small number of small-scale means of mechanization for domestic production, which would be distinguished by mobility, small dimensions and optimal cost relative to foreign analogues.

When choosing the means of mechanization, the following basic provisions should be taken into account: the means of mechanization must be universal, that is, they must perform construction and installation works and operations of various nature, volume and specificity in cramped conditions; the machines and mechanisms used should be as light as possible, small in size, quickly transferred from transport to working position and vice versa, have removable attachments for assembly and transport equipment or with variable overall characteristics.

During reconstruction in the cramped conditions of the existing urban development, it is necessary to select the combination of elements of construction production and options for the production of work, taking into account not only the cramped conditions of the construction site, but also taking into account the cramped temporary construction infrastructure, which will allow by balancing the various costs associated with the change organizational and technological situations (by the timing of the construction of objects, by the methods of performing construction and installation work, by the methods of their mechanization, by the use of new building materials, etc.) will allow achieving the fulfillment of the conditions for the production of work and ensure rational costs of construction production.

To ensure the technical and economic efficiency of the reconstruction or renovation of the existing development, the determining criteria are the following: solving economic and social problems, determining the main directions for the development of the infrastructure of the territory and determining the sources of financing for repair and construction works. Of great importance is the development of organizational and technological documentation, which will allow to ensure the optimal organization of construction production through the use of progressive methods of repair and construction work, which contribute to reducing the cost and labor intensity, reducing the duration of the work production, increasing the degree of use of construction machinery and equipment, improving the quality of work, as well as ensuring safe working conditions and preserving the natural environment.

References

1. Kozhukhina O.N. Organizatsionnyye i tekhnologicheskiye aspekty rekonstruktsii gorodskoy zastroyki v stesnennykh usloviyakh / O.N. Kozhukhina, D. Shlyapnikova // Ustoychivoye razvitiye regiona: arkhitektura, stroitel'stvo, transport: materialy 2-y Mezhdunarodnoy nauchno-prakticheskoy konferentsii. FGBOU VPO «Tambovskiy gosudarstvennyy tekhnicheskiy universitet». - Tambov, Izd-vo Pershina R.V., 2015. pp. 139-142. (in Russ.)

2. Yeremin A.V. Vliyaniye stesnennykh usloviy gorodskoy zastroyki na proizvodstvo remontno-stroitel'nykh rabot / A.V. Yeremin, O. Kozhukhina, V.V. Popov // Materialy 6-y Mezhdunarodnoy nauchno-prakticheskoy konferentsii Instituta arkhitektury, stroitel'stva i transporta. Ustoychivoye razvitiye regiona: arkhitektura, stroitel'stvo, transport »/ FGBOU VO« TGTU ». - Tambov: Izd-vo Pershina R.V., 2019. Pp. 181-183. (in Russ.)
3. Postanovleniye Pravitel'stva Moskvy ot 08.08.2000 N 603 «Ob utverzhdenii Pravil proizvodstva zemlyanykh i stroitel'nykh rabot, prokladki i rekonstruktsii inzhenernykh setey i kommunikatsiy v Moskve». (Na Rusi.) 4. Alenicheva Ye.V. O sovremennykh organizatsionno-tehnologicheskikh problemakh rekonstruktsii v usloviyakh gradostroitel'stva / Ye.V. Alenicheva, V. Ledenev, P. Monastyrev // Arkhitektura i vremya. 2010. № 1. Pp. 2-4. (in Russ.)

УСЛОВИЯ ПРОВЕДЕНИЯ СТРОИТЕЛЬНО-МОНТАЖНЫХ РАБОТ ПРИ РЕКОНСТРУКЦИИ ГОРОДСКОЙ ЗАСТРОЙКИ

Г. В. Бетин, М.Ю. Тарапон, Г.В. Зеленин

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: betin.georgy@yandex.ru

Аннотация. В статье рассматриваются основные факторы, влияющие на выбор проектных технологических решений и организационных форм управления при реконструкции объектов различной сложности. Организационно-технологическая документация должна разрабатываться с учетом прогрессивных методов производства строительно-монтажных работ, местных условий, универсальных средств механизации для обеспечения эффективности производства и снижения затрат.

Ключевые слова: застройка, реконструкция, стесненные условия, строительно-монтажные работы.

Energy Efficiency of a Residential Building Model Depending on the Area of External Walls

V. V. Klyueva *, I. A. Markin

Tambov state technical University, Tambov, Russia

*e-mail: Schumi_f1_87@mail.ru

Abstract

The dependence of the energy efficiency of a residential building model on the area of the enclosing structures of the cladding is analyzed. The energy efficiency of 2 types of building models created in Archicad 20 program was evaluated. The types differ from each other only in the area of the cladding and the shape of the architectural volume. It is concluded that the increase in the area of enclosing structures by 2 times without increasing the total area and volume of buildings leads to a 27 percent overspend of energy for the annual period of operation spent on heating the building. An increase in the area of enclosing structures also results in an increase in heat loss of the building model due to heat transfer of the enclosing structures of buildings and infiltration.

Keywords: building model, calculated resistance to heat transfer, energy efficiency, heat input, heat loss, thermal insulation of a building.

Introduction

The dependence of the energy efficiency of the residential building model on the area of the enclosing structures of the cladding was studied.

A residential building was chosen as the object of the research. The order of stages in ArchiCAD program on energy simulation of buildings is presented in Fig. 1.

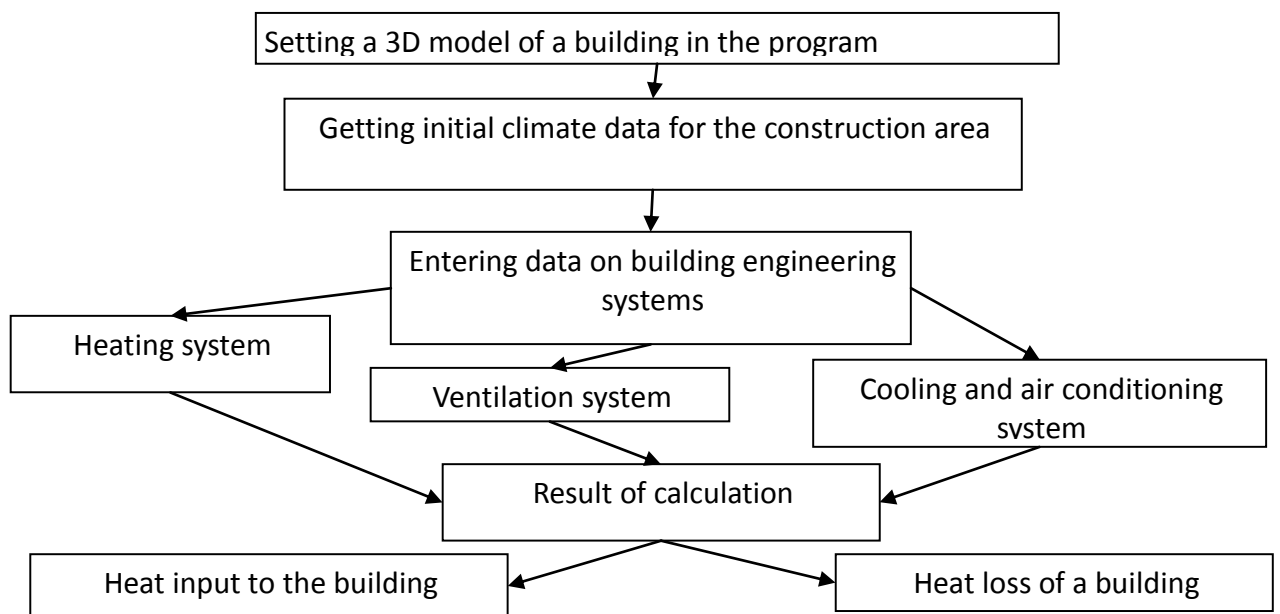


Fig. 1. The order of stages in ArchiCAD 20 on energy simulation of buildings

Energy efficiency analysis

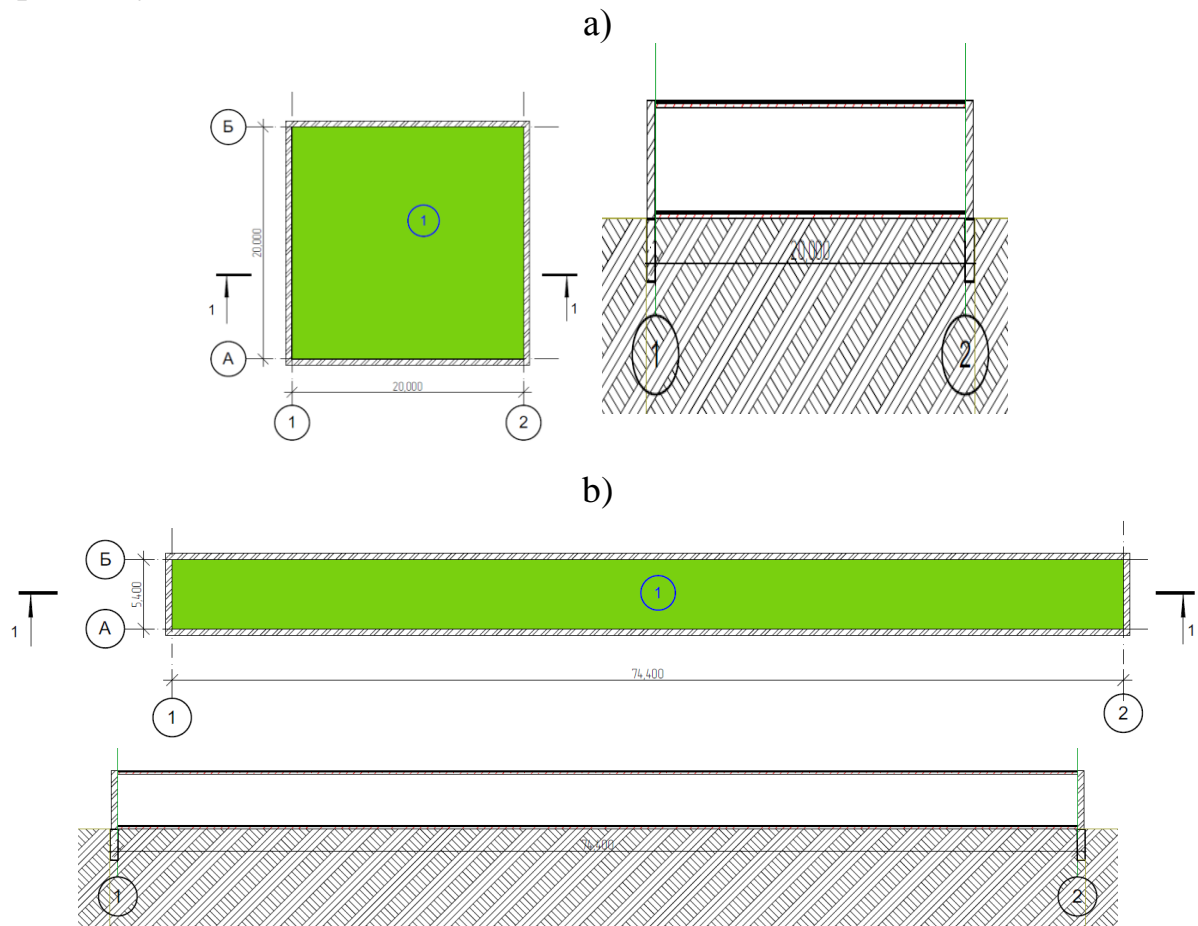
Energy efficiency assessment of 2 types of building models in Archicad 20 program was done. The options differ from each other only in the area of the

cladding and the shape of the architectural volume. Types of building models were not equipped with window and door openings for the purity of the study. The volume of the room in both types and their total area are equivalent to each other. The area of the cladding in type 1 is 2 times less than that in the second type.

The calculated resistance of the enclosing structures and floor structures was set manually by the maximum possible value in the program to minimize heat loss through these enclosing structures. The cladding is made of silicate bricks which are 510 mm thick.

The configuration in the plan of the first type is a square with a side length of 20 m. The configuration in the plan of the second type is a rectangle 74.4 m long and 5.4 m wide. The size of the second type was selected from the condition that the area of the buildings is equal to the area of the buildings of the first type.

Fig. 2 shows plans and sections of the building model for types 1 and 2, respectively.



a – type 1; b – type 2

Fig. 2. Building model configurations

Figs. 3 and 4 show a graph of heat loss by a building over the annual period of operation through external enclosing structures due to heat transfer and infiltration, respectively. Climate parameters are typical for Tambov.

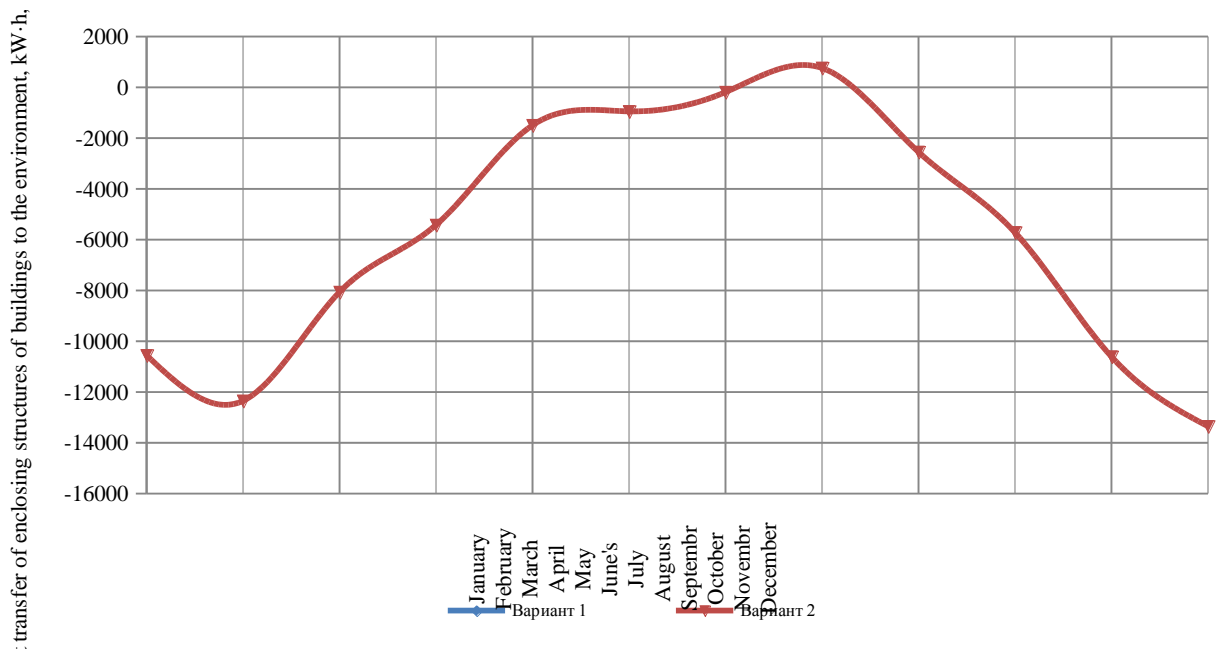


Fig. 3. Heat loss due to heat transfer of enclosing structures of a building to the environment

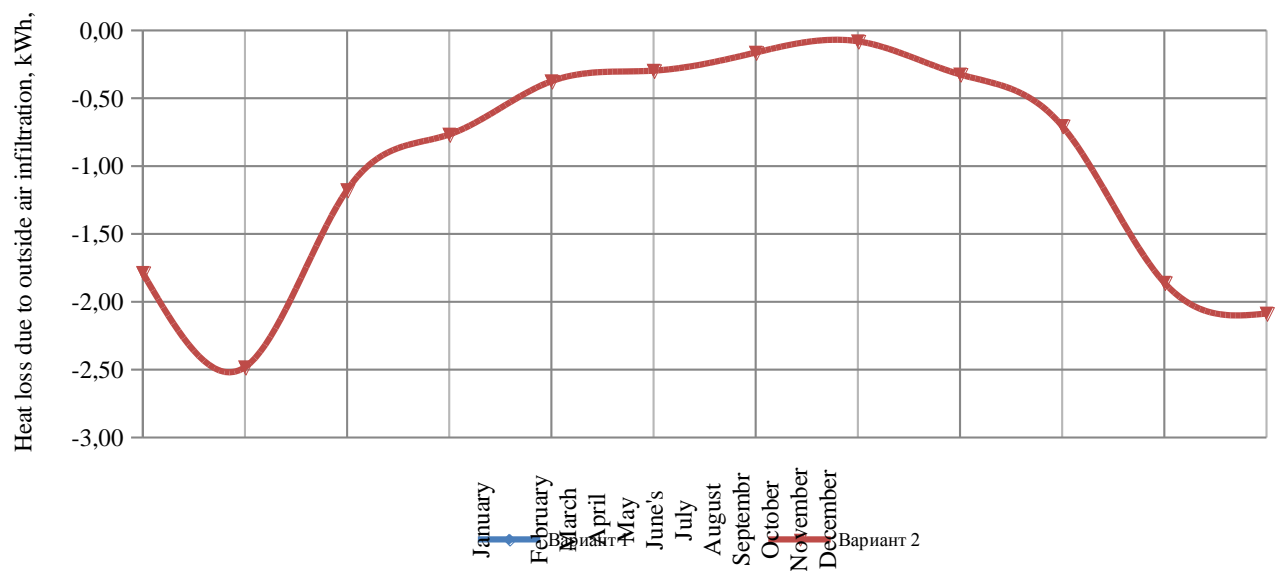


Fig. 4. Heat loss due to infiltration

As can be seen from the graph in Fig. 3, the heat loss of the building model in type 2 is 94% greater than that of type 1. As can be seen from the graph in Fig 4, the heat loss of the building model in type 2 is 84% greater than that of type 1.

The graphs show partial results of the analysis of the study. Summary Table 1 shows a comparison of all the analyzed characteristics for heat loss and heat availability of these building models, as well as a comparison of the characteristics of space-planning solutions

Table 1. Main parameters of building

Indicators	Unit	Type of solution		
		First	Second	Difference, %
1	2	3	4	5
Total area of the building	m.sq.	400	400	-
The area of external surfaces	m. sq.	312	625	100
Vented volume	m. cube.	1560	1560	-
External heat capacity	J / m kV×K	580	790	36
Heat transfer through walls	kW×h	-36324	-70479	94
Infiltration	kW×h	-6.57	-12.10	84
Heating	kW×h	107646	137058	27
Total energy consumed	kW×h	165395	194749	17

Conclusion

As can be seen from the study, an increase in the area of enclosing structures by 2 times without increasing the total area and volume of buildings leads to a 27% overspend of energy for the annual period of operation, spent on heating the building and a 17% increase in total energy consumed.

References

1. Monastirev P.V. Changes in introduction of norms in the conservation of heat for the external walls of dwelling houses in Russia. Transactions of the TSTU, 2000, 6(2), pp.282-284.
2. SP 23-101-2004. Proyektirovaniye teplovoy zashchity zdaniy [Design of thermal insulation of buildings]. Moscow, Gosstroy Rossii, FGU TSPP, 2004. (Rus)
3. SP 50.13330.2012. Teplovaya zashchita zdaniy [Thermal insulation of buildings]. Moscow, NIISF RAASN, 2013. (Rus)
4. SP 131.13330.2012 Stroitel'naya klimatologiya [Construction climatology]. Moscow, 2000, 42 p. (Rus)
5. SP 118.13330.2012 Obshchestvennyye zdaniya i sooruzheniya [Public buildings and structures]. Institut obshchestvennykh zdaniy, 2013. (Rus)

ЭНЕРГОЭФФЕКТИВНОСТЬ МОДЕЛИ ЖИЛОГО ЗДАНИЯ В ЗАВИСИМОСТИ ОТ ПЛОЩАДИ НАРУЖНЫХ СТЕН

В. В. Ключева*, И. А. Маркин

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: Schumi_f1_87@mail.ru

Аннотация. Целью настоящей работы является анализ зависимости энергоэффективности модели жилого здания от площади ограждающих конструкций наружного стенового ограждения. Произведена оценка энергоэффективности 2-х вариантов моделей зданий в программе Archicad 20. Варианты отличаются друг от друга только площадью стенового ограждения и формой архитектурного объема. Выявлено, что увеличение площади ограждающих конструкций в 2 раза без увеличения общей площади и объема помещений приводит к 27-ми процентному перерасходу энергии за годовой период эксплуатации, расходуемому на отопление здания. Увеличение площади ограждающих конструкций также приводит к увеличению теплопотерь у модели здания за счет теплопередачи ограждающих конструкций здания и инфильтрации.

Ключевые слова: модель здания, расчетное сопротивление теплопередаче, теплозащитная оболочка здания, теплопоступления, теплопотери, энергоэффективность.

The Modern State of Road Bitumen Modification Field

P. M. Malin

Tambov State Technical University, Tambov, Russia

e-mail: malin.pavlik@mail.ru

Abstract

Modern state of road bitumen modification is considered in the article. The significance of further investigation in the field of road bitumen modification is emphasized in the paper.

Keywords: road bitumen; modification.

It is known that over the past decades, the service life of asphalt concrete pavements on roads, bridges and airfields has decreased 2-3 times; more than 90% of the material, labor and energy resources allocated to the road industry are not spent on the construction of new ones, but on the repair and reconstruction of old asphalt concrete pavements. This situation is holding back the development of the hard-surface road network in Russia. The situation is aggravated by the continuous increase in the carrying capacity and traffic intensity of vehicles, leading to a significant increase in dynamic loads on the road surface and thereby increasing requirements for the quality of bitumen [1].

Oil road bitumen products are the most important and mandatory component of asphalt concrete mixtures, and it is they that are most susceptible to all types of deformations during operation.

Bitumen products have high viscosity, and most grades have a yield point, i.e. they begin to deform and flow only after some stress is applied to them. It should be noted that for individual brands of bitumen, this limit strongly depends on the duration of the load and the speed of its application. It is essential that all the rheological properties of bitumen are strongly temperature dependent. This allows the heated bitumen to be easily applied to objects of various, complex shape. Bitumen is an extremely complex mixture of hydrocarbons and heteroorganic compounds of various structures, which basically does not boil away at oil distillation temperatures. Identification of all compounds that make up bitumen is impossible.

Bitumen products have the following approximate elemental composition (% wt.): Carbon - 80-85; hydrogen - 8.0-11.5; oxygen - 0.2-0.4; sulfur - 0.5-7.0; nitrogen -0.2-0.5. In addition, they contain trace amounts of various metals. However, the elemental composition of bitumen does not give an idea of the chemical compounds contained in bitumen.

To study the properties of bitumen, they are divided into separate groups of hydrocarbons with similar properties. The following groups of hydrocarbons are most often isolated from bitumen: oils, resins and asphaltenes.

Oils in bitumen lower its softening point, hardness, increase fluidity and volatility. Resins give bitumen hardness, ductility and extensibility. Asphaltenes

are a concentrate of the highest molecular weight compounds of oil, usually heteroatomic. Asphaltenes are the main structural component of bitumen.

Asphaltenes are the main structure-forming component of bitumen, black solid infusible substances. The increased content of asphaltenes in bitumen is responsible for its increased viscosity and thermal stability. Oils, resins, asphaltenes and other groups of hydrocarbons are included in bitumen in various ratios and thereby determine their structure and properties. In terms of their physicochemical structure, bitumen products are colloidal solutions of asphaltenes (with part of the resins adsorbed on their surface) in an oil-resin medium. Bituminous micelle (bitumen molecule) is a complex system of various substances from the asphaltene core (dispersed phase) to oils, which are a dispersion medium in this system.

The group composition of bitumen predetermines its colloidal structure and rheological behavior, and thus - technical properties, which are characterized by certain quality indicators determined under standard conditions. Among these indicators are the most important: penetration (depth of penetration of the needle into the bitumen), softening and brittleness temperatures, ductility (extensibility) - the ability of bitumen to stretch into a thread. Some indicators are determined both for the original bitumen and for bitumen after heating, which simulates the aging process. The standards set certain values for quality indicators which reflect the optimal composition of bitumen. This composition can be different for different bitumen applications.

Road bitumen is divided into viscous and liquid. Viscous bitumen is used as a binder in the construction and repair of road surfaces. The bulk of such bitumen is produced in Russia in accordance with GOST 22245-90.

Currently, to obtain high-quality bitumen, various modification methods are used: compounding and modification.

There are several ways of modifying bitumen: physical methods, chemical methods, the introduction of chemical additives into the bitumen composition, based on the mechanical and physical impact on the bitumen environment [2].

The physical methods of changing the properties of bitumen include the following: electromagnetic exposure, X-ray irradiation, ultrasonic treatment, microwave activation, infrared exposure.

The use of physical methods of bitumen modification, in spite of the effectiveness of their application, requires very large energy costs and large capital investments.

As modifiers for petroleum bitumen, such thermoplastic materials are used, the choice of which is justified for compatibility with bitumen by a number of its valuable properties: high impact resistance, resistance to cracking at low temperatures, good adhesion, physiological harmlessness, low elongation, high softening temperature, high elasticity and relatively low cost [3].

The most common and available methods for modifying bitumen are chemical additives: polymers, rubber, surfactants, and emulsions.

When modifying bitumen, the following modifiers are distinguished: thinning, plasticizing, adhesive, structuring-plasticizing, structuring, adhesive-structuring, stabilizing, emulsifiers.

To obtain homogeneous compositions, it is important to select the conditions for combining thermoplastic material with bitumen. The technological regime of such a combination should exclude or minimize the destruction of both bitumen and polymer material.

Achieving the necessary homogeneity of polymer-bitumen binders in the conditions of road-repair construction departments is still problematic, despite the almost universal equipment of the asphalt concrete plants with special mixers. The difficulty lies in the fact that it is not easy to achieve a uniform distribution of a high-molecular additive throughout the entire volume of bitumen with those mixers that are now used for this.

For bitumen modification, the following type of equipment is used: propeller mixers, sheet mixers, mixers with a frame mixer, mixers with a screw mixer, turbine mixers, and installations for modifying bitumen with polymers, paddle mixers with vertical and horizontal shafts, planetary mixers with several screw mixers [4].

Thus, it is currently advantageous to use modifying additives for bitumen, thereby significantly increasing its technological and operational properties.

References

1. Plewa A., Belyaev P. S., Andrianov K. A., Zubkov A. F., Frolov V. A. The Effect of Modifying Additives on the Consistency and Properties of Bitumen Binders. *Advanced Materials & Technologies* 2016, No 4, pp. 35-40.
2. Belyaev P.S., Mishchenko S.V., Belyaev V.P. and Frolov V.A. Monitoring of the changes in the characteristics of petroleum bitumen in its interaction with the polymer (Monitoring izmeneniya harakteristik neftyanogo bituma pri vzaimodejstvii s polimerami). *AIP Conference Proceedings*, 2017, vol. 1876, No. 1, 020096.
3. Belyaev P.S., Mishchenko S.V., Belyaev V.P., Belousov O.A. and Frolov V.A. Investigation of the Bitumen Modification Process Regime Parameters Influence on Polymer-Bitumen Bonding Qualitative Indicators. *IOP Conf. Series: Journal of Physics: Conf. Series*, 2018, 998.
4. Belyaev P.S., Frolov V.A., Varepo L.G., Belyaev V.P., Makeev P.V. Shashkov I.V. Equipment desing automation at asphalt-concrete production modernization. *IOP Conf. Series: Journal of Physics: Conf. Series*, 2019, 1260, 032004.
5. Monastirev P.V. Changes in introduction of norms in the conservation of heat for the external walls of dwelling houses in Russia. *Transactions of the TSTU*, 2000, 6(2), pp.282-284.

СОВРЕМЕННОЕ СОСТОЯНИЕ В ОБЛАСТИ МОДИФИКАЦИИ ДОРОЖНЫХ БИТУМОВ

П. М. Малин

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: malin.pavlik@mail.ru

Аннотация. Рассмотрено современное состояние в области модификации дорожных битумов. В статье подчёркивается значение дальнейшего исследования области модификации дорожных битумов.

Ключевые слова: дорожные битумы; модификация.

The Environmental Humidity Effect on Expanded Polystyrene Density

A.V. Sevostyanov*, D. N. Krylov

Tambov State Technical University, Tambov, Russia
*e-mail: sevo-andrey@yandex.ru

Abstract

Currently much attention is paid to the changes of building materials characteristics under the influence of adverse conditions. The paper considers the effect of environmental humidity on the density of expanded polystyrene PSB-S-25. The study of the latter allows to predict the performance and durability of the material. It was found that changes in the humidity of the environment do not affect the density of the material under study.

Keywords: density, expanded polystyrene, humidity.

Introduction

One of the most common thermal insulation materials is Styrofoam (polystyrene) PSB-S-25. A low coefficient of thermal conductivity (0.039 W/m·K) is achieved by increasing the porosity of the material, which in turn affects the sensitivity of the material characteristics to changes in environmental humidity, which is one of the factors that affect operational reliability [1]. With increasing humidity, the density of the material should increase at a constant temperature.

The study was aimed at the determination of the density of Styrofoam PSB-S-25 when environmental humidity changes from 60 to 70 and 80 %.

It was necessary to solve the following problems:

- analyze existing methods for predicting the performance of building materials;
- determine the effect of humidity changes on the density of expanded polystyrene.

The subject of the study was Styrofoam PSB-S-25.

Methodology of the experiment

Samples measuring 120x50x20 (h) were placed in a chamber that maintained the specific humidity (Fig. 1). Then the mass and size of each sample were determined. The mass of the sample was determined using an electronic scale with an accuracy of 0.01 g. The sides of each sample were measured and their volume was determined by the multiplication of the lengths of the three sides of the sample, which were measured using a caliper with an accuracy of 0.1 mm. The density was determined by the following formula:

$$\rho=m/V,$$

where m is the mass of the sample, g; V is volume of the sample, cm³.

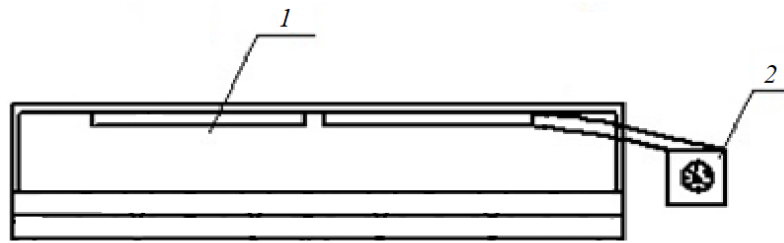


Fig.1. Schematic view of the test device

The final density result was taken as the arithmetic value of 6 samples tested under the same conditions. Based on the obtained values of the mass and volume of the material, graphs were plotted in the coordinates p (gr/cm^3) - φ (%) (Fig. 2) [2].

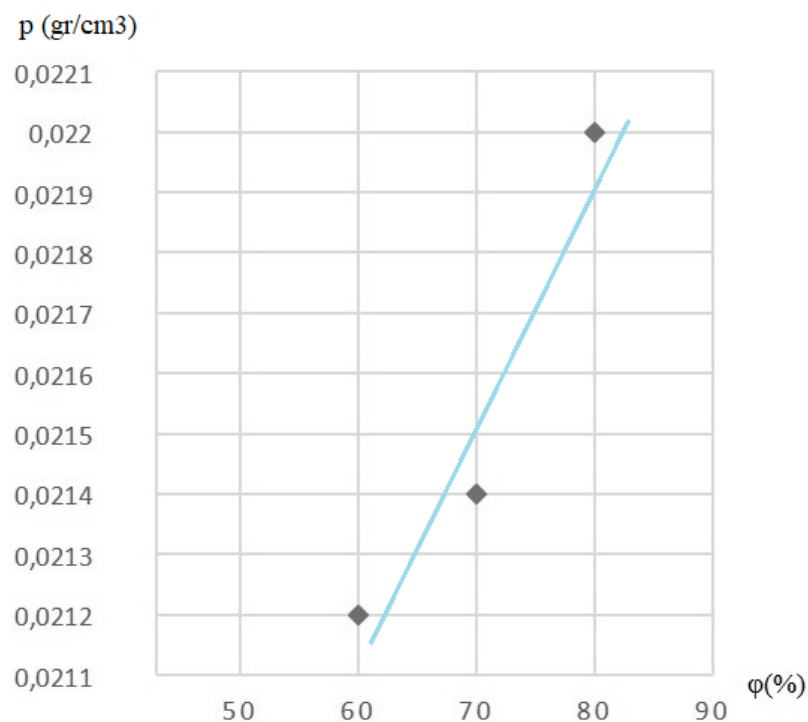


Fig.2. Dependence of changes in the density of expanded polystyrene PSB-S-25 on humidity

At $\varphi=60\%$ - $p=0.0212 \text{ g} / \text{cm}^3$; $\varphi=70\%$ - $p=0.0214 \text{ g}/\text{cm}^3$; $\varphi=80\%$ - $p=0.0220 \text{ g}/\text{cm}^3$.

It was found that the increase in environmental humidity up to 80% causes increases in the density of expanded polystyrene PSB-S-25 by no more than 1.0 % which is insignificant.

Conclusion

Thus, it can be concluded that changes in environmental humidity do not affect the density of Styrofoam PSB-S-25.

References

1. Rozhdestvenskaya T.S. Analiz faktorov, vliyayushchikh na parametry ekspluatatsionnoy nadezhnosti stroitel'nykh konstruktsiy sportivnykh sooruzheniy [Analysis of factors affecting the parameters of operational reliability of building structures of sports facilities]. *Mezhdunarodnye akademicheskie chteniya*, 2006, pp. 143-146. (Rus)
2. Yartsev V.P. Ekspluatatsionnyye svoystva i dolgovechnost' teploizolyatsionnykh materialov (mineral'noy vaty i penopolistirola) [Operational properties and durability of heat-insulating materials (mineral wool and expanded polystyrene)]. *Krovel'nyye i izolyatsionnyye materialy*, 2013, No. 1, pp. 8-11. (Rus)
3. Monastyrev P.V. Changes in introduction of norms in the conservation of heat for the external walls of dwelling houses in Russia. *Transactions of the TSTU*, 2000, 6(2), pp.282-284.

ПЛОТНОСТЬ ПЕНОПОЛИСТИРОЛА ПРИ ИЗМЕНЕНИИ ВЛАЖНОСТИ ОКРУЖАЮЩЕЙ СРЕДЫ

А. В. Севостьянов*, Д. Н. Крылов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: sevo-andrey@yandex.ru

Аннотация. В настоящий момент времени при исследовании характеристик строительных материалов большое внимание уделяется их изменению в процессе эксплуатации под воздействием неблагоприятных условий. В статье рассмотрено влияние влажности окружающей среды на плотность пенополистирола марки ПСБ-С25, исследование которого позволяет прогнозировать работоспособность и долговечность материала. Установлено, что изменение влажности окружающей среды не влияет на плотность исследуемого материала.

Ключевые слова: влажность, пенополистирол, плотность.

Relevant Issues of Cast Mixture Application When Installing Asphalt Concrete Pavement

L. S. Zarapina

Tambov State Technical University, Tambov, Russia

e-mail: lyubov.guseva.2012@bk.ru

Abstract

The article describes relevant issues of cast mixture application when installing asphalt concrete pavement.

Keywords: mastic asphalt, asphalt concrete.

Currently, there is a wide range of asphalt concrete mixtures used for the construction of asphalt concrete pavements for various functions. They all have their own advantages and disadvantages and determine their area of application.

One of the varieties of asphalt concrete is mastic asphalt, which is a rationally selected mixture of viscous-flowing consistency with a minimum content of air voids. The mixture consists of a mineral part (crushed stone, sand and mineral filler) and a bituminous binder, taken in certain proportions and mixed in a heated state. The mixture is laid without compaction, while the temperature of the mixture must be at least 190 ° C [1].

A distinctive feature of mastic asphalt concrete mixtures is that all intergranular pores in it are filled with an asphalt binder. At the same time, the bitumen/filler ratio is slightly higher than in the binder of common asphalt concrete. After the mass is laid and compacted, there are practically no residual pores and voids in the monolith, therefore the coatings made of it are more waterproof. It is this feature that makes mastic asphalt concrete less resistant to plastic deformation [2].

To combat this drawback, when preparing the mixture, bitumen of increased viscosity or bitumen with polymer modified asphalt cement is used. The production of such asphalt concrete is possible only at elevated temperatures (180-220°C). The increased temperature during preparation also provides the required technological mobility of the mastic mixture.

The complexity of technological processes for preparing the mixture and the viscous-flowing consistency of the finished mastic mixture requires special attention to the selection of the granulometric composition of the mixture and the prevention of its segregation during transportation. Therefore, there is a need for continuous mixing of the mixture with its simultaneous heating during transportation from the asphalt concrete plant to the construction site. Poured asphalt concrete mixtures, most often, are delivered to the place of work in special mixers (cohers).

The properties of mastic asphalt concrete mixture and mastic asphalt concrete are regulated by GOST R 54401-2020 «Public automobile roads. Hot mastic

asphalt concrete road mixtures and mastic asphalt concrete for roads. Technical specifications». According to it, depending on the nominally maximum size of the mineral aggregate used, mastic mixtures and mastic asphalt concrete are divided into 9 types (MA16N, MA16T, MA16E, MA11N, MA11T, MA11E, MA8N, MA8T, and MA4).

Table 1. Types of mastic asphalt concrete according to GOST R 54401-2020

Type of mastic asphalt according to GOST	Largest filler size, mm Maximum	Binder content, % by mass	Mix temperature during preparation and laying, ° C	Application area
MA 16 (N, T, E)	22.4	6.2-8.5	190-230- when using bitumen with a penetration index of 36-70	For lower layers of coating and for waterproofing layers (type N), for upper layers of coating and wear layers (type V), for patching
MA 11(N, T, E)	16	6.5-9.5	190-220 - when using bitumen with a penetration index of 71-100	
MA 8(N, T)	11.2	7.2-9.5	200-215 – when using polymer modified asphalt cement	
MA 4	5.6	8.5-11.0	For mixtures with a low laying temperature, laying is carried out at a temperature of 170-190 ° C	Walking and cycling paths

According to STO NOSTROY 2.25.39-2011 “Construction of asphalt concrete pavements of highways. Part 4 Construction of asphalt-concrete pavements from mastic asphalt concrete” and STO Soyuzdorstroy 2.1.3.1.3.4-2012 “Construction of asphalt-concrete pavements of highways. Part 4 Construction of asphalt concrete pavements made of cast asphalt concrete” the construction of pavements using mastic asphalt concrete mixtures includes 4 main stages:

- ✓ preparatory work, including traffic management, surface treatment with bitumen emulsion (0.2-0.4 l / m²) and formwork installation;
- ✓ acceptance and unloading of the delivered mixture. Delivery of the mixture to the place of laying is carried out in special machines - thermoses-mixers, while the maximum time the mixture is in the mixer is 5 hours.

Laying the mixture. The document defines the temperature ranges of the mixture during paving (185-230 °C), the recommended lengths of the paved strip depending on the ambient temperature, describes the detailed paving process when using pneumatic pavers and finishes.

Distribution and pressing of black macadam. The temperature of the macadam during laying must be at least 100 °C at a coating temperature of 140-180 °C. Macadam is pressed in with a light roller.

The process of performing works on maintenance and installation of sidewalks using mastic asphalt concrete mixtures is described in the Regulations for the use of mastic asphalt concrete mixtures in the construction and repair of urban highways, issued in 1998.

The practice of using traditional mastic asphalt mixtures and mastic asphalt concrete has shown a number of their advantages. First of all, these include:

- ✓ high density and ductility, which allows them to resist dynamic loads well;
- ✓ water tightness and durability, due to which mastic asphalt concrete can be used for waterproofing on bridge structures;
- ✓ high corrosion resistance, resistance to deicing agents;
- ✓ good adhesion to higher and lower layers;
- ✓ without compaction, it can reach maximum density without pore formation (residual porosity is approximately zero);
- ✓ the possibility of laying at low temperatures;
- ✓ the possibility of paving without the use of an asphalt paver.

The listed advantages of cast asphalt concrete provide it with a wide range of possible applications:

- ✓ during the construction, reconstruction, repair and overhaul of highways as the top, bottom or wear layer;
- ✓ during construction, reconstruction, repair and overhaul of artificial structures as a protective layer of waterproofing;
- ✓ during construction, reconstruction, repair and overhaul of sidewalks as a covering;
- ✓ during the current (patching) repair of the road surface of abundant roads;
- ✓ when arranging coverings for underground and surface multi-level parking lots, roofs of buildings used for vehicle traffic.

Despite all the advantages of mastic asphalt concrete mixture, it is rarely used now when constructing road surfaces. The main reasons for this are:

- ✓ high cost due to high energy consumption during production and delivery to the place of laying;
- ✓ low resistance to static loads;
- ✓ the presence of plastic deformation during operation.

Taking into account the numerous advantages of mastic asphalt concrete, currently in the world there are large targeted studies on changing the properties of the mixture, reducing plastic deformation, increasing its environmental characteristics and reducing the cost of the material.

In recent years, a large number of modified compositions of mastic mixtures have been studied and introduced into production, which change the characteristics of traditional mastic asphalt concrete, reducing its disadvantages while maintaining positive qualities.

One of the reasons for the formation of plastic deformations on the surface of their asphalt concrete is their heating in summer; dark coloured asphalt concrete intensively absorbs the sun rays and heats up to a temperature significantly higher than the ambient air temperature. One of the ways to reduce the heating temperature of asphalt concrete pavement during operation was proposed by Chinese scientists in 2019. By introducing glass microspheres into the asphalt mix, a series of tests was carried out, as a result of which it was proved that the use of

glass microspheres reduces the thermal conductivity of asphalt mastic by 40%, and the infrared reflection coefficient of the asphalt mastic increases by 60% [4].

To improve the performance of mastic asphalt concrete under the influence of static loads, viscous bitumen of the BND 40/60 brand and polymer-bitumen binders (PBB) are used. It is shown that this leads to an increase in the temperature of the preparation of laying the asphalt concrete mixture and an increase in the cost of both the material itself and the cost of paving with its use. It has been established that an increase in the viscosity of bitumen increases shear resistance, but decreases temperature crack resistance (this is largely manifested on pavements made of mastic asphalt concrete mixture).

Investigations of the properties of mastic asphalt concrete using asphalt granulate and Sasobit additives are being carried out. It has been proven that due to the introduction of asphalt granulate and the additive "Sasobit" in the amount of 0.3% of the mass of the binder, it is possible to improve the physical and mechanical properties of mastic asphalt concrete and reduce the temperature of preparation and applying asphalt concrete mixtures by 20° C [3].

In general, at present, research is associated with improving the composition of the mixture in order to increase the environmental characteristics of the material, save energy costs, and reduce the temperature of its laying of the mixture. One of the important problems is a decrease in the shear capacity of mixtures due to the selection of the optimal particle size distribution of the mixture, as well as an increase in the reflectivity of the surface of the asphalt concrete pavement.

References

1. Kotlyarevskiy A.A., Korolev S.A., Vovko V.V., Akchurin T.K. Ocenka effektivnosti remonta i stroitelstva avtomobilnyh dorog [Evaluation of the efficiency of repair and construction of highways by the example of mastic asphalt concrete technology]. Bulletin of the Volgograd State University of Architecture and Civil Engineering. Series: Construction and architecture, 2006, No. 6, pp. 125-127. (Rus)
2. Melik-Bagdasarov M.S., Gioev K.A., Melik-Bagdasarova N.A. Stroytelstvo i remont dorognyih pokrytii [Construction and maintenance of road asphalt concrete pavements]. Belgorod, Constanta, 2007. 216 p. (Rus)
3. Lupanov A.P., Sukhanov A.S., Silkin V.V., Kozikov I.O., Iiina O.N. Issledovanie vliyeniya asfaltovogo gralulyata na svoistva litogo asfaltobetona [Investigation of the effect of asphalt granulate on the properties of mastic asphalt concrete]. Izvestia of Kazan State University of Architecture and Civil Engineering, 2018, No. 2. pp. 201-207. (Rus)
4. Du Yinfei, Dai Mingxin, Deng Haibin, Deng Deyi, Cheng Peifeng, Ma Cong. Incorporating hollow glass microsphere to cool asphalt pavement: Preliminary evaluation of asphalt mastic. Construction and Building Materials, 2020, vol. 244.

СОВРЕМЕННЫЕ ПРОБЛЕМЫ ПРИМЕНЕНИЯ ЛИТЫХ СМЕСЕЙ ПРИ УСТРОЙСТВЕ АСФАЛЬТОБЕТОННЫХ ПОКРЫТИЙ.

Л. С. Зарапина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: lyubov.guseva.2012@bk.ru

Аннотация. Представлены современные проблемы применения литых смесей при устройстве асфальтобетонных покрытий.

Ключевые слова: литой асфальт, асфальтобетон.

Modern Architecture of a Provincial Town

A. I. Kozhukhina, G. L. Ledeneva, O. N. Kozhukhina*

Tambov State Technical University, Tambov, Russia
*e-mail: gsiad@mail.tambov.ru

Abstract

The article presents a short biography of the architect L.N. Kekushev. It focuses on his work and the architecture of the mansions erected in Moscow, Tambov and the Moscow region. The research shows that all mansions have a compositional and spatial relationship that characterizes the Art Nouveau style. The influence of the architect on the work of provincial architects is revealed through the example of various mansions in the city of Tambov.

Keywords: architecture, architect, modernist style, mansion, construction, manufacturer.

The main sight of the city of Tambov is the mansion of the manufacturer M.V. Aseev, dating back to the beginning of the twentieth century. According to the findings of the researchers, it was built by an outstanding Moscow architect Lev Nikolaevich Kekushev. Initially, this was an assumption based on intuition and similar works of the outstanding master (I. Mindovsky's mansion on Povarskayastreet in Moscow, etc.). Subsequently, this hypothesis was confirmed in the documents. Today, the authorship of L.N. Kekushev can be seen by anyone who is lucky enough to scroll through the magazine "Architect" for 1911. One copy of this folio can be also observed in the closed library of the Tambov art gallery.

The drawing of the M.V. Aseev's house façade with the signature of the architect is presented in Table No. 23 under the title "Yar restaurant Project in Moscow". This title may be misleading, but a detailed review of the project shows the date and signature under the main facade of the planned restaurant "1905, Architect Kekushev", but the most important thing is the full compliance of the submitted drawing with the construction implemented in Tambov.

The comparison of the date of the mansion construction (1905) and the date of the above-mentioned publication (1911) refutes the version that any of the local architects could have used the master's idea. Based on the study, it was found that L.N. Kekushev often interpreted his developments and developed previous ideas. The same thing probably happened with the Moscow restaurant project, which was never built as a result.

Analyzing the architecture of the mansion of the manufacturer Aseev, in the context of the master's work, a "genetic" connection with other works and the very path of the idea was established. Here you should separately stop at the Grachev's mansion in the village of Khovrino near Moscow, which appeared shortly before the Tambov mansion - at the end of the 19th century. According to the researchers of L. N. Kekushev, the prototype of the Khovrino house was the casino building in

Monte Carlo, the author of which was the French architect Sh. Garnier (the customer wanted to see in his mansion the image of the institution where he was lucky).

The Tambov mansion repeats the compositional and spatial solution of the house in Khovrino, and the theme of modernity can also be clearly seen here. Even more parallels with the specified structure, there is another not less luxurious mansion, owned by the Aseev – their home, located in Rasskazovo. This allowed us to suggest that this mansion was created by the same architect.

It is known that L.N. Kekushev became the author of the first program work in the art Nouveau style in Moscow and, at the same time, its customer. This was his mansion in Glazovsky lane (1898). The construction of the mansion had a great public response. With the appearance of the building, Kekushev became a key figure of Moscow art Nouveau, along with such architects as V. F. Valkot, G.A. Gelrich, F. Shechtel and other masters.

Not every contract organization in the capital was able to fulfill such complex orders, not to mention local construction companies. It is known that the principle of building “turnkey” mansions, as well as large commercial establishments and apartment buildings, was carried out by the Northern house-building society, which was organized in 1898 by the famous philanthropist and entrepreneur S. I. Mamontov. Then Lev Kekushev, being the chief architect of the society, took part in the development of the project of the Moscow hotel “Metropol”.

But the cooperation of the architect and the patron of art was not long. In the year of the Foundation of the society, S. I. Mamontov was arrested. However, despite the difficult circumstances, Kekushev found funds to build another landmark mansion, selling his first house in Glazovsky lane (today it is better known as the Smitsky house).

During the construction of the house of M. V. Aseev, the architect collaborated with the banker Yakov Rekk, who accepted the idea of S. I. Mamontov to decorate Moscow with stylish houses. For this purpose, a Trade and Construction joint stock company was founded, and Lev Kekushev took the position of the chief architect of this company. In collaboration with the banker Yakov Rekk, Kekushev became one of the most successful architects. The period from 1903 to 1905 is considered the peak of the architect's creative career. Then the mansions of M.G. Ponizovsky and I. A. Mindovsky were built on Povarskaya street, and I.P. Isakov's apartment house on Prechistenka street. The construction of the mansion of the manufacturer M. V. Aseev in Tambov also dates back to this time.

It is not surprising that everything in the house of the manufacturer Aseev, including furniture and accessories are stylish and can be considered as the work of art. It is known that L. N. Kekushev developed sketches of furniture and interior accessories for various Moscow factories and in the period from 1898 to 1901 taught forging, silvering, ironworking and composition at the Stroganov art school.

Clients of such a high-class artel could only be wealthy customers - representatives of the rich merchant class, manufacturers. One of them was the

owner of the Tambov mansion. It is known that M. V. Aseev graduated from Moscow University, had the degree of a doctor and the title of a district doctor. He gained national fame on the basis of business activities in Tambov. He founded the production of high-quality cloth. He was awarded the order of St. Stanislaus and St. Anna, had the rank of full state Councilor, in 1915 for services to the Fatherland received a noble title, and was elected an honorary citizen of the city of Tambov. It is no accident that the house where the famous manufacturer lived became a model of elite housing. The name of the owner also helped Moscow researchers to find drawings in the archives confirming the authorship of L.N. Kekushev.

The architect, probably due to his workload with capital orders, did not build much in the province. This increases the value of the Tambov mansion. Apparently, contemporaries also understood this. It is no accident that in the architecture of Tambov in those years you can see elements of imitation and copying the technique of an outstanding architect. You can find quite a lot of such examples. The works are close in spirit to the original, so there is an assumption about the close cooperation of Kekushev's design workshop with Tambov customers or architects. This applies to both the Shorshorov trading house and the Anosov estate complex, where the master's hand is easily recognized. Moscow experts also agree with this assumption.

In 2012, the architectural community widely celebrated the 150th anniversary of the birth of L. N. Kekushev. Our research has made it possible to fill in the gaps in the biography of this outstanding master, and previously unknown Tambov mansions with well-preserved interiors have become the decoration of anniversary publications in recent years.

References

1. Ledeneva G.L. Grazhdanskaya arkhitektura rossiyskoy provintsii kontsa XIX-nachala XX stoletiy (na primere zastroyki g. Tambova) [Civil architecture of the Russian province of the late XX-early XX centuries (on the example of the development of the city of Tambov)]. Moscow, MArkhl, 1999. (Rus)
2. Zochiy. SPb., 1911, 40 p. (Rus)
3. Nashchokina M.V. Usad'ba Grachevka: obrazy simvolizma [Manor Grachevka: images of symbolism]. Arkhitektura i stroitel'stvo Moskvy, 1995, No. 6, pp. 38-43. (Rus)
4. Nashchokina M.V. Arkhitekory i zakazchiki moskovskogo moderna [Architects and customers of Moscow Art Nouveau]. Arkhitekturnoye nasledstvo. 1996, No. 40, pp. 115-125. (Rus)

СТИЛЬ МОДЕРН В АРХИТЕКТУРЕ ПРОВИНЦИАЛЬНОГО ГОРОДА

А. И. Кожухина, Г. Л. Леденева, О. Н. Кожухина *

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: griad@mail.tambov.ru

Аннотация. В статье представлена краткая биография архитектора Л.Н. Кекушева. Анализируется его творчество и архитектура особняков, возведенных в г. Москве, г. Тамбове и Подмосковье. Исследования установили, что все особняки имеют композиционную и пространственную связь, характеризующую стиль модерн. Выявлено влияние архитектора на работы провинциальных зодчих на примере различных особняков в г. Тамбове.

Ключевые слова: архитектура, зодчий, модерн, особняк, строительство, фабрикант.

Development of the Hotel Industry in Russia

A.A. Potapova*, O.N. Kozhukhina, O.V. Proskuryakova

Tambov State Technical University, Tambov, Russia
e-mail: mlp.anna@mail.ru

Abstract

The article analyzes the stages of formation and development of the hotel industry in Russia. Requirements and standards have been established for the level of comfort that apply to places of temporary residence of people.

Keywords: designing, hotels, motels, architecture.

Inns were the predecessors of hotels in Russia in the 12-13th centuries. They served for rest and were located at a distance equal to the equestrian crossing. In the 15th century there were post stations, which were controlled by the Yamskoy order. The construction of a large number of inns attached to the stations was carried out. At the same time, numerous guest yards were built in the cities, which served not only for trade, but also for housing. The courtyards consisted of a number of the following premises:

- chambers that were the living quarters for merchants, consisting of two tiers, one for sleeping, the other for storing small pieces of goods;
- churches that served not only a cult function, but are also a place for storing the most valuable goods;
- salt barns were structures for mass storage of goods.

Gostiny yards were built next to shopping centers in the 18th century, guests were resettled along ethnic lines. Thus, in Moscow, English, Swedish and Greek appeared, and in Novgorod - Dutch and German guest houses [1].

In connection with the growth of industry and the expansion of trade relations in the 18-19th centuries the population of cities was growing, new hotels were opening. The development of tourism fell on the 19th century. In this regard, the construction of large and small hotels in picturesque places, on the sea coast, near mineral springs is being developed. By the end of the 19th century, in large cities, hotels with modern conveniences, such as: sewerage, hot water, electricity, lifting machines.

By the beginning of 1928, only 1/3 of cities had hotels in the RSFSR. But with the growth of industrial centers, the need for their construction increased. The first standard designs were developed in 1930. They do not have a sufficient level of improvement: the lack of sanitary equipment in the rooms, a combination of premises for different purposes.

In the second and third five-year plans, rooms of increased comfort appeared, consisting of several rooms, an entrance hall and a combined sanitary unit, one-

room rooms are equipped with washbasins, the composition of public and service premises is increasing, new standard hotel projects are being developed, providing for the accommodation of 100-150 people.

The compositional solutions of buildings are greatly influenced by urban planning factors. During the Great Patriotic War, colossal damage was caused to the hotel industry. Therefore, the main construction of new and reconstruction of old hotels, and this is more than 80%, falls on the post-war years. This time is characterized by the emergence of hotels for more than 1000 people, hostels, and motels. Motels are used for temporary stay of people, as a rule, the level of comfort in them is lower than in a hotel, they are located near busy highways and have a large parking lot.

The constant growth of the material well-being of the working people, the improvement of living conditions is accompanied by an increase in the requirements for the level of comfort in hotels, the quality of service in them. On August 26, 1977, a resolution of the Council of Ministers was issued: "On measures to further improve the service of the population in hotels". This decree provided for: carrying out work to improve the technical, sanitary and fire safety of hotels, increasing their improvement, increasing the volume and expanding the range of services for residents, etc.

A significant number of hotels were built for the 1980 Olympics in Moscow. The largest hotel complex in Europe was erected near Izmailovsky Park, which can accommodate 10 thousand people. For the first time a 22-storey building of the Salyut Hotel is being built, made of large-panel structures.

The growth in the number of new hotels led to the need to improve their level of quality, as a result of which, a new version of the chapter of SNiP P-79-78 was revised and approved, which included general hotels, tourist, resort, motels and campings. The new standards were aimed at streamlining the design of hotels, increasing their quality level and comfort while maintaining the economic efficiency of construction. SNiP provided for the following five categories of hotels, characterizing the level of comfort: Highest, I, II, III, IV. He directly influenced the decision of the residential and public areas of the hotel. The higher the category is, the larger the size of the residential rooms, their sanitary and technical and engineering equipment, the size and nature of the groups of public premises. Moreover, it was noted that the buildings of hotels of the highest and I categories should be designed only for the capitals of the Union republics, the largest cities and resorts of the Union and republican significance [2].

Today, the current set of rules for the design of hotels is SP 257.1325800.2016. According to this document, the level of comfort of hotels is determined by categories, taking into account the material and technical equipment and the level of services provided: "no stars", "one-star", "two-star", "three-star", "four-star", and "five-star". It is also necessary to have residential and reception-lobby groups of premises. Premises for catering, consumer services, business, administrative, are included depending on the category and level of comfort of the hotel. The

obligatory availability of natural lighting in the administrative and office premises located in the underground floors, if necessary, must be provided through the pits. The construction of residential premises without natural light is not allowed.

In hotels of the highest categories (“five-star” and “four-star”), located in any climatic region, air conditioning should be provided in dining rooms and industrial premises of public catering establishments.

The minimum area of a room, excluding a bathroom, a loggia and a balcony, should be: for the “no stars”, “one-star”, and “two-star” categories: single rooms - 9 m², double rooms - 12 m²; for the “three-star” category: single rooms - 12 m², double rooms - 15 m²; for the “four-star” and “five-star” categories: single rooms - 14 m², double rooms - 16 m².

In multi-bed rooms, the area per person must be at least 6 m² [3]. Sanitary premises have the following requirements: for the “no stars” and “one star” categories: 1.75 m²; for the “two-star” and “three-star” categories: 2.5 m²; for “four-star” and “five-star” categories: 3.8 m².

This set of rules does not apply to hotels located in buildings that are cultural heritage sites. In this case, the design should be guided by the Federal Law “On Cultural Heritage Objects” dated April 24, 2020.

At present, with the development of domestic tourism, it is necessary to provide comfortable conditions in places of temporary residence of citizens not only in large, but also in small and provincial cities. More and more travelers are interested in little-known towns where you can wander around the manors, castles, and ancient ruins. Therefore, the development of the hotel infrastructure must be improved in different directions, taking into account world standards and taking into account the increasing requirements for living conditions. Hotels must meet the requirements of various groups of the population, including the most sophisticated.

References

1. Olhova A. P. Gostinici. Moscow, Stroyizdat, 1983. 171 p. (Rus.)
2. SNiP II-79-78. Gostinici [Hotels]. M.: Gosstroj Rossii, 1978. (Rus.)
3. SP 257.1325800.2016 Zdaniya gostinic. Pravila proektirovaniya [Hotel buildings. Designing rules]. Moscow, Minstroy Rossii, 2016. (Rus.)

РАЗВИТИЕ ГОСТИНИЧНОЙ ИНДУСТРИИ В РОССИИ

А.А. Потапова*, О.Н. Кожухина, О.В. Проскуракова

ФГБОУ “Тамбовский государственный технический университет”, Тамбов, Россия
e-mail: mlp.anna@mail.ru

Аннотация. В статье проанализированы стадии формирования и этапы развития гостиничной индустрии в России. Установлены изменения требований и стандартов к уровню комфорта, которые предъявляются к местам временного проживания людей.

Ключевые слова: здания гостиниц, проектирование, мотели, архитектура.

Synergetics in Architectural Design

A. O. Samotoylov*, A. A. Minakova

Tambov State Technical University, Tambov, Russia

*e-mail: samotoylov_a@mail.ru

Abstract

The prospects for the formation and development of architectural space in accordance with the variability of the needs of society and the environment are focused in the paper. It is noted that synergetics is a theory of self-organization, which can provide ways for scientific research and ways to address issues of architectural theory and practice.

Keywords: adaptation, self-organization, sustainability, synergetics.

Introduction

In the modern realities characterized by the advancements of scientific and technological progress and the expansion of the geography of people's activities, the search of new approaches and ways of development of absolutely all spheres of life, including architecture, is of great importance. One of these ways is the desire for the synthesis of sciences, the search for a universal method that would help to find a unified way of development. Synergetics as a science that harbors a lot of opportunities for obtaining new knowledge can be useful in this case.

Since architectural objects should be considered in relation to their inhabitants, environment, natural factors, they represent complex, changing, dynamic systems. Proceeding from this task, modern architectural synergetics is aimed at finding means and methods for constructing an architectural object adaptable to external and internal factors, which has many development options and scenarios.

Synergetics in architecture

The founder of synergetics is Hermann Haken, PhD in Mathematics, physicist, who introduced this concept in 1970 to designate an interdisciplinary field. At the heart of Haken's reasoning is the hypothesis that the nature of any system is not so important: it can be people, water molecules, society as a whole; but the behavior of the elements of this system is important, which is subject to general laws and principles of organization and interaction.

It is worth noting that there are many different schools that have applied a synergistic approach in their theoretical and practical research. For example, the Physicochemical and Mathematical Physics Brussels School; or the school of Physics and Mathematics named after S.P. Kurdyumov. But they all came to one main conclusion: any organism is a complex organization, a system that depends on external and internal factors, subject to the processes taking place in it. Likewise, in the field of architecture, hypotheses have long been put forward that architecture is a complex combination of many scientific branches and spheres, the interaction of which leads to the creation of an architectural object. There are many theoretical works that reveal the similarities, for example, the growth of plants and

the construction of buildings. It is worth highlighting the studies of M.V. Shubenkov in the dissertation “The structure of architectural space” and Ledeneva G.L. in the article “Nature-like technologies in architecture and urban planning”. Smart homes, energy efficient buildings, and green architectural structures began to appear, largely due to new technologies and materials and the development of scientific and technological progress in general.

Thus, synergetics has entered a wide variety of areas of knowledge in full swing. Using the accumulated experience, synergetists are trying to establish a universal language for the natural and humanitarian fields and find a general scientific methodology based on the integrity of knowledge.

From the point of view of synergetics, any architectural space can be compared to the behavior of a living organism, because it is, first of all, a complex system that can change depending on a variety of factors. This is what prompts many researchers and theorists to develop and search for evidence of the existence of the city gene. However, you need to be careful when using terminology borrowed from another area. After all, this can lead to the massive use of interdisciplinary terms in architectural theory. The legitimacy of such an application can be explained only when these concepts are interpreted identically in both spheres of knowledge. Only in case of identity of concepts a transdisciplinary transfer of methods and terms from one science to another will be possible. In this regard, it is necessary to clearly identify the subject and object of synergetics, which will allow its further use in other sciences in general and in architecture in particular.

The object of synergetics is complex open systems. They are characterized by the penetration of substances of various natures both inward and outward, which leads to the exchange and replenishment of resources, the development or, conversely, the death of any substructure or the entire organism as a whole.

The subject of synergetics is laws, ways and methods of organization, development and existence of systems.

All this suggests that modern architectural space is a combination of subsystems of different sizes and functions, which together form a single organism capable of adapting to any changes and performing a task or a set of tasks that are needed at a given moment of time. Failure to execute will lead to partial or complete destruction of the entire structure.

Therefore, depending on the nature of changes and the principles of the formation of an adaptable space, the following directions of development of dynamic architecture are distinguished: evolutionary-adaptive, mobile and transformative. These are very complex, multicomponent organisms capable of transforming into a new structural quality that is almost impossible to predict in advance. That is why the task of synergetics is to break the system into many substructures, to reveal their signs and features of the organization, which will lead to the construction and the possibility of using a complex evolutionary whole organism.

Conclusion

In general, the active use of synergetic methods and developments in architecture will make it possible to analyze the design process at a completely new, deeper level of comprehension. The principles of synergetics are relevant in many areas of life, including architecture. The development of architecture taking into account these features and methods can be an alternative approach to solving design issues and creating new, modern and convenient systems.

References

1. Saprykina N.A. Sinergeticheskie podhody k formirovaniyu arhitekturnogo prostranstva. [Synergetic approaches to formation of architectural space]. Architecture, 2016, pp.171-178. (Rus)
2. Shubenkov M.V. Struktura arhitekturnogo prostranstva [Structure of architectural space]. Moscow, 2006. 57 p. (Rus)
3. Ledeneva G.L. Prirodopodobnye tehnologii v arhitekture i gradostroitel'stve [Nature-like technologies in architecture and urban planning]. Architecture, 2019, pp. 23-26. (Rus)

СИНЕРГЕТИКА В АРХИТЕКТУРНОМ ПРОЕКТИРОВАНИИ

А. О. Самотойлов*, А. А. Минакова

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: samotoylov_a@mail.ru*

Аннотация. В статье рассматриваются перспективы формирования и развития архитектурного пространства в соответствии с изменчивостью потребностей общества, окружающей среды. Отмечается, что синергетика – теория самоорганизации, которая может дать пути для научного поиска и способы решения вопросов архитектурной теории и практики.

Ключевые слова: адаптация, самоорганизация, синергетика, устойчивость развития.

Problems of Reconstruction and Restoration of Cultural Heritage Monuments

T. O. Sitnikova*, O. M. Balashova

Tambov State Technical University, Tambov, Russia

*e-mail: *sitnikova.tatiana06@yandex.ru*

Abstract

This article deals with the preserving problems of cultural heritage objects. The subject of the study is modern methods for the architectural heritage monuments restoration, which can improve the design, operational qualities, historical and cultural heritage objects durability.

Keywords: architecture, modern methods, restoration, cultural heritage objects.

The data of research centers for the study of objects of cultural heritage of federal significance show that most buildings and structures in our country of historical value need reconstruction and restoration.

At present, the preservation of the architectural heritage in many cities is a very big problem, and therefore it must be addressed. Since our country is rich in history, and over the years and centuries, the architecture of cities has undergone changes in styles, construction technologies, all historical buildings have mixed with the modern architectural environment. As a result, they need to improve the appearance or carry out conservation work.

Stages of design by the architectural and restoration method include: (1) pre-design analysis; (2) technical solutions and their integrated development in the development of a reconstruction project; (3) layout, optimization, aesthetic solution and evaluation of tasks, as well as the use of computer technology.

On the territory of the Russian Federation there are thousands of monuments and objects of cultural heritage requiring restoration work, because the main task of restoration is to return the original, as close as possible to its original form. It is much cheaper to demolish architectural monuments than to restore them. It is for this reason that the historical buildings of almost all cities in the Russian Federation are not being restored. Such a policy may lead to the fact that after a certain time there will not be a single building that could tell anything about the past of our cities, and even more so of our country.

It is noteworthy that historical buildings should not be ignored not only by the state, but also by the society. After all, if you realize the fact that with what difficulty and professionalism, with developed creative thinking, our ancestors created the architectural environment, and if their works wipe our century off the face of the earth, it will be an irreparable loss for the culture of mankind.

Cultural monuments should be preserved, restored and repaired only with written permission. Restoration is a time-consuming work that requires the involvement of highly qualified specialists, expensive materials and funds. In conclusion, the real problem in the reconstruction and restoration of cultural heritage sites in our country is not obstacles from the state, not problems with funding, but often just a lack of a sense of beauty or the ignorance of performers about the importance of historical buildings and structures.

References

1. Art konservatsiya masterskaya [Art conservation workshop]. URL: <http://art-con.ru/node/3734> (Accessed 15.12.2020). (Rus)
2. Al'manakh pedagoga [Almanac of the teacher]. URL: <https://almanahpedagoga.ru/servisy/publik/publ?id=28497> (Accessed 15.12.2020). (Rus)
3. Forumhouse. URL: <https://www.forumhouse.ru/entries/1922/> (Accessed 15.12.2020).
4. Art konservatsiya masterskaya [Art conservation workshop]. URL: <http://art-con.ru/node/2544> (Accessed 15.12.2020). (Rus)

ПРОБЛЕМЫ РЕКОНСТРУКЦИИ И РЕСТАВРАЦИИ ПАМЯТНИКОВ КУЛЬТУРНОГО НАСЛЕДИЯ

Т. О. Ситникова*, Балашова О. М.

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: sitnikova.tatiana06@yandex.ru

Аннотация. В данной статье рассмотрены проблемы сохранения объектов культурного наследия. Предметом исследования являются современные методы по восстановлению памятников архитектурного наследия, способные повысить конструктивные, эксплуатационные качества, долговечность исторических объектов культурного наследия.

Ключевые слова: Архитектура, современные методы, реставрация, объекты культурного наследия.

Restoration of the Natural and Cultural Heritage Site – the Watermill in the Voronezh Oblast

D. S. Shorina

Tambov State Technical University, Tambov, Russia
e-mail: bee-flower@mail.ru

Abstract

The article addresses the problems of restoration and preservation of wooden buildings, and more specifically wooden watermills. The research object is a historical and cultural heritage site – The Watermill built in 1885 in the village Kolodezhnoye in the Voronezh oblast. This study analyzes the role of historical watermill complexes in the development of civilizational tourism in the Voronezh oblast and in Russia. The findings point out the huge potential of watermills for the creation of new sites for tourist attraction that could be used for educational, recreational and commercial purposes. The article gives brief information on the main watermills reconstructed and built in Russia at the moment. The research examines how working waterwheels of Russian and European types may be involved in the culture restoration projects to create manor house museums and peasant life museums. There may also be the possibility of exploiting reconstructed watermills for practical demonstrations in the programmes on conservation and revival of industrial architecture's monuments in their original environment. Thus, the study suggests the main directions for restoration of Russian cultural landscape.

Keywords: watermill, tourism, monuments of wooden architecture, industrial architecture's monuments, historical-cultural heritage.

In accordance with the UN General Assembly Resolution 56/6 “Global Agenda for Dialogue among Civilizations” the programmes of civilizational tourism are being developed in order to provide a comprehensive picture of culture, historical background, long-established traditions and customs of different civilizations. In Russia there are all the necessary conditions for a dialogue among cultures and the promotion of civilizational tourism.

The diversity and richness of Russian history and culture are most vividly represented in a large number of unique landscapes, historical and cultural sites, as well as industrial architecture's monuments. The latter include not only factories and plants, but also technical facilities: dams, mills and other hydraulics made of wood, which can be used for practical demonstrations. In this regard, the problem of preservation, restoration and recreation of wooden architecture's monuments is becoming more and more urgent.

In order to support and promote the project of civilizational tourism in the Russian Federation one must take into account the problem of environmental management for small rivers (there are more than 2.5 million of them in Russia) and other bodies of water. Therefore, it is necessary to implement special engineering measures along with environmental ones.

The analysis of domestic and international experience in the restoration of small water bodies shows that the most successful results may be achieved by restoring watercourses at the level of the period prior to the industrialization of the area. Environmental restoration programmes should include both measures to improve water quality and the reconstruction of hydraulic structures that correspond to the historical period. For instance, watermills and millponds are being restored now in many European countries [1].

Water mills (flour mills, textile mills, etc.) became industrial plants in Russia in the 16th century. The first paper mill was built in Russia around 1564 on the Ucha River in the village Vanteevka (now it is Ivanteevka, a city in Moscow Oblast). Apart from small watercourses, they also tried to build mills on large rivers. In the 17th century whorled mills became widespread on dammed streams in mountainous areas (the Urals, the Carpathians, etc.), while wheel mills with one or more wheels were built predominantly in the lowlands [2].

In the 18th century there was extensive land development in metallurgical areas so that water wheels appeared in the Urals, Altai, and Lugansk. About 65 thousand water mills were operated on the Russian watercourses.

Until 1917 the watermill wheel had remained the main industrial engine in Russia, whereas turbines were used rather sparsely. Watermills in many non-industrialized areas worked even in the Soviet period until the mid-twentieth century. The construction of mills was carried out unsystematically and without taking into account topographic features that often led to flooding and bogging of the floodplains of watercourses.

At the present, there could not be found any wooden watermill operating for economic purposes in Russia as opposed to the United States, Holland, Germany, India, Japan, Belarus, etc. There are either single museum copies or non-operating reconstructions.

The mill in the village Kolodezhnoe of Voronezh Oblast is a unique historical and cultural heritage site according to the Resolution of Administration of Voronezh Oblast of 14 August 1995 No. 805 “On Administration of Historical and Architectural Monuments in Voronezh Oblast”. The mill was built presumably in the first half of the 18th century on a unique natural site – the largest karst spring on the right bank of the Don. Before the October Revolution of 1917 the owner of this facility had been Mr Ishchenko. After the collectivization in the 1930s the mill was passed to the collective farm (Kolkhoz). In 1950 it was reconstructed, and after that the mill worked until the end of the 1960s. The last reconstruction of the facility and its surrounding area was carried out in 2014, but the mill mechanism is not set in motion, the floodplains of the watercourse are blocked, so the facility does not serve its primary function.

Abroad watermills are part of museums and various funds, thus being the foundation of the tourism infrastructure. At least a thousand mills still operate in the Netherlands: the open-air Museum “Zaanse Schans”, the Molenmuseum in the town Koog aan de Zaan, the famous windmills of Schiedam and hydraulic mills in

Schermerhorn. They operate mainly during the tourist season, but they still perform a number of important production functions: De Gekroonde Poelenburg is a sawmill, De Kat grinds raw materials to make pigments for paints, De Zoeker and De Bonte Hen are oil mills, De Huisman makes mustard, De Hadel is used for water drainage, Schiedam grinds grain, the main ingredient for gin. There are also paper mills, malt mills, etc. The International Wind- and Watermill Museum is an open-air museum, which occupies an area of around 16 hectares in the small German town Gifhorn. There are 16 windmills from 12 countries, each set in a landscape typical of their countries.

Today, in developed countries historical mills are being restored as micro-hydroelectric power stations. They mostly work for the demonstration, i.e. Wayside Inn Grist Mill in the USA. However, in recent years water wheels have been adapted to produce electricity in the UK, Germany and the USA.

The analysis of the international practice of modern hydraulic engineering and the historical experience of using mills allow us to single out a number of promising options of the watermill use in Russia. The building of mills on a watercourse or a pond has a positive effect on oxygenation of a pond and its stocking with fish. It is proved that the slow rotation of blades of a waterwheel provides additional water aeration up to 10~20%, stimulates water circulation in a pond or a cascade of ponds, and it is practically safe for fish.

The restoration of wooden architecture's monuments, including watermills, is the most important phase in the formation and development of the national identity. In order to strengthen the cultural bonds, to enrich our culture and traditions it is good practice to work at the restoration of watermills, especially in historical places. In addition to this, the restoration of mills in old manors will contribute to the preservation of natural landscapes. The preservation of traditional crafts, the flour grinding, and the creation of a historical and ethnographic complexes may give rise to the economic development of a territory: by increasing the tourist traffic, by providing the locals with new jobs, by building the necessary infrastructure (roads, communications, etc.).

In conclusion, it is obvious that even now the improved water wheel can serve as an effective hydraulic engine for different specified purposes. The restored mill complex may become a new mixed center of recreation and commerce and at the same time may help create the necessary tourist infrastructure, make an appeal to tourists for its natural landscapes, historical wooden architecture and a possibility to expand horizons and to explore enigmatic Russian culture.

References

1. Chernykh O.N., Rumyantsev I.S., Altunin V.I. Ispol'zovanie vodyanyh mel'nic pri vosstanovlenii i ekologicheskoy rehabilitacii vodnyh sistem [The use of water mills in the restoration and ecological rehabilitation of water systems]. M.: MGUP, 2010, 369 p. (Rus)
2. Chernykh O. N., Altunin V. I., Volshanik V. V., Piavkin S. V. Vodyanye mel'nicy - pamyatniki kul'tury i istorii tekhniki v Rossii [Water Mills – Monuments of Culture and History

ВОПРОСЫ РЕСТАВРАЦИИ ПРИРОДНО-ИСТОРИЧЕСКОГО ОБЪЕКТА НАСЛЕДИЯ «ВОДЯНАЯ МЕЛЬНИЦА» В ВОРОНЕЖСКОЙ ОБЛАСТИ

Д. С. Шорина

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: bee-flower@mail.ru

Аннотация. Объектом исследования является памятник исторического и культурного наследия, водяная мельница, построенная в 1885 г. в Воронежской области в селе Колодежное. В статье затрагиваются проблемы реставрации и сохранения памятников деревянного зодчества. Приведен анализ роли исторических водяных мельничных гидроузлов в развитии цивилизационного туризма в Воронежской области и в России. Отмечен их большой туристический потенциал для образования как историко-культурных, так и парковых зон для полноценного отдыха, познавательного и культурного досуга населения. Приведена краткая информация об основных водяных мельницах, построенных или реконструированных на данный момент в России. Рассмотрены варианты применения водяных колес русского и европейского типов при создании и формировании музеев усадебной и крестьянской культуры и быта. Проанализирована возможность эксплуатации воссозданных водяных мельниц для экскурсионной демонстрации при разработке программ сохранения и возрождения памятников промышленной архитектуры в сохраняемой природной и историко-культурной среде. Предложены основные направления возрождения русского культурного ландшафта.

Ключевые слова: водяная мельница, туризм, памятники деревянного зодчества, памятники промышленной архитектуры, историко-культурная среда.

Current Problems of Teaching Students a Foreign Language

G. M. Abdykarimova, M. M. Abdykarimova*, A. B. Baltabayev

Karaganda Technical University, Karaganda, Kazakhstan

*e-mail: abdykarimova.moldir@mail.ru

Abstract

At present, the attitude towards a foreign language is changing in society. In the Republic of Kazakhstan, there is a real need for specialists who speak foreign languages at the proper level. Universities are switching to a three-level system. At different levels of higher education (bachelor's, master's, PhD), multi-level training in a foreign language is implemented. Most modern countries are developing in a changing socio-political paradigm: post-industrial economic laws are giving way to information trends. The current economic direction of society development is an uneven unity of technological, political, socio-psychological and information components, which necessitates innovative developments to optimize intellectual and organizational resources. In this article, the authors consider the importance of improving the methods of teaching foreign languages in higher educational institutions of Kazakhstan, mainly in technical areas.

Keywords: educational problems, foreign languages, higher education, professional activity.

Under the current conditions, achieving balance in all aspects of social life is possible only through sustainable development. This definition reflects a three-pronged concept proposed by the UN, represented by such dimensions of sustainability as ecology, social development, and economics. At the same time, the connecting element of this model is a communicative space that correlates with the entire society.

Sustainability of development is associated with the implementation of long-term scientific and innovative development policies of the country/region and its business partners. Modern socio-economic conditions imply the development of innovative approaches to the professional training and skill level of specialists in various areas of the innovative economy of a single economic environment. This is inevitably reflected in the language and its specialized professional subsystems. The linguistic space of Kazakhstan, the CIS countries and the SCO is being transformed in accordance with changes in the quality characteristics of the unified business space, which necessitates the creation of a forecasting system and the development of strategies for the formation of the linguistic space. Linguistic space is a multicomponent dynamic system that is influenced by the socio-cultural activity of a person and, in turn, determines this activity. Linguistic space is also defined as a complex integrated system based on language stratification resulting from the interaction of factors such as social, cultural, national, gender, and professional. Integration of an individual into the socio-cultural environment is

carried out through the assimilation of culture transmitted by communication channels.

The question of strategies for creating a competitive linguistic space is of particular interest. The strategy of creating a unified educational space is international cooperation in the field of science and education; development of a system of qualifications comparability in higher education; building models of continuing education; research and implementation of opportunities for continuous updating of knowledge; in-depth research of knowledge management issues; intensive use of innovative pedagogical and technological tools, modern information technologies.

In the conditions of globalization of the economy and cooperation of Kazakhstan with the world community, with the development of business, economic, legal and scientific relations with foreign countries, the main requirement for future specialists is practical (oral and written) knowledge of a foreign language at a good professional level. Students are in the competitive environment of the modern world and must quickly and competently solve professional tasks in the context of foreign language communication. It is known that improving the teaching of a foreign language to students in a non-linguistic university requires taking into account the professional specifics, focusing on the implementation of the tasks of future professional and scientific activities, i.e. training should be professionally oriented, which contributes to its interaction with special disciplines in order to obtain additional professional knowledge.

The transition to multilevel system of higher professional education (bachelor, master, PhD) entails a need to develop new approaches to the formation and development of the content of language education and methods of teaching foreign language at different levels of training. In this situation, it is necessary to specify in detail the content and the new structure of the foreign language course for non-linguistic universities, taking into account modern educational tasks. This structure will be based on an analysis of the actual use of a foreign language by students for professional purposes, considering the expansion of the number of areas of activity. In order to solve these problems, students must be fluent in a foreign language as a means of professional communication, as well as increase and improve their personal and professional level.

In accordance with state educational standards of higher education undergraduate students should be prepared to use a foreign language in professional activity, which in Kazakhstan is carried out in the native language; masters should have the opportunity to study a foreign language, which will relate to professional education; graduate students should be given the opportunity of more detailed and profound, on a very high quality level of professional proficiency in the foreign language, which involves research and analytical work. The professional orientation of teaching a foreign language should consider the interests of postgraduates in the field of research where they conduct their research.

Based on the principle of professional orientation of the process of teaching foreign language by students, we can distinguish three main professional areas of application of a foreign language in the field of engineering in modern conditions: engineering, translation (discursive), educational activities [1].

The work of an engineer related to communication, i.e. the development of communicative (discursive) competence in a foreign language, the role of which is constantly increasing. Professional research activity of students implies the ability to correctly translate scientific articles (both from their native language and from a foreign one).

Translation activity (both written and oral) is considered as the sphere of application of a foreign language in the improvement and development of discursive competence at the professional level. Translation requires the ability to work with different genres of text, both written and oral [2].

Translation is a language mediation in which the original text is transferred to another language by creating a communicative equivalent text in that language.

The educational activity of students is the development of academic mobility and the introduction of an international dimension in education related to the Bologna process. Master's and postgraduate students in the field of engineering are engaged in research, design, production and technological, organizational and managerial activities [3]. They use a foreign language in different ways in the production process or in scientific activities.

Educational activities, both teaching and learning, involve different conditions for use of a foreign language. Students use a foreign language depending on the types of activities they perform. This can be both oral and written communication, which, of course, contributes to the development and improvement of discursive competence.

For example, students studying abroad need the following skills: to listen and take notes on lectures in a foreign language; to write an article on the topic of a dissertation in a foreign language; to analyse the results of their research; to participate in scientific discussions, make presentations and present their research. They must also use Internet resources correctly: participate in teleconferences, webinars, search for scientific information - all this contributes to the natural need to improve their knowledge of a foreign language.

The advantage of education and professionalism, the demand in the field of innovative economy for qualified personnel - raise the role of education as the main resource of society and an important factor in ensuring the needs of the high-tech economy, competitiveness in the world market and national security.

References

1. Polyakova T.Yu. Professionalnaya orientaciya obucheniya inostrannomu yaziku v inzhenernom vuze – tradicii i perspektivi [Professional orientation of teaching a foreign language in an engineering university – traditions and prospects]. M.: MGLU, 2012, pp. 24. (Rus)
2. Azimov E.G., Schukin A.N. Slovar metodicheskikh terminov: teoriya i praktika prepodavaniya yazikov [Dictionary of Methodological Terms: Theory and Practice of Language Teaching]. SPb.: Zlatoust, 1999, pp. 472. (Rus)

3. Berman I.M. Metodika obucheniya angliiskomu yaziku v neyazikovom vuze [Methodology of teaching English in a non-linguistic university]. M.: Vissh. shk., 1970, pp. 230. (Rus)
4. Voyakina E.Yu., Koroleva L.Yu. K probleme prepodavaniya delovogo anglijskogo yazyka kak yazyka dlya spetsial'nyh tselej v vuze [To the problem of teaching Business English as ESP in higher educational institutions]. Voprosy sovremennoj nauki i praktiki. Universitet im. V.I. Vernadskogo, 2014. № 1 (50). Pp. 47-55. (Rus)
5. Mordovina T.V., Voyakina E.Yu. To the problem of the discourse competence formation. Prepodavanie anglijskogo yazyka v professional'nom kontekste: soedinyam kul'tury cherez granicy: materialy 4 Mezhdunar. nauch.-prakt. konf. 2019. Pp. 38-44. (Rus)
6. Gunina N.A. Ispol'zovanie pragmaticheskikh tekstov dlya razvitiya navykov professional'nogo obshcheniya na inostrannom yazyke v vuze [Pragmatic Texts for the development of communication skills in a foreign language in non-linguistic university]. Problemy lingvistiki i lingvodidaktiki v neyazykovom vuze. Sbornik tezisov Rossijsko-kitajskoj nauchno-metodicheskoy konferencii. 2017. M.: Izd-vo MGTU im. N.E. Baumana. Pp.184-186. (Rus)

СОВРЕМЕННЫЕ ПРОБЛЕМЫ ОБУЧЕНИЯ СТУДЕНТОВ ИНОСТРАННОМУ ЯЗЫКУ

Г. М. Абдыкаримова, М. М. Абдыкаримова*, А. Б. Балтабаев

Карагандинский технический университет, Караганда, Казахстан
**e-mail: abdykarimova.moldir@mail.ru*

Аннотация. В настоящее время в обществе меняется отношение к иностранному языку. В Республике Казахстан существует реальная потребность в специалистах, владеющих иностранными языками на должном уровне. Университеты переходят на трехуровневую систему. На разных уровнях высшего образования (бакалавриат, магистратура, докторантура) реализуется многоуровневая подготовка по иностранному языку. Большинство современных стран развиваются в меняющейся социально-политической парадигме: постиндустриальные экономические законы уступают место информационным тенденциям. Современное экономическое направление развития общества представляет собой неравномерное единство технологической, политической, социально-психологической и информационной составляющих, что обуславливает необходимость инновационных разработок по оптимизации интеллектуальных и организационных ресурсов. В данной статье авторы рассматривают важность совершенствования методов преподавания иностранных языков в высших учебных заведениях Казахстана, преимущественно технического направления.

Ключевые слова: проблемы образования, иностранные языки, высшее образование, профессиональная деятельность.

Written Discursive Competence as a Component of the Foreign-Language Communication Competence

M. M. Abdykarimova*, G. M. Abdykarimova, E. S. Yermek

Karaganda Technical University, Karaganda, Kazakhstan

*e-mail: *abdykarimova.moldir@mail.ru*

Abstract

The article covers the issues of forming written discursive competence as the basis for written foreign language communication of university students. The introduction of new standards of education, which reflect the social order of the modern multicultural and information society, required the universities to create optimal conditions for learning foreign language communication in order to solve problems of interpersonal and intercultural interaction at the global level. In this regard, to ensure socio-cultural mobility of university graduates, the teaching of written foreign language communication should occupy an important place in the educational process. At the same time, the authors have made an attempt to reveal the structure and content of components of written discursive competence as a component of foreign language communication competence in the context of its application in foreign language classes in the conditions of a non-linguistic university.

Keywords: text, discourse, written speech activity, universal characteristics of the text, specific features of the discourse.

The introduction of state educational standards of the new generation into higher education encourages universities to create optimal conditions for teaching foreign language communication in order to solve the problems of interpersonal and intercultural interaction. The ability to communicate is a necessary component of student's life and ensures socio-cultural mobility of university graduates as the ability to act freely and actively in a multi-lingual space to ensure intercultural interaction and cooperation.

Written discursive competence is a component of the foreign-language communicative competence. The analysis of the studies showed that the very concept of "discursive competence" is interpreted by scientists in a controversial manner. According to the document "Common European Framework of Reference for Languages: Learning, Teaching, Assessment" it is knowledge of the rules of construction of statements, their association in the text taking into account the topicality, information, natural causal relations, topic, coherence and integrity, logic, style and register of communication, etc., i.e. it includes only the knowledge component.

Moreover, discursive competence is considered as: (1) knowledge of various types of discourse and the rules of their construction, as well as the ability to create and understand them, taking into account the situation of communication (E.M. Bastrikova, A.N. Shchukin, H. Boyer, M. Canale, M. Swain and others); (2) the ability to coherently and consistently express their thoughts in a situation of oral / written communication (K.A. Kobzeva, A.N. Shamov, E.V. Schuman, L. Bachman, J.A. Van Ek and others) [1]; (3) the ability to generate text adequately to the situation of its creation in productive speech activities [2].

The written discourse as a product of professionally-oriented foreign language communication can be characterized according to 5 groups of features: (1) strategical which is responsible for planning communicative behavior; (2) tactical which is associated with selecting adequate means of professionally-oriented foreign language communication in writing; (3) genre-related which is responsible for the range of genres in the written speech and the choice of genre and style related norms; (4) text-related including cohesion, integrity and complete character of written discourse; (5) linguo-rhetorical revealing in the composition and a certain linguo-rhetorical structure of written discourse [3].

This diversity of interpretations of discursive competence requires further research into this phenomenon from a written perspective, taking into account the fact that the result should be the ability of learners to communicate in a written foreign language through written discourses of various types, reflecting the characteristics of the factors that influence its creation.

We will therefore understand written discursive competence to be the ability of the writer to write as an individual according to the socio-cultural situation and the communicative task of creating different types of discourse to participate in written foreign language communication with the intended recipient in order to achieve the expected result. It is based on a set of knowledge, skills, abilities and activity experience, which is the content of social experience, the possession of which ensures the formation of this competence.

Written discursive competence is a complex multicomponent phenomenon; therefore, a certain number of sub-competences are distinguished in its structure. Thus, in N. P. Golovina's research, written discursive competence consists of four components, each of which, in turn, is represented by corresponding skills underlying many other models: strategic (the ability of a subject to understand the communicative intention and plan a communicative event); tactical (the ability to select adequate and optimal means and methods); genre (the ability to organize a discourse in accordance with the canons of the genre) and text components (the ability to organize sentences into a coherent text).

According to I.N. Khmelidze, the genre and text components are combined into one sub-competence and a reflexive component is added. It consists of control and self-monitoring of written works by students and teachers and is a necessary element in mastering foreign language written speech on the basis of an autonomous approach. N.L. Nikulshina took N.P. Golovina's theory as a basis and expanded the discursive competence with the rhetorical component, i.e. the ability to produce texts on the basis of knowledge of generally accepted rhetorical methods of deploying written speech and rhetorical techniques [4].

Having analyzed the researchers' views on the component composition of written discursive competence and taking into account typological features of written discourse, we initially included five components into this competence: strategic, tactical, genre, text and linguistic.

However, the analysis has led us to think that the language component, which is responsible for the design of written discourse of various types in accordance with the lexical-grammatical norms of foreign-language written speech and is therefore essential for written foreign-language communication, falls out of the field of view. It receives insufficient attention in foreign language classes, which leads to a decrease in the quality of written works.

For this reason, we have expanded the component structure of written discursive competence to include the sixth, language component. It should be noted, however, that the strategic component includes an intercultural component. The latter involves the writer becoming aware of his or her own culture and recognizing the culture of the intended recipient as a necessary condition for enriching his or her personal experience, understanding a different way of life, values and customs and rejecting existing stereotypes and prejudices.

As for the experience of value-orientation activities, it acts as an “exemplary behaviour” expected from the subjects of communication in solving their communicative task in a certain socio-cultural situation, i.e. in the process of creating a written discourse of a certain type. It manifests itself in the willingness of learners, in accordance with their personal position and social status, to apply the knowledge they have learned, the skills they have developed and the skills they have acquired in writing in a separate act of communication. This presupposes such qualities as personal interest, motivation, activity, independence, responsibility for the results of their written activity and tolerance towards another culture, etc.

The final step in solving the tasks set in this paragraph was to identify criteria for the formation of written discursive competence, which will help diagnose its level.

Thus, written discursive competence is an integral part of foreign-language communicative competence and provides students with the ability, in accordance with their social and foreign-language speech experience and personal aspirations, to carry out written foreign-language communication with the intended recipient using a certain type of written discourse, thereby solving their communicative task within a certain socio-cultural situation.

It includes the following components: strategic, tactical, genre, text, linguistic-rhetorical, and language sub-competence. They are based on a set of knowledge, skills, abilities and experience of value-oriented activities, adequate to the dose of social experience that must be learned by students to acquire written discursive competence. These components are closely interrelated, so the process of its formation should be aimed at mastering all the components of the university students.

Written discursive competence is an integral part of the foreign-language communication competence and ensures that learners are able to learn in accordance with their social and foreign language speech experience and personal aspirations to communicate in written foreign language with the intended recipient

through a written discourse of a certain kind, thus solving their communication task within a certain socio-cultural situation. It includes the following components: strategic, tactical, genre, textual, linguistic and linguistic sub-competence. They are based on a body of knowledge, skills, and experience in value-orientation activities that is adequate to the dose of social experience that learners must learn to acquire written discursive competence. These components are closely interlinked, so the process of its formation should be aimed at the students' mastery of all the components, which is what we take into account when developing the methodology of forming a foreign-language written discursive competence, which is the focus of the second chapter of the dissertation research.

References

1. Kucherenko O.I. Formirovanie diskursivnoi kompetentsii v sfere ustnogo obshcheniia [Formation of discursive competence in oral communication]. Extended abstract of candidate's thesis. Moscow, 2000. (Rus)
2. Elukhina N.V. Rol diskursa v mezhkulturnoi kommunikatsii i metodika formirovaniia diskursivnoi kompetentsii [The role of discourse in intercultural communication and methodology for forming discursive competence]. M.: Inostrannye iazyki v shkole – Foreign languages at school, 2002, vol. 3, pp. 9-13. (Rus)
3. Kuklina S.S. Written Discourse as a Product of a Completed. European Journal of Contemporary Education, 2017, 6(4), pp. 674-683.
4. Nikulshina N.L. Kognitivnyi i diskursivnyi aspekty obucheniia pismennoi rechi v kontekste nauchnogo issledovaniia [Cognitive and discursive aspects of writing instruction in the context of scientific research]. Uchitel, uchenik, uchebnik: materialy V Iubileinoi vs Rossiiskoi nauchno-prakticheskoi konferentsii: sbornik statei – Teacher, pupil, book: materials of V Jubilee all-russian scientific and practical conference: a collection of articles, Moscow, 2009, vol.2, pp. 108-114. (Rus)
5. Mordovina T.V., Voyakina E.Yu. To the problem of the discourse competence formation. Prepodavanie anglijskogo yazyka v professional'nom kontekste: soedinyaem kul'tury cherez granicy: materialy 4 Mezhdunar. nauch.-prakt. konf. 2019. Pp. 38-44. (Rus)

ПИСЬМЕННАЯ ДИСКУРСИВНАЯ КОМПЕТЕНЦИЯ КАК СОСТАВНАЯ ЧАСТЬ КОММУНИКАТИВНОЙ КОМПЕТЕНТНОСТИ В ОБЛАСТИ ИНОСТРАННЫХ ЯЗЫКОВ

М. М. Абдыкаримова*, Г. М. Абдыкаримова, Е. С. Ермек

Карагандинский технический университет, Караганда, Казахстан

*e-mail: abdykarimova.moldir@mail.ru

Аннотация. В данной статье рассматриваются вопросы формирования письменной дискурсивной компетентности как основы письменного общения студентов вузов на иностранном языке. Внедрение новых стандартов образования, отражающих социальный порядок современного мультикультурного и информационного общества, потребовало от вузов создания оптимальных условий для изучения иноязычной коммуникации с целью решения проблем межличностного и межкультурного взаимодействия на глобальном уровне. В этой связи для обеспечения социально-культурной мобильности выпускников вузов преподавание письменной иностранной языковой коммуникации должно занять важное место в образовательном процессе. Вместе с тем, авторы предприняли попытку раскрыть структуру и содержание компонентов письменной дискурсивной компетентности как составной части компетентности общения на иностранном языке в контексте ее применения на занятиях по иностранным языкам в условиях нелингвистического вуза.

Ключевые слова: текст, дискурс, письменная речевая деятельность, универсальные характеристики текста, особенности дискурса.

Representation of the Concept “Smart House/Smart Home” in the English Language Picture of The World

O. N. Apraksina

Tambov State Technical University, Tambov, Russia
e-mail: Apraksina-Olga@rambler.ru

Abstract

The article discusses the problems of identification of the distinctive features inherent in the English-speaking consciousness, when comprehending the concept of SMART HOUSE / SMART HOME and when verbalizing it by means of the English language.

Keywords: concept, language picture of the world, representation.

In order to compare the naive pictures of the world of Russian and English native speakers, we conducted an associative experiment dedicated to identifying the characteristics and national-cultural features of the representation of the concept of SMART HOUSE / SMART HOME.

For this particular study, through the analysis of the concept SMART HOUSE / SMART HOME based on the materials of the COCA case, we identified such main characteristics in the content of the concept as “high technology”, “computerization”, “comfort” and “security”, which were selected as stimulus words.

To participate in the experiment, we invited Anglophone undergraduates and postgraduates studying at the Tambov State Technical University (students who came from the following countries: Botswana, Ghana, Zambia, Zimbabwe, Kenya, Malawi, Nigeria, Swaziland, USA, Sudan) to composed of 50 people. The place of the experiment was room No. 304 of the building “D” of TSTU, Department of “Structures of buildings and constructions”. The time of the experiment is September 12, 2020, 13.00 - 13.45. The participants in the experiment were asked to respond to the suggested stimulus words high technology, computerization, comfort and security. It was also explained to the participants of the experiment that it is necessary to explain these characteristics of the building object “smart house” / “smart home”. As a result of the experiment, 50 forms with answers were received, there were no blank forms. The spelling of the responses received has been preserved.

The experimental data showed that the following responses were obtained to the HIGH TECHNOLOGY stimulus: high tech (24), hi-tech (23), Intermediate technology (18), startup company (17), Industrial design (15), scientific decision-making, (14), creativity (12), software (10), functionality (9) interactive environment (7), quality material (5), upward trend (3), new (3), being in demand (2), house of the future (2), necessity (1), future (1), fundamentality (1). The most frequently repeated LUs: high tech, hi-tech, intermediate technology, startup

company, industrial design.

The following responses were received to the COMPUTERIZATION stimulus: remote management (28), remote control (27), software (26), introduction of electronic computing technology (25), a computer (20), sensors (18), virtual reality (16) , informatization (12), informatics (9), human intellectual activity (8), artificial intelligence (8), programming (6), Internet (5), save energy (4), tailored to personal needs (3), energy- saving (3), applications (2), Control of smart appliances (1), free (1). The most frequently repeated LUs: remote management, remote control, software, introduction of electronic computing technology, a computer, sensors, and virtual reality.

The following responses were received to the COMFORT stimulus: quality of life (26), devices for a comfortable life (24), voice control (20), gadgets (18), special remote control (16), beautiful house (14), comfortable space (13), climate management (12), control temperature (10), the creation of comfort zones (10), warm house (8), warm floor (6), climate system (4), limitless climate possibilities (4), functionality (2), home sweet home (1), luxury (1), wealth (1), a house that takes into account the wishes of the owners (1). The most frequently repeated LUs: quality of life, devices for a comfortable life, voice control, gadgets, and special remote control.

And the following reactions were received to the SECURITY stimulus: my home is my fortress (30), security systems (26), basic security kit (24), safety (20), CCTV camera (20), signaling (18), special services console (15), doors and Windows (13), protected property (12), lock (12), protection against invasion of private territory (11), alarm button (10), fire and smoke detectors (8), smart constipation (5), baby monitor (3), modern (1), smart home (1), vicious dog (1). The most frequently repeated LUs: my home is my fortress, security systems, basic security kit, safety, CCTV camera, signaling.

The results of processing the materials of the associative experiment in an abbreviated form are given in Table 1, where we will demonstrate the most frequent and indicative answers.

Table 1. Summarizing the results of the questionnaire by the participants in the experiment

Characteristics of the SMART HOUSE concept	Nuclear components (more than 20 units)	Units of the nearest zone of the semantic field (from 10 to 20 units)	Units of the further zone of the semantic field (from 5 to 9 units)	Elements of the extreme periphery (from 1 to 4 units)
HIGH TECHNOLOGY	high tech hi-tech	Intermediate technology startup company Industrial design scientific decision-making creativity	functionality interactive environment quality material	upward trend new being in demand house of the future necessity future fundamentality

		software		
COMPUTERIZATION	remote management remote control software introduction of electronic computing technology a computer	Sensors virtual reality informatization	informatics human intellectual activity artificial intelligence programming Internet	save energy tailored to personal needs energy-saving applications Control of smart appliances free
COMFORT	quality of life devices for a comfortable life voice control	gadgets special remote control beautiful house comfortable space climate management control temperature the creation of comfort zones	warm house warm floor	climate system limitless possibilities functionality Home sweet home luxury wealth a house that takes into account the wishes of the owners
SECURITY	my home is my fortress security systems basic security kit safety CCTV camera	signaling special services console doors and Windows protected property lock protection against invasion of private territory alarm button	fire and smoke detectors smart constipation	baby monitor modern smart home vicious dog

Thus, as a result of the generalization of the respondents' answers, it was concluded that in the minds of young native English speakers (undergraduates, graduate students), future builders and architects, the concept of SMART HOUSE / SMART HOME is identified, first of all, with such concepts as high tech, hi-tech (the actual application of high technologies), remote management, remote control, software, introduction of electronic computing technology, a computer (software and control, the presence of a computer and the Internet), quality of life, devices for a comfortable life, voice control, security systems, basic security kit, safety, CCTV camera (ensuring the quality of life, the use of various smart devices, such as voice control, security systems, video cameras, basic security package). The proverb "my home is my fortress, which reflects the national consciousness of English speakers, moves into the nuclear zone (in comparison with the experiment carried out with the participation of Russian students and undergraduates). Safety, the use of gadgets, special consoles and sensors, alarms, providing reliability, protection and versatility of smart home systems are appreciated. Attention is focused on the use of the latest technologies and materials. Anglophones are not devoid of humor, offering the vicious dog as security and protection at home.

References

1. Kashkin V.B. Vvedenie v teoriyu kommunikacii: uchebnoe posobie [Introduction to communication theory: a tutorial]. Voronezh, 2000, pp. 23-24. (Rus)
2. Lavrinenko V.N. Psihologiya i etika delovogo obshcheniya: uchebnik dlya vuzov [Psychology and ethics of business communication: textbook for universities]. Moscow, 2008, pp. 111-113. (Rus)
3. Zubkov O.S. Nekotorye lingvisticheskie i kul'turnye aspekty reprezentacii professional'nyh medicinskih metafor v obshchenii [Some Linguistic and Cultural Aspects of representation of professional medical metaphors in communication]. Vestnik of Chelyabinsk State University, vol. 60, No. 33 (248), 2011, pp. 53-55. (Rus)
4. Borodulina N.Y., Glivenkova O.A., Gulyaeva E.A. Lingvo-kognitivnoe izuchenie metafor v yazyke special'nogo naznacheniya (naprimer, yazyk ekonomiki) [Lingvo-cognitive study of metaphor in language for special purposes (for example, the language of the economy)]. Vestnik CIE Moscow State University, 2015, No. 4, pp. 7-12. (Rus)
5. Borodulina N.Y., Gulyaeva E.A., Makeeva D.D. Lingvo-kognitivnye harakteristiki professional'nogo yazyka arhitektorov: perevodcheskij aspekt [Lingvo-cognitive characteristics of professional language of architects: translation aspect]. Bulletin of scientific conferences 2015, 1-2(1), pp. 80-84. (Rus)
6. Kuznetsov N.G. Zaitseva I.E., Stepicheva O.N. Yazyk professional'nyh arhitektorov: sistemnyj podhod k slovarju (na materiale anglijskoj, nemeckoj i francuzskoj filologii) [Professional architects language: a systematic approach to the dictionary (on the material of English, German and French Philology)] Questions of theory and practice. Tambov: Diploma, 2016, 6 (60), P. 2, pp. 98-107. (Rus)
7. Kuznetsov N.G., Stepicheva O.N. Nazvaniya novyh stroitel'nyh materialov v arhitekturno-stroitel'noj terminologii [Names of new building materials in architecture and construction terminology]. German Philology. Theory and practice, 2015, 9-2 (51), pp. 122-126. (Rus)

РЕПРЕЗЕНТАЦИЯ КОНЦЕПТА «УМНЫЙ ДОМ» В АНГЛОЯЗЫЧНОЙ КАРТИНЕ МИРА

О. Н. Апраксина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: Apraksina-Olga@rambler.ru

Аннотация. В статье рассматриваются проблемы выявления отличительных черт, присущих англоязычной картине мира, при осмыслении концепта «УМНЫЙ ДОМ» и при ее вербализации посредством английского языка.

Ключевые слова: концепт, языковая картина мира, репрезентация.

Irony and Sarkasm in the Context of the Novel “Morality Play” by Barry Unsworth

D. A. Gladilina, K. V. Polovinkina

Derzhavin Tambov State University, Tambov, Russia
e-mail: gladilina.darja@yandex.ru, ksenpol99@gmail.com

Abstract

The article is an attempt to analyze the implementation of such stylistic devices as irony and sarcasm in the novel “Morality play” by Barry Unsworth. The lexical means and context of the situations are described. The author's main tendencies in the representation of humor are considered, as well as the objects to which this humor is directed.

Keywords: humor, irony, sarcasm, fiction, contemporary literature.

Introduction

The exploration of “humor” began a long time ago. Such philosophers as Aristotle, Plato, I. Kant, A. Schopenhauer, T. Hobbes, S. Hall, and others, examined this notion.

Currently, not only representatives of philosophy have become interested in humor, but also researchers of other scientific fields: sociologists, linguists, psychologists, etc. In this article, we will consider humor and its implementation in a literary work through such stylistic means as irony and sarcasm. The novel “Morality play” by English writer Barry Unsworth tells the story of the life of medieval actors and a runaway priest. It follows their active participation in the investigation of a mysterious murder and concludes with an unpredictable ending.

Theoretical basis

In modern linguistics, sarcasm and irony are usually viewed as closely related phenomena. Sarcasm is considered as some kind of irony, namely, the highest degree of its manifestation.

The word sarcasm comes from the Greek “sarkasmos”, which literally means “to tear flesh”. The literary encyclopedia of terms and definitions by A. Nikol'yukin offers the following definition of sarcasm: “a kind of comic; a judgment containing an acrimonious, sarcastic mockery of the depicted person, the highest degree of irony” [3, p. 934]. In the “Merriam-Webster Dictionary” sarcasm defined as: “a sharp and often satirical or ironic utterance designed to cut or give pain” [1]. As can be seen from the examples of these two dictionaries, irony usually always appear in the definition of sarcasm, thereby showing their interconnection.

According to some researchers (T.V. Vavilova, M.M. Filippova, etc.), people use sarcasm in order to feel some moral superiority over those to whom this sarcasm is addressed. While irony can be viewed in certain contexts as a sufficiently positive phenomenon, sarcasm almost always contains only negative

connotations. Therefore, people who use sarcastic language are often portrayed as angry, aggressive and frustrated individuals.

The dictionary of literary terms and definitions edited by A. Nikolyukin gives the following definition of irony: “irony - (from Ancient Greek “eironeia” - dissimulation, mockery) - ridicule, containing an assessment of what is being ridiculed” [3, p. 315]. Unlike sarcasm, which conveys a negative, critical assessment of an object or phenomenon, irony is a more positive stylistic device that hides the humorous component “under the mask” of seriousness.

Becoming a part of artistic discourse, irony becomes a part of the text, and, therefore, a part of the reflection and intention of the author. Irony within the framework of a literary text serves the pragmatic aims of the writer, and is mostly subjective. Realizing irony in a literary text, the writer most often refers to the so-called situational or contextual irony, which is instantly recognized by the reader due to the fact that it has a clear context, expressed by a brief description of the situation and subsequent commentary from the author or the character.

Often, within the framework of irony, objective reality is compared with a certain aesthetic ideal, and the comic effect of irony is based on the presence of a hidden subtext, double meaning, which create a sharp, unexpected contrast or contradiction.

The comic nature of this contrast is based on the binary nature of human perception of the situation, where the real does not correspond to the ideal, and the form of expression does not correspond to the expected one: not the direct meaning of words is true, but the opposite. The binarity of human thinking finds its embodiment in many products of human’s activity, including religion, which becomes one of the key themes of the novel by Barry Unsworth “Morality Play”. According to D. Muecke, the “irony” of religion lies in the fact that it introduces the idea of an eternal, peaceful and ideal sphere, thereby exacerbating the contradictions of worldly existence, instead of happiness bringing more pain and suffering [2; p.196].

Analysis

For this research, 6 examples of the implementation of irony and sarcasm in the novel “Morality Play”, published by “Windmill Books” in 2014, were selected.

“I am only a poor scholar, open-breeched to the winds of heaven as people say, with nothing but Latin to recommend me” [4, p. 1]. In this context, the main character, Nicholas, is being ironic about his life situation. “Breeches” is a medieval type of pants. “Open-breeched” can be perceived as literally “having no pants”, i.e. to be very poor, to have no decent clothing. The irony here is revealed through metonymy. The notion of clothing replaces the concept of poverty. In addition, the use of this phrase with an ironic reference to paradise implies a certain characteristic to the clergyman.

“He was captured in a skirmish by the Earl of March's men and they severed his right thumb at the first joint, disabling him forever as a bowman and forcing him to change trade. This had been done at the lord's behest; nevertheless, Stephen

was an admirer of the aristocracy and proud of his part in these bloody disorders. 'I know men who had their eyes put out,' he said. 'I was lucky' [4, p. 21]. In this case, the author uses irony in relation to another character. Despite the fact that Stephen severely suffered from the aristocracy (he could no longer engage in military affairs because of his injury), he still honors people of the upper social class. The semantic contrast can be seen in phrases such as “was captured by the Earl of March's men”, “had been done at the lord's behest”, “an admirer of the aristocracy”. The motivation for the character's positive attitude towards the aristocracy and their actions, as well as a sense of some pride that he lost only a finger, and, for example, not an eye, is completely unclear.

“I am surprised you praise knights so much when it was one of them that had your thumb chopped off” [4, p. 61]. One of the characters sincerely does not understand Stephen's baseless delight with the aristocracy, and so he sarcastically declares it. In this example, sarcasm is implemented using the phrases “praise knights” and “one of them that had your thumb chopped off”. The general mood of the phrase and the essentially antonymous phrases create the effect of a snarky utterance.

These two examples describe the same situation from the point of view of two characters that have very different perspectives and mindsets. Both irony and sarcasm are directed at Stephen with the purposes of revealing the foolishness of character and also for a comic relief moment.

“Satan retires to Hell and sulks when Eve refuses at first to take the fruit and he has to be comforted”. [4, p. 43]. The verb “to sulk” meaning “refuse to smile, get angry because you want people to know that you are upset” in this context creates a humorous effect due to the emerging oxymoron representing Satan, formidable and ruthless in the classical Christian sense, as helpless and infantile creature. The irony in this case is that the object becomes the bearer of those qualities that cannot belong to it. It was the devil who needed support at that moment, which is contrary to generally accepted logic.

“There was only God inside the barn, sitting on the straw, drinking ale. He seemed depressed and did not speak to me”. [4, p. 43].

In this case, the irony arises from the deliberate decline of the image and metonymy: it is clear that this is not about God, but about the actor playing the role of God during the performance and wearing a suit.

In both examples, irony also appears due to the sharp contrast between images and their actions: Satan – “sulks”, “has to be comforted” and God – “sitting on the straw, drinking ale”, “seemed depressed and did not speak to me”.

“- They are poor...

- He finds money for ale...” [4, p. 73].

This dialogue is another example of insolvency, commented on with sarcasm. In discussing the affected family, everyone concludes that they are very poor and in need of money. However, one of the actors notes that when the father of the

family needs a drink, the money is there. This ridicule is based on the contrast between the plight of the family and the last money spent on ale.

Conclusion

From these examples, it becomes clear that the irony and sarcasm used by the author are mainly implemented within the framework of topics such as religion, interpersonal relations and social problems. The writer deliberately allows examples of different topics to intersect within specific situations to create a humorous effect, and the stylistic devices that he chooses are aimed at a more detailed disclosure of characters and their motives.

References

1. Merriam-Webster Dictionary. URL: <https://www.merriam-webster.com/dictionary/sarcasm> (Accessed 05 Feb 2020).
2. Muecke D. *The Compass of Irony*. L.: Methuen, 1969, 276 p.
3. Nikolyukin A.N. *Literaturnaya enciklopediya terminov i ponyatij* [Literary encyclopedia of terms and concepts]. M.: Intelvak, 2003, 1596 p. (Rus)
4. Unsworth B. *Morality Play*. L.: Windmill books, 2014, 222 p.

ИРОНИЯ И САРКАЗМ В КОНТЕКСТЕ РОМАНА БАРРИ АНСУОРТА “MORALITY PLAY”

Д. А. Гладилина, К. В. Половинкина

Тамбовский государственный университет им. Г. Р. Державина, Тамбов, Россия
e-mail: gladilina.darja@yandex.ru, ksenpol99@gmail.com

Аннотация. В данной работе была предпринята попытка проанализировать реализацию таких стилистических средств как ирония и сарказм в романе Барри Ансуорта “Morality play”. Были рассмотрены лексические средства и контекст описанных ситуаций, а также основные тенденции автора в подаче юмора и объекты, на которые этот юмор направлен.

Ключевые слова: юмор, ирония, сарказм, художественное произведение, современная литература.

Sprechakt „Bitte“. Kognitiver Ansatz

V. S. Grigoriewa

Staatliche Technische Universität Tambow, Russland
e-mail: grigoriewa@mail.ru

Zusammenfassung

Der Zweck dieses Artikels ist es, die propositionale Struktur des diskursiven Genres "Bitte", der Arten von Wissen des Adressanten und des Adressaten, die die Wahl bestimmter sprachlicher Mittel bestimmen, die den Erfolg des dominanten Kommunikationsakts sicherstellen, zu beschreiben. In Übereinstimmung mit dem ausgewählten Modell des Diskurses "Bitte" ist die Klassifizierung dieses diskursiven Genres in der Arbeit durchgeführt.

Schlüsselwörter: diskursives Genre, kognitiver Ansatz, Modell, Proposition, Sprechakt, Struktur.

Einführung

Viele Wissenschaftler erkennen die Proposition als eine spezielle Form der Wissensrepräsentation, als eine grundlegende kognitive Einheit der Informationsspeicherung an, die ihre Teilnahme an den Prozessen der Diskursorganisation und -interpretation sicherstellt. Dabei werden Propositionen "Atome" kognitiver Formationen einer höheren Ebene - Frame genannt. Der Begriff "Proposition", der in Übereinstimmung mit der Tradition der Sprachanalyse verwendet wird und auf die logisch-sprachlichen Ideen von G. Frege zurückgeht, ermöglicht es uns, einen Gedanken vor seiner Genehmigung durch den Sprecher zu bezeichnen. Die Integrierbarkeit des Sprechinteraktionsformats in verschiedenen diskursiven Genres wird durch die Struktur des Satzes vorgegeben, die von den Kommunikanten kognitiv beherrscht wird. Die Wahl dieses oder jenes Kommunikationsmodells hängt direkt von der Propositionsstruktur des diskursiven Genres ab, in dem die Kommunikation durchgeführt wird. Daher bestimmt die Analyse des Sprechinteraktionsformats die vorläufige Beschreibung der Propositionsstruktur der ausgewählten diskursiven Genres.

Die Satzstruktur des Sprachgenres "Bitte" wird durch die folgende Sprechsituation dargestellt. Der Adressat befindet sich in einer Situation, in der er einen Plan für eine bestimmte Aktion hat, aber nicht die Fähigkeit, diese auszuführen. Der Adressat kann diese Aktion ausführen, d.h. er hat eine Reihe von Möglichkeiten für seine Implementierung. Der Sprecher und der Zuhörer stehen in einer kooperativen Beziehung. Die Qualifikationen dieser Beziehungen hängen von den sozialen Rollen und dem Raum-Zeit-Kontinuum ab, in das diese Beziehungen verwoben sind. Die Aussage des Adressanten wird als Übertragung des Aktionsplans auf den Adressaten und damit als Aufruf zur Ausführung dieser Aktion aufgenommen. Die Motivation für den Adressaten enthält somit ein

kognitives Element, worüber der Aktionsplan mitgeteilt wird. Dieses Element entspricht dem propositionalen Inhalt der Bitte.

Verursachte Handlungen werden je nach prototypischer Situation durch den Grad der Verpflichtung als Bitte um einen Gefallen und als Bitte-Forderung klassifiziert. Man unterscheidet kategoriale und nicht kategoriale Aufforderungsaussagen: Befehle, Anweisungen, Verbote einerseits und Anfragen, Wünsche, Ratschläge und Empfehlungen andererseits. Die kategorialen Direktiven drücken den Willen des Sprechers aus, während die Meinung des Adressaten nicht berücksichtigt wird. Tatsächlich implizieren diese Sprechaktionen keine Antwort des Adressaten. Nicht kategoriale Anweisungen sind eine komplexere Formation als kategoriale, da der Sprecher aus verschiedenen Gründen versucht, den Grad der direkten Auswirkung auf den Adressaten zu verringern. Bei kategorialen Richtlinien wird die Position des Adressaten nicht berücksichtigt, bei nicht kategorialen Anweisungen wird sie in Betracht genommen. Charakteristisch für sprachliche Aufforderungshandlungen im weitesten Sinne des Wortes ist vor allem die Tatsache, dass sie weitgehend mit einer bestimmten Situation verbunden sind, die in spezifische kooperative Prozesse der soziokulturellen Praxis eingebunden ist. Bei der Bitte ist der Sprecher dem Hörer fast nie sozial überlegen. Bei dem Befehl hingegen ist die maßgebliche Position oder die Hauptrolle des Sprechers im Vergleich zur Rolle des Untergeordneten, in der der Hörer handelt, deutlich verfolgbar.

Abhängig davon, wie viel allgemeines Wissen Kommunikanten in einer Situation synergetischer Handlungen haben, wie integrativ sie sind, gibt es ein informatives Volumen der Aufforderungsdiskurse. Bei einem großen Bereich des Allgemeinwissens muss der Adressant nur ein bestimmtes Objekt benennen oder darauf verweisen und die Aktion benennen, die mit diesem Objekt ausgeführt werden muss. Wenn wir über die Einleitung einer Aktion sprechen, deren Plan nur im Kopf des Sprechers existiert, muss der Adressat diesen Plan erläutern. Beim Zuhörer bewirkt die motivierende Aussage einen Reflexionsprozess. Infolgedessen muss die Übermittlung des Aktionsplans motiviert werden. Diese Tatsache bestimmt in der Regel die Notwendigkeit, die Motivation zu begründen. Zum Beispiel: *"Gib mir noch eine Bockwurst", sagte ich, "ich habe so eine Lust am Leben"* (E.M. Remarque).

Die richtige Wahl der Sprachmittel stellt sicher, dass der Adressat der Erfüllung der Anfrage zustimmt. Soziokulturelles Wissen im folgenden Beispiel garantiert den Erfolg der Sprecheraufforderung: *«Können Sie mir wenigstens noch einen Kognak bringen?» knurrte ich den Kellner an. «Sehr wohl, mein Herr. Wieder einen großen?» «Ja». «Bitte sehr»* (E.M. Remarque). Die Erfüllung der Bitte in diesem Fall ist auf den sozialen Status des Adressaten und den Ort des Gesprächs zurückzuführen.

Das Grundmodell der Überzeugung, das eine Bitte enthält, ist durch das Vorhandensein motivierender Aussagen vor der Textbegründung gekennzeichnet. Zum Beispiel: In einem Auszug aus H. Manns Roman „Der Untertan“ wird

Diederichs Bitte, ihn nicht auf den Rücken zu schlagen, von einem Hinweis auf das kollektive Wissen begleitet, dass es ungesund ist: „*Höchstens bat er den Kameraden:., Nicht auf den Rücken, das ist ungesund*“ (T. Mann). In diesem Fall enthält die Begründung der Bitte nur ein Argument.

Die als Beispiel angegebenen diskursiven argumentativen Konstruktionen können als kanonischer Prototyp betrachtet werden, als einfachste Grundlage für die Implementierung des diskursiven Genres "Bitte". Dieses Schema funktioniert, wenn der Unterschied im "Bild der Welt" der Dialogteilnehmer minimal ist. Neue Informationen, die vom Sprecher übermittelt werden, sind in die kognitiven Kommunikationsstrukturen integriert, über die der Hörer bereits verfügt. In einigen Fällen ist dieses Wissen bereits vorhanden, es reicht aus, um es zu aktivieren.

Die Implementierung der genannten kognitiven Operationen garantiert jedoch nicht immer den Erfolg der Aussagen. Das kognitive Gepäck des Adressaten sollte in der Regel Kenntnisse über die individuellen Merkmale der Weltwahrnehmung und der kognitiven Aktivität enthalten, die durch die Besonderheiten des Adressaten bedingt sind. Wenn die Ursache der „Bitte“ nicht ausreicht, wendet der Adressat zusätzliche kognitive Mechanismen an. Wir betrachten eine solche Ergänzung des Grundmodells als Ausdruck der Kreativität des Adressaten. In diesem Fall ist der Grad an Kreativität umso höher, je origineller das Argumentationsmodell und je effektiver das Ergebnis der Überzeugung ist (siehe ausführlicher: [Grigorieva 2015, 2018]).

In einigen Fällen wird die Zustimmung zur Erfüllung der Bitte von Anfragen des Adressaten begleitet, der zusätzliche Informationen über den Adressanten und die Bedingungen für die Erfüllung der Bitte erhalten möchte. Um die Sprechaktion "Bitte" – darzustellen, wählen die Kommunikanten solche sprachlichen Mittel wie: Konjunktiv mit der Bedeutung einer Annahme; Modalwörter und Modalverben; Konjunktiv zur Übermittlung der fremden Rede; Kausalsätze; rhetorische Fragen; Imperativ u.a. Es sei bemerkt, dass die Verwendung des Imperativs in der russischen Sprache im Vergleich zur deutschen Sprache dominiert.

Die Entwicklung des „Aufforderungsdiskurses“ für den Fall, wenn sich der Adressat weigert, die Bitte zu erfüllen, bietet mehrere Möglichkeiten. Der Adressat kann die Ablehnung akzeptieren und Versuche, den Adressaten zu beeinflussen, nicht wiederholen. Oft gibt der Kommunikant jedoch seine Absichten nicht auf, und dann verwandelt sich der Diskurs der „Bitte“ in Überzeugung, Beharren, Verlangen oder Betteln. Das Modell dieses Diskurses, das durch Beharrlichkeit gekennzeichnet ist, nennen wir das Modell des Diskurses "dringende Bitte".

Wie das analysierte Material zeigt, führt die Taktik der Beleidigung selten zum Erfolg. Aber „Knöttern“, „Überzeugung“ endet oft mit einer positiven Entscheidung für den Adressanten. In diesem Fall ändert sich das Weltbild des Empfängers nicht. Er gibt einfach der Bitte des Adressanten nach.

Schlussfolgerung

Abschließend seien folgende Grundmodelle des "Aufforderungsdiskurses“ genannt, die wir ausgesondert haben: 1) Kausalmodell: Bitte - die Beschreibung

des Sachverhalts, der den Adressanten nicht befriedigt und der als Ursache einer Aufforderung auftritt; 2) Konsekutives Modell: die Beschreibung eines unbefriedigenden Sachverhalts - "Bitte" als Folgerungsfaktor; 3) Dringende Bitte; 3) Mit einer eindringlichen Bitte erfolgt die Entwicklung des Diskurses "Knöttern", „Flehen“.

Literaturverzeichnis

1. Grigor'yeva V.S. Struktura integrativnogo formata rechevogo vzaimodeystviya v dialogicheskom diskurse [The structure of the integrative format of speech interaction in dialogical discourse]. Voprosy sovremennoy nauki i praktiki. Universitet im. V.I. Vernadskogo, Tambov: Tambovskiy gos. tekhn. un-t, 2015, 4 (58), pp. 86-97. (Rus)

2. Grigor'yeva V.S. Integrativnost' formata rechevogo vzaimodeystviya v dialogicheskom diskurse: Dis. ... d-ra filol. nauk: teoriya yazyka [Integration of the format of speech interaction in dialogical discourse: Dis. ... Dr. Filol. sciences: 10.02.19 – language theory]. Tambov, 2018. (Rus)

РЕЧЕВОЙ АКТ «ПРОСЬБА». КОГНИТИВНЫЙ ПОДХОД

В. С. Григорьева

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: grigoriewa@mail.ru

Аннотация. Цель данной статьи – описание пропозициональной структуры дискурсивного жанра «Просьба», типов знаний адресанта и адресата, которые обуславливают выбор тех или иных языковых средств, обеспечивающих успешность доминирующего коммуникативного акта. В соответствии с выбранной моделью дискурса «Просьба» в работе осуществлена классификация данного дискурсивного жанра.

Ключевые слова: дискурсивный жанр, когнитивный подход, модель, пропозиция, речевой акт, структура.

Communicative Teaching of Phrasal Verbs: A Theme-Based Approach

P. I. Gunina^{1*}, N. A. Gunina²

¹Derzhavin Tambov State University, Tambov, Russia

²Tambov State Technical University, Tambov

*e-mail: guninap@gmail.com

Abstract

Teaching phrasal verbs to secondary school learners is one of the most challenging tasks. The main problems related to teaching this type of words are their idiomatic character and compositional structure. This paper explores a theme-based approach to teaching phrasal verbs; the advantages of the theme-based approach are discussed, a set of exercises facilitating the learning of phrasal verbs are presented.

Keywords: phrasal verbs, communicative competence, compound phrases, role-play, communicative teaching.

Introduction

Over the past two decades, the requirements to teaching English have changed dramatically. The ultimate goal of learning a foreign language is the development of a whole set of language skills and competences. In line with communicative teaching, learners are expected to acquire the communicative competence, which comprises a linguistic competence, a sociolinguistic competence, an educational competence, a cognitive-compensatory competence, as well as a general educational competence. This means that students learn and practice the target language through the interaction with one another and the teacher, the study of authentic texts, and through the use of the language both in class and outside of class

A phrasal verb is understood as a “phrase that consists of a verb with a preposition or adverb or both, the meaning of which is different from the meaning of its separate parts” [1]. Phrasal verbs are used in English, but are non-existent in Russian, which makes it difficult for non-native speakers to learn them. Phrasal verbs are formed by adding a prepositional particle - a preposition / an adverb to a mono-lexemic verb, as a result of which the meaning of the original verb can completely change. In other words, a phrasal verb is a unity of a verb and a preposition / an adverb.

Researchers agree on three main characteristics of phrasal verbs. Firstly, phrasal verbs are unique lexical units that are considered as a special linguistic phenomenon in the English language. Secondly, the idiomatic nature of phrasal verbs is one of the main features of phrasal verbs. Like other idiomatic expressions (idioms, clichés, fixed expressions), a phrasal verb is a combination of two or more words that form a phrasal unity, the meaning of which does not coincide with the meaning of its constituents, for example: *give in - to give up*, *give up - to refuse*. Thirdly, the unique nature of phrasal verbs also lies in their “phrasal” character. In all definitions, the special composition of the phrasal verb is emphasized, which is

an inseparable combination of a verb with a postposition. Phrasal verbs can be replaced by “simple” mono-lexemic verbs: *call up* = *telephone*, *come by* = *obtain*, *put off* = *postpone*, *put up with* = *tolerate*.

Phrasal verbs are important for the English-speaking community, and convey the meaning in a concise and clear way. These lexical units are extremely common in speech and are more preferable than verbs of Latin origin with a similar meaning, e.g. *to find out* - *to discover*, *to blow up* - *to explode*, etc. Phrasal verbs replenish the lexical system of the English language in two directions: the more and more new phrasal verbs appear, and at the same time the existing verbs acquire new meanings.

Materials and Methods

The teaching experience shows that students find learning phrasal verbs quite challenging. Phrasal verbs are used mainly in English, which makes it difficult for non-native speakers either to use these verbs, or to distinguish shades of meanings of phrasal verbs. According to the statistics, 40% of a native speaker’s speech consists of phrasal verbs, acquired in a natural way along with other linguistic structures. However, phrasal verbs are hardly ever used by English learners [2]. It is worth noting that for language learners it is crucial to be familiar with phrasal verbs as they are included in the assignments for Russian National Exam.

Methods of teaching phrasal verbs are based on several principles. Most teachers start with teaching a main verb and introducing phrasal verbs with different prepositions / adverbs added to the same verb. This approach is often implemented in the majority of textbook by domestic and international authors. Take for instance a very popular “Round up” series of grammar textbooks by Virginia Evans. A typical exercise on phrasal verbs will include the explanation of the meaning and a gap-filling exercise (Fig. 1).

<p>Phrasal Verbs</p> <p>get away: escape</p> <p>get on:</p> <ul style="list-style-type: none"> • make progress • enter a bus, train, etc. (opp. get off) • have a friendly relationship with sb; get along with sb <p>get through:</p> <ul style="list-style-type: none"> • reach sb by telephone • finish or complete 	<p>1 Fill in the correct particle.</p> <p>1 My sister is getting <i>on</i> well at college.</p> <p>2 If I can get all my homework, I'll go to the cinema later.</p> <p>3 The thief got by climbing over the garden wall.</p> <p>4 I really get with my brother. We never argue.</p> <p>5 I can't get to Joe. I'll phone again later.</p> <p>6 Ann got the train just as it was about to leave and got at Portland.</p>
--	---

Fig. 1. A typical exercise to teach and practice phrasal verbs
Source: V, Evans, J. Dooley *New Round up 5*

Despite the popularity of the given approach, it focuses mainly on the form and meaning rather than practical use of the verbs in communication. Students

memorize long lists of verbs, complete the sentences, but they fail to use them correctly when producing their own texts.

Results and discussion

A productive approach to teaching phrasal verbs should be based on methods and techniques that facilitate learning and raise student motivation. One of the approaches that meet these requirements is a theme-based approach to teaching phrasal verbs. Phrasal verbs can be grouped by topics to facilitate the acquisition [3, p. 13–25]. It seems appropriate to organize teaching phrasal verbs through exercises that focus on the high frequency verbs, as well as prepositions and adverbs that change their semantics.

Phrasal verbs can be divided into thematic groups in the following way:

- **Police and Crime:** *break in/into, bump somebody off, catch somebody out, do away with somebody, get away with a crime, get off with a warning, give oneself up, go for somebody, hold somebody up, let somebody off, look into, make off with;*

- **Feelings:** *break down, get browned off, not care for, carry away, cheer somebody up, cut up, fall for somebody, fall out with somebody, be/get fed up with, flare up, get on/along well with somebody, let somebody down, pick on somebody, put somebody down, strike up a friendship, take somebody aback, take to somebody, warm to/towards somebody.*

There are a number of ways in which students can practise phrasal verbs.

(1) Training phrasal verbs through their synonyms

Students have to be familiar with the verbs, e.g., *be up to = to do sth wrong; break out = begin suddenly; bring out = to publish; call off = cancel; carry on = continue.*

(2) Practicing phrasal verbs in communicative situations

For example, a role-play can be organized to practice the phrasal verbs under study in communication. When studying the topic *Medicine*, one student plays the part of a patient and is supposed to make use of the following phrasal verbs: *run down, come down in spots, let up, throw up while the other is a doctor and his role involves using the verbs break out, black out, come down with an infection, stay in, ease off, carry on taking the antibiotics.*

Below is the example of a typical conversation [4]:

*D: What seems to be wrong?
P: I feel tired and run down. I've also come down in spots.
D: Let me take a look at them. When did they break out?
P: Almost a week ago. They are still very sore. The pain hasn't let up.
D: Have you ever felt like blacking out at any time?
P: Yes, I felt like fainting earlier today and I wanted to throw up.
D: I think you've come down with an infection. It's not serious but you'll have to stay in and rest. Take these antibiotics and the pain will soon ease off. Carry on taking the medicine for a week and then see me again.*

(3) Filling in the gaps in the text using pictures as clues (Fig.2)



1 I ran _____ the bus, but it didn't stop for me.

2 The dog is running _____ from the boy.

3 The car ran _____ petrol

Fig. 2. An example of a gap-filling exercise to practice phrasal verbs

(4) Reading and answering questions using phrasal verbs

For example, "There is a plan to build a new supermarket where the old cinema now stands. What will happen to the cinema before the supermarket can be built?" – "It will be pulled down".

(5) Doing a survey

Below is an example of a multiple-choice survey.

1 Which of the following do you get (on with) best of all?

A Other people B Animals C Children

2 Do you prefer to go (out)

A with only one close friend B with a lot of friends C by yourself

3 If you ran (into) an old friend, would you

A talk about old times B say hello and walk on C arrange to meet (up) soon

4 Which of the following do you prefer to do in the evening?

A Stay (in) and watch TV B Go (out) with a friend C Ask a friend (out).

[4].

(6) Picture-based story writing

For example, "Linda was late for work yesterday" (The pictures show what happened to her before she arrived): Linda was so sleepy yesterday morning that she didn't hear the alarm **went off** at half past six. In fact, she didn't **get up** until ten past eight. On the way to work, she was **held up** in heavy traffic, and then a wheel of her car **came off**. After she had **put it back on**, her car **broke down!** Later, when she managed to repair it, she had to wait as some workmen were **digging** the road **up**. She then began to drive quickly until a policeman saw her and made her **slow down**".

(7) Writing an email to a friend

The task can be formulated as follows: “You have a friend who is becoming overweight. What advice would you give your friend about eating and doing sport”? Use the following phrasal verbs: *cut out, cut down on, go in for, take up, wolf down*.

(8) Using mobile apps such as Quizlet

This can make learning more interactive as most learners of school age like using technology in language learning. The use of electronic devices will make it possible to facilitate learning and combine it with recycling of the target vocabulary. *Quizlet* provides learning tools for students and includes flashcards, study, testing and game modes (Fig.3).

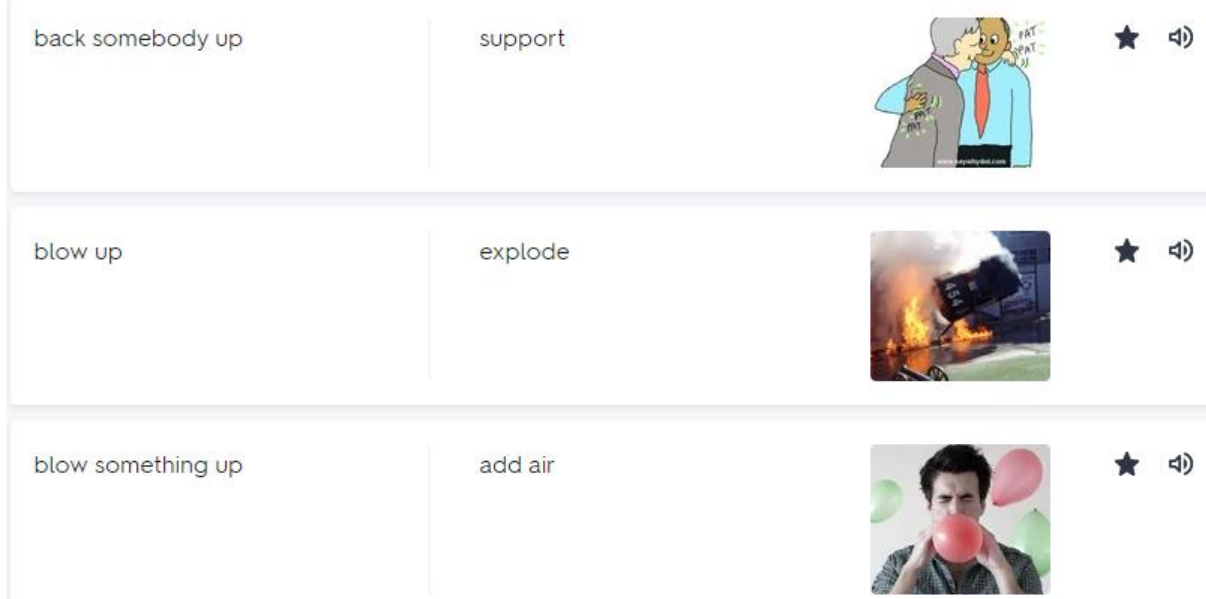


Fig. 3. A webpage of a Quizlet module on phrasal verbs

The proposed approach to teaching phrasal verbs compares favorably with traditional methodologies that provide students with lists of “verb + preposition / adverb” combinations, “phrasal verbs and their definitions” and encourage students to learn them by heart. When teaching phrasal verbs, it is important to turn to communicative teaching that implies direct participation of learners in communication, creation of simulated learning environment, and use of the target language in open-ended structure. Learners are expected to produce the language in a spoken or written manner, which can be achieved through the following activities: question-answer work, role-plays, “imaginary situations”, filling out questionnaires, writing a letter in response to the information received, essays, etc.

Conclusion

The proposed methodology improves the teaching and learning of phrasal verbs as it shifts from testing to creating an interesting, effective and feasible process of acquiring the language through practical use of the target language. Instead of focusing on a linguistically correct end result, the methodology offers a student-centered approach which implies reduced stress and anxiety, increased motivation and critical thinking as well as support from the teacher who acts as a facilitator

rather than an instructor. Individualization of the learning process helps to create a positive attitude to studying.

References

1. Cambridge dictionary. URL: <https://dictionary.cambridge.org/ru>
2. Nezhvedilova L.A. K voprosu ob obuchenii anglijskim frazovym glagolam studentov I-II kursov neyazykovykh vuzov [On the issue of teaching English phrasal verbs for 1st-2nd year students of non-linguistic universities]. *Filologicheskie nauki. Voprosy teorii i praktiki*. Saransk: MGU, 2013, pp. 119-120. (Rus)
3. Heaton J.B. *Practise your phrasal verbs*. Longman Group Limited, 1995, 63 p.
4. Pozdnyakova O.V., Gunina N.A. Teaching Phrasal Verbs. *Voprosy sovremennoj nauki i praktiki*. Universitet im. V.I. Vernadskogo, 2011, 3(34), pp. 357-360.
5. Voyakina E.Yu., Koroleva L.Yu. K probleme prepodavaniya delovogo anglijskogo yazyka kak yazyka dlya spetsial'nykh tselej v vuze [To the problem of teaching Business English as ESP in higher educational institutions]. *Voprosy sovremennoj nauki i praktiki*. Universitet im. V.I. Vernadskogo, 2014. 1(50). Pp. 47-55. (Rus)
6. 5. Mordovina T.V., Voyakina E.Yu. To the problem of the discourse competence formation. *Prepodavanie anglijskogo yazyka v professional'nom kontekste: soedinyam kul'tury cherez granicy: materialy 4 Mezhdunar. nauch.-prakt. konf. 2019*. Pp. 38-44. (Rus)

КОММУНИКАТИВНЫЙ АСПЕКТ ОБУЧЕНИЯ ФРАЗОВЫМ ГЛАГОЛАМ: ТЕМАТИЧЕСКИЙ ПОДХОД

П. И. Гунина^{1*}, Н. А. Гунина²

¹Тамбовский государственный университет им Г.Р. Державина, Тамбов, Россия

²Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: guninar@gmail.com

Аннотация. Обучение фразовым глаголам учащихся средней школы – одна из самых сложных задач. К основным трудностям изучения слов этого типа традиционно относят идиоматичность и композиционную структуру. В статье рассматривается возможность применения тематического подхода к обучению фразовым глаголам, обсуждаются его преимущества, а также представлен комплекс упражнений, облегчающих изучение фразовых глаголов.

Ключевые слова: фразовые глаголы, коммуникативная компетентность, ролевые игры, коммуникативное обучение.

Strategies of Distance Language Learning

L. Yu. Korolyova

Tambov State Technical University, Tambov, Russia

e-mail: lyu-korolyova@yandex.ru

Abstract

Distance language learning, its aspects and strategies on part of both teachers and students are focused on. Independence, control and autonomy are distinguished as the main principles of distance language learning. Cognitive and metacognitive strategies needed for the successful distance language learning are considered. Attention is paid to vocabulary learning as a key element for the development of four main language skills as well as the strategies used to do it effectively.

Keywords: distance language learning, independent learning, language learning strategies, language skills.

Introduction

The last year witnessed the wide use of distance learning all over the world due to the extraordinary circumstances all people turned out to be in. These are the pandemic of the new disease and the necessity to teach disciplines and learn them in force majeure conditions. The idea of distance learning is not unique. This type of learning has already been used for some time. Generally, online education can be considered from different angles depending on tools, users and resources. Basically, four types are distinguished:

- courses on CD-ROMs;
- distance learning with teachers;
- online learning with the use of special interactive programs;
- massive online open courses (MOOCs) [1].

However, the second type was the one needed in most educational institutions in 2020 and it will be essential in the forthcoming years too. New challenges forced teachers to look for the tools that could allow them to conduct classes effectively trying to meet all the requirements of education standards and combine traditional and modern technologies. At the same time students also had to adapt to specific conditions and develop skills necessary for distance learning, such as self-management, independent learning of the material, strong will etc. We would like to focus on teaching foreign languages within the framework of distance education as language learning is not a simple process even in case of conventional education and it becomes even more complicated under new conditions. Peculiar strategies are required to succeed in this on the part of both teachers and students.

It should be noted that distance language learning is mainly based on independent learning. Therefore, independence, control and autonomy are the main principles guiding distance language learning. They involve the optimization of

learner choice, being centered on individual learners' needs but not teachers' interests, transferring the right to make decisions to learners themselves. Consequently, independent learning makes individuals take the responsibility for their education and various methods were developed to raise learners' awareness and knowledge of themselves as well as their motivation and strategies needed to develop competences in the target language. It is argued that the biggest challenge for learners is to acquire abilities which will help them to deal with learning environments which are not supervised directly by teachers [8].

Research done by some linguists (Cotterall, 1995; White, 2008) shows that it is quite difficult for many students to adapt to distance learning as they consider the environment guided and controlled by the teacher to be an ideal one. They explain it by the fact that in this environment they can expect the immediate assistance from the teacher and what is more, they get the opportunity to make social contacts and practise language in the situation which is not frightening. So, to solve the problem some learners use a strategy aimed at creating "a study-nurturing environment" which imitate approximately the ideal learning environment with the teacher playing the main role [ibid., p.9].

Language learning strategies

The use of different strategies helps learners to achieve success in developing language skills. Considering distance language learning mainly as an independent process we must consider those strategies that students themselves apply. White Cynthia focuses on some strategies which can be classified in the following way:

- the so-called communication making and context making activities with imagined partners whom learners can speak to;
- autonomously controlled tasks aimed at the use of language in context;
- intensive vocabulary learning which includes several stages:
 - a) memorization of as many words as possible;
 - b) understanding of word-formation models;
 - c) guessing the meaning of unknown words relying on the knowledge of word-formation models;
 - d) reading of authentic texts [8].

Carson J. and Longhini A. found out that in the initial stages of language learning the main strategy is "compensating for missing knowledge" when learners have communicative demands and try to learn the new material to succeed in communication, then the strategies become more cognitive and result in the improvement of the command of the target language, and finally, learners use metacognitive strategies (evaluation and analysis of the material) [2, p. 432]. It was noted that learners who use metacognitive strategies possess specific personal characteristics as they understand the importance of such strategies for the development of their language skills [ibid.].

Distance learners were also reported to use metacognitive strategies four times more often than classroom learners. Among these strategies self-management can be distinguished as the one that is applied by distance learners more frequently

than others. From the point of view of distance learning self-management involves full comprehension of the ways which allow the student to learn best and cope with the language material studied. Moreover, it is the strategy that is essential for learning how to control emotions and motivation as well as attitudes to the learning environment. Two more strategies were singled out such as self-talk and self-encouragement [8].

Considering the problem of distance language learning from the point of view of teachers' attention should be paid to two aspects:

- 1) the development of strategies to help students learn the target language;
- 2) the preparation of the teaching material and resources to provide distance learners with all necessary tools for the successful mastering of the target language.

The first aspect requires the proper feedback on the part of teachers that will allow learners to improve their strategies and use those that are really effective. It is very important to give learners clear instructions concerning the material studied and methods to do it well.

The second aspect implies the involvement of information and communication technologies without which distance learning is impossible in the modern world [5]. The teaching material must include lecture texts, presentations, audio and video recordings, quizzes, tests, games. Moreover, the former should focus on the development of four main language skills: reading, writing, speaking and listening. These skills are based on the knowledge of vocabulary; thus, it is the key element that remote learners and teachers should pay attention to [7].

Vocabulary is commonly divided into active and passive and its learning can be aimed at achieving receptive and productive purposes. It is argued that learning a word takes a long time. Several stages can be distinguished here:

- 1) students learn a word focusing on its form, pronunciation etc.;
- 2) students learn a word focusing on its meaning (including its connotations in different contexts) and associations;
- 3) students learn a word focusing on its use, i.e. grammar, register, restrictions on use [6].

The strategies that can help to learn vocabulary are various. But it is worth mentioning one of them, namely semantic associations relying on keyword techniques. Learners memorize words with the help of associations they can make with this or that keyword. For example, to teach students doing a Bachelor's programme in Economics at Tambov State Technical University the coursebook "Language Leader" is used as the basic tool for distance learning. Students are given instructions how to use it, moving from one unit to another one. As for vocabulary, the coursebook contains specific exercises that can be done independently by learners. Along with these assignments, students can be asked to make several associations based on keywords. It is possible to create their own mind maps and then share them with other students and the teacher during online classes which are part of distance learning implying metacognitive strategies, analyzing and evaluating the work of peers.

For instance, learners are given the assignment to read the article from “Virginia Business Online” called “Perks that work” and make associations with the word ‘perks’ relying on the text:

«Keeping people happy is an increasingly tough trick. With unemployment at record lows, ‘companies are trying just about anything’ to retain employees, says Jay Doherty of the New York -based human-resources consulting firm William M. Mercer Inc. Not only are employees being pampered, they are getting more money, better benefits and help with personal problems such as child care and financial planning. Bosses once shunned such intervention. Retention ‘is no longer a human resource issue, it’s a business issue,’ Doherty says» [8].

Here is the sample of the mind map with the word ‘perks’:

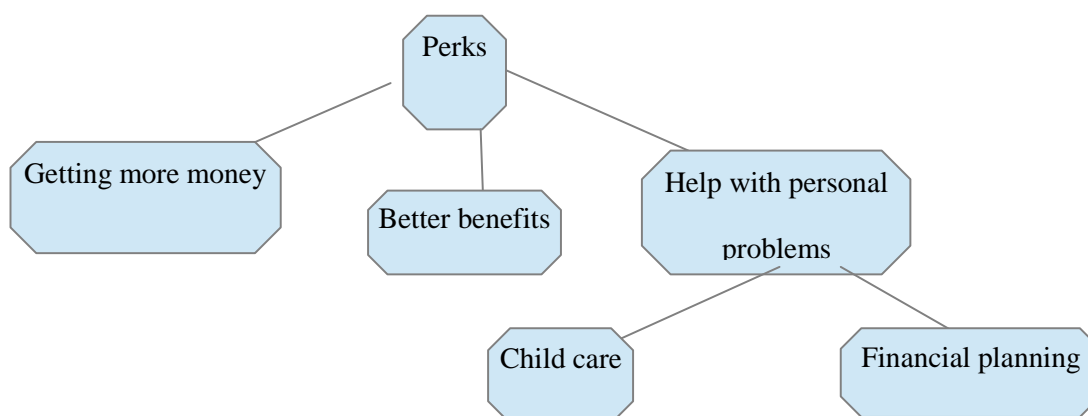


Fig. 1 Mind map with the word “perks”

This strategy can provide distance learners with the useful technique of memorizing words based on semantic associations which can be found in the context of the reading material at the same time.

Conclusion

Thus, distance language learning is a complicated process which requires particular skills on the part of students and teachers. As the former is based mainly on independent learning students should be provided with strategies to help them develop main language skills effectively.

References

1. Elektronnoe obuchenie [E-learning]. URL: https://ru.wikipedia.org/wiki/elektronnoe_obuchenie. (Accessed 23 December 2019). (Rus)
2. Carson J., Longhini A. Focusing on learning styles and strategies: a diary study in an immersion setting. *Language learning*, 2002, vol. 52, issue 2, pp. 401-438.
3. Cotterall S. Readiness for autonomy: investigating learner beliefs. *System*, 1995, vol. 23, issue 2, pp. 193–206.
4. Cotton David, Falvey David, Kent Simon. *Market Leader. New Edition: Upper Intermediate Business English coursebook*. Pearson Education Limited, 2006, 174 p.
5. Mordovina T.V. Nekotorye aspekty ispol'zovaniya IKT v obuchenii inostrannomu yazyku [Some aspects of using ICT in foreign language teaching and learning]. *Mir nauki bez granits: materialy 6 Mezhdunar. nauch.-prakt. konf. molodyh uchyonyh*, 2016, pp. 30-34. (Rus)

6. Schmitt N. Tracking the incremental acquisition of second language vocabulary: Longitudinal study. *Language Learning*, 1998, vol. 48, issue 2, pp. 281–317.

7. Voyakina E.Yu. Osobennosti prepodavaniya professional'noj leksiki budushchim specialistam [Peculiarities of teaching vocabulary for specific purposes to future specialists]. *Voprosy sovremennoj nauki i praktiki. Universitet im. V.I. Vernadskogo*, 2016, 1(59), pp. 141-146. (Rus)

8. White Cynthia. Language learning strategies in independent language learning: an overview. In: Stella Hurd and Tim Lewis (eds.) *Language learning strategies in independent settings*. Bristol, Buffalo, Toronto: Multilingual Matters, 2008, pp. 3-25.

СТРАТЕГИИ ДИСТАНЦИОННОГО ИЗУЧЕНИЯ ЯЗЫКОВ

Л. Ю. Королева

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: lyu-korolyova@yandex.ru

Аннотация. Рассмотрено дистанционное изучение языков, его аспекты и стратегии, применяемые как со стороны преподавателей, так и со стороны студентов. Выделены основные принципы дистанционного изучения языков, а именно: независимость, контроль и автономия. Описаны когнитивные и метакогнитивные стратегии, необходимые для успешного дистанционного изучения языков. В статье уделяется внимание изучению лексики как ключевого элемента для развития четырех основных языковых навыков, а также тем стратегиям, которые используются для эффективного овладения вокабуляром.

Ключевые слова: дистанционное изучение языков, независимое обучение, стратегии изучения языков, языковые навыки.

Ritual as an Ethnocultural Phenomenon

O. G. Lasskaya, T. V. Logina, E. E. Oreshina

Tambov State University named after G.R. Derzhavin, Tambov, Russia
e-mail: violet8905@rambler.ru

Abstract

The article is devoted to a comprehensive study of the sociocultural phenomenon “ritual” since the origin of society. Its essence and functions are determined, the sign orientation of the ritual is analyzed. The article clarifies the features of the functioning of ritual in society. The ritual appears in all spheres of human life and acts as one of the tools which organizes daily life of the society and most important information is passed from generation to generation.

Keywords: ethnoculture, ritual, social interaction.

Ritual actions form an integral part of any ethnic culture and acts as its relevant feature, thus ensuring the uniqueness and revealing specific features of the cultural system.

Culture provides the instrumental and integral needs of society; therefore, the ritual can be considered as one of the ways of passing the cultural heritage to the following generations. It seems appropriate to refer ritual to one of the methods of cross-cultural communication within not only a separately considered culture, but in interaction of a number of such systems.

Ritual actions influence the world view formation of a certain culture, enable to have a comprehensive understanding of history, society development and follow the evolutionary changes that it has undergone. The social significance of the ritual is also undeniable, that is how people solved the vital tasks of preserving, controlling and reproducing their core values. Regarding the ritual as an ethnocultural phenomenon, it is necessary to define its sense.

The concept of “ritual” was introduced by Konrad Lorenz. He was the first to identify actions undergoing ritualization, which were subsequently identified by Yu.S. Stepanov regulations: “These are actions that do not get anything and do not work out anything - they only bring some order into the environment. But they are precisely such actions that turn out to be directly related to the actions of animals” [4: 302].

One of the main features of ritual is its simultaneous focus on two opposite addressees: “your own” and “someone else’s”. Based on these directions, according to K. Lorenz, ritual’s basic functional parameters are distinguished:

1. cohesion of a limited number of individuals of the same species into the social whole (coordinating, or uniting function, addressing “your own”);
2. isolation of this whole from the external environment (protective, or protective and defensive function, addressing “someone else’s”) [2:141]

Ritual restrains aggression and brings the members of group together. An example of a ritual is ethical conduct, business etiquette, diplomatic reception, and many other things that we do not consider being rituals, though they are. Human culture is based entirely on ritual.

According to Yu.V. Monich, ritual, in a broad sense, can be presented as a manifestation of sign behavior observed in a whole class of self-organizing systems: from animal communities to various forms of human social life. Both at the biological and cultural levels, ritual appears as a tool which is used to create, structures and maintains living space [3:191].

Based on this definition, the main idea of ritual can be considered as the transition to a new state, as well as the transformation of “nature” into “culture”.

Ritual involves three main roles: presenters, participants, observers. In ritual, there is a mandatory change of roles, a transition from one status to another. It should be noted that a person changes status at critical moments in his life, i.e. society strives to realize fundamentally important events.

If we concern the linguistic ways of expressing ritual actions, the most typical one is cliched speech of people who may not know each other, but must communicate in accordance with the norms of this society. A certain social position of the participants in communication is expressed in the following signs:

1. Individual characteristics of people get concealed;
2. people behave according to a certain pattern to blend in with environment, they put on certain role masks to ensure good interaction;
3. actualization of relations between participants in communication [1:48].

Ritual is performed and fully realizes its purpose only in extreme situations. The range of rituals is strictly limited and correlates with the critical moments in the life of society, caused either by transformations in the social structure (birth, initiation, wedding, death), or by changes in the surrounding world (turning points of the calendar cycle, epidemics, epizootics, natural disasters). Ritual can be defined as the only possible way of behavior of a person and a group of people in critical situations that require special (mandatory for all members) programs of behavior.

Each ethnic culture is characterized by their own ideas about the significance of certain aspects of behavior and, consequently, their own configuration of the border between typical (everyday) and free (“ritual”) behavior. Let us consider a variation of human behavior using the example of the “baptism” ritual.

If in everyday life a person is concerned mainly with maintaining his biological status, satisfying his material needs, personal interests, etc., while in “baptism” ritual his spiritual aspirations, always emotionally positively colored, find their realization. Symbolizing the transition from one spiritual state to another, higher in its level, a person, accordingly, enters into completely new relations with the world, acquires a previously unknown understanding of life, purifies himself morally and gradually changes his worldview, and, consequently, norms of behavior. It is not a coincidence that many researchers point to the pronounced

psychotherapeutic effect of this ritual [1:10], which consists in reconsideration one's life and changing for the better.

The nature of the world exploration is also fundamentally different. In everyday life, the external (extensive) "expansion" of oneself dominates: household, labor, vehicles, etc. are typical examples of an expansion of a person and organs of his body. In "baptism" ritual a different type of development is presented: a person activates his inner self, his thought, the ability to create.

It is no coincidence that ritual is increasingly seen as the primary source of future arts, science and philosophy [1:17].

References

1. Bajburin A.K. Ritual v tradicionnoj kul'ture. Strukturno-semanticheskij analiz vostochnoslavjanskij obryadov [Ritual in traditional culture. Structural and Semantic Analysis of East Slavic Rites]. SPb, 1993. (Rus)
2. Lorenc K. Oborotnaya storona zerkala [The reverse side of the mirror]. M., 1998. (Rus)
3. Monich Yu.V. Na styke rituala i yazyka: kompleksnaya motivaciya v semanticheskoj evolyucii [At the junction of ritual and language: complex motivation in semantic evolution]. Yazyk i kul'tura. Fakty i cennosti. K 70-letiyu Yu. S. Stepanova. M., 2001. (Rus)
4. Stepanov Yu.S. Konstanty. Slovar' russkoj kul'tury. Opyt i issledovaniya [Constants. Dictionary of Russian culture. Experience and research]. M., 1997. (Rus)

РИТУАЛ КАК ЭТНОКУЛЬТУРНЫЙ ФЕНОМЕН

О. Г. Ласская, Т. В. Логина, Е. Е. Орешина

Тамбовский государственный университет им. Г.Р. Державина, Тамбов, Россия
e-mail: violet8905@rambler.ru

Аннотация. Статья посвящена комплексному исследованию социокультурного феномена «ритуал» с момента зарождения общества. Определяются его сущность и функции, анализируется знаковая направленность ритуала. В статье выяснены особенности функционирования ритуала в социуме. Ритуал фигурирует во всех сферах жизнедеятельности человека и выступает одним из инструментов, благодаря которым организуется упорядоченная повседневная жизнь коллектива и происходит передача ключевой, самой важной, информации из поколения в поколение.

Ключевые слова: ритуал, социальное взаимодействие, этнокультура.

The Language Picture of the World of the Renaissance Epoch and Modern France (Lexical Units Denoting “Men’s Clothing”)

A. V. Menshova, D. V. Naletova, K. V. Vlasova

Derzhavin Tambov State University, Tambov, Russia

e-mail: alyono4ka.menshova@yandex.ru, iskralive@yandex.ru, vkristino4ka@mail.ru

Abstract

The article is devoted to the problem of the linguistic picture of the world. Understanding the linguistic picture of the world of speakers of a foreign language is very important in connection with the increased need to study intercultural communication in order to study the cultural differences of peoples, their worldview and mentality. The purpose of this article is to study a specific fragment of the linguistic picture of the world of a Frenchman of the 16th and 21st centuries using the example of lexical units with the general meaning of “men's clothing”. This goal is concretized in the following tasks: to study the specifics of the linguistic picture of the world in France in the 16th and 21st centuries; to reveal the similarities and differences of the linguistic picture of the world of the Frenchman of the Renaissance and the modern Frenchman.

Keywords: borrowings, etymology, lexeme, lexical system of the French language, linguistic picture of the world, suffixation, word formation.

The concept “picture of the world” is one of the fundamental concepts expressing the specificity of a man and his being, his relationship with the world, the most important condition for his existence in the world. The imprints of the picture of the world can be found in language, gestures, fine arts, music, rituals, etiquette, things, facial expressions, human behavior. Modern authors define the picture of the world as a global image of the world that underlies a person’s worldview and expresses the essential properties of the world in understanding of a person as a result of his spiritual and cognitive activity.

The linguistic picture of the world is changeable in time, and, like any living organism, it undergoes development.

The vocabulary of the French language has always been the subject of close linguists’ attention in the different countries. The 16th century is of particular interest for study, mainly because during this period formation of the French national language took place. The language of the French people develops into the language of the French nation, and the general French written and literary language acquires the features, which are peculiar for the national written literary language.

Before embarking on the study of the vocabulary denoting a man's suit in France in the 16th century, we need first to turn to the general concept – “**vêtement**” (m) – “*clothing*”.

The lexeme with the general meaning "clothes" appeared in the 12th century. The modern word “**vêtement**” (m) comes from “**vesture**” – «*clothing*».

During the Renaissance, this lexeme changed significantly: the word with the meaning “clothing” was written in a completely different way: “**vestment**” (it is example of suffixation: attachment of *-ment* suffix).

However, the previous version did not disappear: in the 17th century, the lexeme “**véture**” (‘s’ has disappeared before ‘t’) referred to “*religious robe*”.

The modern spelling of “**vêtement**” (**m**) appeared in the 18th century. It is still actively used in modern French today.

Men in the 16th century took care of their appearance no less than women, that’s why the number of the elements of men's clothing in the Renaissance is so significant.

After analyzing the French vocabulary of the 16th century with the meaning “men's clothing”, it is possible to divide it into several groups:

a) words that have retained their meaning: *béret (m)* – beret, *chapeau (m)* – hat, *vêtement (m)* – clothes, *gilet (m)* – vest,

Chapeau (m) – «hat». This word is formed by the suffixal way: to the stem “*chapel*” they added suffix *-eau*. Hat – men's headdress, which can be made from a wide variety of materials: fabric, paper, straw etc. They distinguish different types of the hats: round (with round brims), triangular etc. In the 16th century, most men wore large, wide-brimmed hats decorated with feathers. Until the 15th century, a wreath of flowers was also called “chapeau”, and only at the beginning of the 16th century this word acquired the familiar meaning of a headdress.

In addition to hats, men in the 16th century wore berets.

Béret (bérret) (m) – “beret, cap”. Beret is a headpiece without visor. The beret gained the greatest popularity at the end of the 16th century. “**Béret**” is a Provençal word (<berret) that appeared in French at the end of the 15th century. The word has retained its meaning to the present day.

Gilet (m) – “vest”. Vest is a sleeveless outerwear. It is a Spanish word (<jileco). According to another point of view, the word comes from the name Jiles. This is the name of a young man who wore a “sleeveless shirt”, i.e. this lexeme comes from a proper name.

The word for this piece of clothing appeared in French in the early 16th century. Its meaning has survived to this day, but if during the Renaissance the vest was an element of the men’s wardrobe, now both men and women wear the vests. There is a unification of the elements of clothing, that is so unique for modern society.

b) words that have partially retained their meaning: *blouse (f)*: in the 16th century it was the subject of both male and female wardrobe; in the 21st century there’s only women's blouse; *manteau (m)*: during the Renaissance, this lexeme meant “cloak” and “cape”; nowadays the above word means “coat”; *collet (m)*: in the 16th century it was “men's short fitted jacket without sleeves”, in the 21st century it is “collar”; *culottes (f.pl)*: in the 16th century it was one of the types of men's pants, in the 21st century it is “men's underwear”; *doublet (m)*: during the Renaissance, this lexeme meant “leather shirt with wide sleeves”, now the lexeme

“doublet” has several meanings: 1) a second copy of something, 2) an etymological doublet, 3) a fake gem; *pantalon (m)*: in the 16th century it was “short pants, underpants”, in the 21st century it is “pants”, but not necessarily long, “pants” of classic length.

Manteau (m) – “cloak, cape, raincoat”. The word goes back to the Latin etymon (<*mantellum* – “cloak, cape”; “**mantellum**” – diminutive from “**mantum**” – “mantle”). This lexeme appeared in French in the 12th century and denoted a long cape (both male and female). This lexeme is formed by adding the *-eau* suffix.

In modern French there is a lexeme with the meaning “cape”, but this word now has a different spelling – “mantelet” (m), It is formed by a suffixal way: the stem from “mantel” (Latin – “fabric”) and a diminutive *suffix -el*.

Collet (m) (diminutive from “**col**” – “collar”. The word has Latin origin (“**collum**” – «neck»).

In the 16th and 17th centuries, the word “**collet**” meant “a men's short, sleeveless fitted jacket, fastened around the neck, usually made of light leather.

This element of clothing dates back to the Middle Ages. Back then, men wore a “bull's tunic” - a jacket made of oiled bull or buffalo skin, which was worn for protection.

The lexeme “**collet**” is formed by suffixal way (attachment of *-et* suffix).

At present, the meaning of this word has changed. Now “**collet**” stands for “collar”.

One of the main elements of the women's and men's wardrobe of the 16th century is the “blouse” (“**blouse**” (f)). This word was firmly entrenched in the French language at the end of the 15th century. Initially, the blouse was worn only by representatives of the lower classes, but at the beginning of the 16th century it became an article of clothing for both aristocrats and ordinary people. The 17th century also brought its own changes: the blouse began to be considered exclusively clothing for peasants and workers (until the middle of the 19th century). And only in the XX century, this word began to denote an element of only a woman's wardrobe (“**blouse**” (f) - “women's blouse”). For a man's blouse (shirt) in modern French there is a separate name - “**chemise**” (f).

As for the etymology of this lexeme, the researchers still have not come to a common conclusion. According to the first point of view, “**blouse**” is derived from “bleu” - “blue”. As it has been already mentioned, the blouse has been considered for a long period of time as the clothing of workers. Blue color was the most common color for this type of clothing.

Others researchers associate the etymology of this lexeme with *Pelusia (fr. Péluse; lat. Pelusium)* - the name of the city "exporting indigo" (the place where this dye appeared). Still others believe that the lexeme “**blouse**” originated from the old French “**blidalt**”, meaning one of the types of clothing.

All these mentioned opinions are controversial and contradictory today. As you can see, this part of clothing has a very long and changeable history. The meaning

that the “**blouse**” had during the Renaissance epoch has not survived to the present day.

Doublet (m) – “*dublet*” is a leather shirt with a stand-up collar (until the 15th century; after the 15th century, the collar became optional); in the 15th century, pieces of chain mail began to be hung on it. Sometimes it was made with separate sleeves, which were sewn in the shoulder area. This lexeme appeared in the 12th century, its original meaning was “matter, fabric”. It is a word of Latin origin (<*duplare*). It is generated by changing the word form, i.e. use of specific suffix (adding a diminutive suffix *-et*).

The lexeme “*doublet*” is present in modern French, but now it does not mean clothing.

Each historical epoch has its own, if it is possible to say so, trouser appearance. The Renaissance in France was no exception. In the 16th century, the first trousers appeared, at least there was some sort of clothing, which approximately could resemble the trousers that we know now.

“Culotte” (f) - “*culottes*”. A word is of Latin origin (<*cûlus*), meaning short trousers (till knees). They were worn by aristocrats and ordinary citizens, soldiers and generals. Poor people and sailors wore these pants predominantly. During the French Revolution, aristocrats called poor revolutionaries with the contemptuous nickname “**sans-culottes**”.

Currently, the word “*culottes*” (f.pl) means “men's underwear”. We see a radical change in the meaning of this word.

“Pantalon” (m) - “*cropped pants, underpants*”.

The word comes from the Italian “*pantaleone*”. Pantalone is the main character in the Italian comedy. The comedy is set in Venice, where the indigenous people wear these “**petit pantalon court**” (“little short pants”). These residents were nicknamed “*Pantalonî*”. They got such a nickname precisely because of their love for this kind of pants. In other words, the name of this item of clothing comes from the proper name.

c) words out of use: *pourpoint (m)*, *mi-parti (m)*.

Pourpoint (m) – “under-armor” (French name – “*purpuen*”) is a term used to refer to a type of clothing worn under armor. Already in the 13th century, *purpuen* became a secular outer piece of clothing, and its cut was somehow modified. During the subsequent time, the second half of the 14th, 15th and 16th centuries, a number of new types of *purpuen* appeared, but a characteristic feature of its cut like “a detachable bodice that fits the figure» remained.

During the Renaissance, musketeers dressed in *purpuen*.

However, it is not possible for scientists to determine the origin of this word.

Currently, the term “**pourpoint**” has so-called intermediate position. It is estimated as an archaism, i.e. the word is not a part of the “active vocabulary” of the French language.

Mi-parti (m) (“*behalved*”). The origin of the word is unclear.

This type of clothing was considered as the precursor trousers. It was a pair of stockings, which were pulled alternately on both legs. This explains such an unusual name. They were worn by all men, from the 14th century until the end of the 16th century. There is also a point of view that “**mi-parti**” is the prototype of modern tights.

After the 16th century, this lexeme completely lost its meaning and disappeared from use.

Nowadays there is neither such item of clothing, nor a word for its naming.

d) words that have not retained their meaning: *camisole (f)*: in the 16th century it was «a men’s shirt», in the 21st century it is a piece of women’s underwear “camisole is a short top with straps”.

Camisole (f) – “shirt”. The word has an Italian origin (<*camiciola*, is diminutive from *camicia* – “wide shirt”). In the 16th century the synonym “**chemise**” – “shirt” - appeared (it was often named in the Italian manner - “**chemisole**”).

This word appeared in French in the middle of the 15th century and meant "a spacious man's shirt". Until the 17th century, this meaning was the only one for this lexeme. In the 17th century, its meaning was transformed into "camisole" - men's clothing of knee-length, sewn narrow into the waist, sometimes without sleeves.

In the middle of the 17th century, “camisole” ceased to be the subject of only a man's wardrobe: women began to wear it in combination with a long skirt.

Later, this lexeme began to mean “women's blouse”.

As for the current meaning of the word “camisole”, it is already an element of women's underwear, which means "short top with straps."

The meaning of this word has changed many times over the centuries, which once again proves that the lexical system of the French language is mobile and changeable.

In conclusion, it should be emphasized that language is a very dynamic system. The vocabulary of the French language reflects the social life of a person, his material and spiritual culture, and that’s why lexis is in a state of continuous change.

Evidence of the variability of the linguistic picture of the world can be the fact of expansion and contraction of the meaning of individual lexical units with the meaning of “clothing”. Word formation plays a significant role in vocabulary enrichment. Some changes influence on the meaning of the word (the formation of the new words on the base of the proper names, substantiation, etc.), while other changes affect the form of the word (prefixation, suffixation, etc.).

Also, a special place in the enrichment of vocabulary is given to borrowings. In this article, it was revealed that Latin borrowings dominated in French in the 16th century. Borrowings from other languages are also clearly represented in the vocabulary of the 16th century, but their number is not so great in comparison with

the Latin language. In modern French, borrowings from the English language prevail.

But not every new word that appears in the language is firmly fixed in it. This is exactly what can be observed in the case of French names of men's clothing.

It should be noted that a fairly impressive percentage of words used in the 16th century is still in use today.

References

1. Dal' V.I. Tolkovyj slovar' zhivogo velikoruskogo yazyka. [Explanatory Dictionary of the Living Great Russian Language]. M.: Olma-press, 2005. (Rus)
2. Ermakova L.M. [Fragment of the linguistic picture of the world of French and Russian youth (based on lexical units with the meaning of "clothes", "shoes")]. Fragment yazykovoj kartiny mira francuzskoj i russkoj molodyozhi (na materiale leksicheskikh edinic so znacheniem «odezhda», «obuv'»). Ezhegodnik Centra frankofonii, 2010, vol. 3. (Rus)
3. Popova Z.D., Sternin I.A. Yazyk i nacional'naya kartina mira. [Language and national picture of the world]. Voronezh, 2002. (Rus)
4. Huguet E. L'évolution du sens des mots (depuis le XVI siècle). Librairie Droz – Genève, 1967.
5. Dictionnaire Étymologique de l'Ancien Français: <http://www.lexilogos.com/etymologie.htm>, <http://www.deaf-page.de/fr/>
6. Wiktionnaire – le dictionnaire étymologique libre: https://fr.wiktionary.org/wiki/Wiktionnaire:Page_d'accueil

ЯЗЫКОВЫЕ КАРТИНЫ МИРА ФРАНЦУЗА ЭПОХИ ВОЗРОЖДЕНИЯ И СОВРЕМЕННОГО ФРАНЦУЗА (НА МАТЕРИАЛЕ ЛЕКСИЧЕСКИХ ЕДИНИЦ СО ЗНАЧЕНИЕМ «МУЖСКАЯ ОДЕЖДА»)

А. В. Меньшова, Д. В. Налетова, К. В. Власова

Тамбовский государственный университет им. Г.Р. Державина
e-mail: alyono4ka.menshova@yandex.ru, iskralive@yandex.ru, vkristino4ka@mail.ru

Аннотация. Статья посвящена проблеме языковой картины мира. Понимание языковой картины мира носителей иностранного языка имеет очень важное значение в связи с возросшей необходимостью изучения межкультурной коммуникации в целях изучения культурных различий народов, их мировоззрения и менталитета. Цель настоящей статьи заключается в изучении конкретного фрагмента языковой картины мира француза XVI и XXI веков на примере лексических единиц с общим значением «мужская одежда». Поставленная цель конкретизируется в следующих задачах: исследовать специфику языковой картины мира во Франции XVI и XXI веков; выявить сходства и различия языковой картины мира француза Эпохи Возрождения и современного француза.

Ключевые слова: заимствования, лексема, лексическая система французского языка, словообразование, суффиксация, этимология, языковая картина мира.

How to Write an Abstract to a Scientific Article: Master Students Teaching

T. V. Mordovina

Tambov State Technical University, Tambov, Russia
*e-mail: tvmordovina76@mail.ru

Abstract

The purpose of this study is to analyze the rhetorical structure of an abstract as a part of a scientific article, its lexical and grammatical features that need to be taught to Master students. The study will consider some teaching techniques and classroom activities which can be useful for university English language education. The relevance of the study is that Master students, as junior scientists, need to write and publish their scientific researches in the form of articles. That is why it is so necessary to develop their writing skills conforming to the norms and stereotypes of scientific discourse.

Keywords: abstract, lexical and grammatical features, preparatory exercises, rhetorical structure, teaching techniques.

Introduction

Writing for scientific purposes in a native language is clearly a complex task for a junior scientist without any publishing experience. Writing for scientific purposes in English can be a real challenge for even senior scientists with great publishing experience. It demands a thorough knowledge not only of the subject, a researcher is writing about, but also of the specific rules and stereotypes of research writing shared by the members of the world scientific community. Mastering these norms and conventions, however, is worth efforts and time, for as R. Day wrote: “Scientists become known (or remain unknown) by their publications” [1]. Thus, in terms of professional success, developing effective scientific writing skills of EFL Master students seems quite obvious.

This work analyzes the rhetorical structure of an abstract as a part of a scientific article, its lexical and grammatical features and the tasks based on various teaching techniques to develop scientific writing skills are highlighted.

The rhetorical structure of an abstract to a scientific article

An abstract is a brief overview of the whole paper in which basic ideas developed in research are summarized. Although the abstract is placed at the beginning of the paper, after the title and before the introduction, it should be written last. The abstract helps readers decide whether or not the paper is relevant to their own research interests and therefore worth reading. Hence, it should be clear, concise, specific, objective and complete.

Despite the fact that an abstract is quite brief, it must do almost as much work as the multi-page paper that follows it. This means that it should in most cases include the following sections:

- motivation/background;
- the purpose of the study;
- the procedure/methodology used;
- the main results/findings obtained;
- the conclusions reached/any recommendations if applicable.

Each section is typically a single sentence. But not all abstracts have five parts. Sometimes they are reduced to four, even three parts. The reduction of an abstract may be caused by word limitations established by journal editors. To satisfy the requirements, the authors can 1) eliminate motivation/background information, 2) combine purpose and method of research, 3) exclude conclusions.

However, for beginners it is highly recommended to follow at least four-step structure. Abstracts need to set the problem, but do not need to justify why it is important (the introduction does that). Therefore, we can omit motivation/background information loss-free. As for the part that represents our contribution (conclusion), it should be presented.

Lexical and grammatical features of an abstract to a scientific article

It is necessary to start the description of the lexical and grammatical features of the abstract to scientific article with verb tenses. The use of verb tenses in the abstract depends directly on the type of information presented in it.

- motivation/background – **present simple/ present perfect tense:**

e.g.: *Flow cytometry is a powerful technique for the rapid analysis of single cells in a mixture, by means of light-scattering and fluorescence measurements. Heavy metal pollution has become a more serious environmental problem in the last several decades as a result of its toxicity and insusceptibility to the environment.*

- purpose/ principal activity – **past simple / present perfect tense:**

e.g.: *Wave-like gas-solid flow in a horizontal pipe has been investigated experimentally. The aim of the investigation was to develop a non-intrusive measuring technique for monitoring the transition from a dilute phase flow to wave-like flow and to measure the properties of a wave-like flow.*

- procedure/methodology - **past simple tense:**

e.g.: *Two different heating rates, 0.05 and 1 K/s, were employed to determine kinetic parameters. Dynamic and isothermal pyrolysis tests were carried out on beech and pine wood previously dried in an oven.*

- results/findings – **past simple tense:**

e.g.: *At the lower relative humidity, the elutriation rate constant increased with increasing relative humidity. When the relative humidity increased and reached a certain higher value, the elutriation rate constant decreased with an increase of relative humidity.*

- conclusions – **present simple tense/ modal auxiliaries:**

The results show, that the proposed model for reservoir operation and waste load allocation can reduce the salinity of the allocated water demands as well as the salinity build-up in the reservoir. The system described here could serve as the basis for a study of automatic measurement systems in an instrumentation course. This study may lead to a better understanding of flow behaviour of a developer in developing equipment.

The second important point about the abstract is the use of both active and passive verb forms. But whatever is placed at the beginning of a sentence is given greater prominence and therefore receives greater emphasis. Hence, it is

recommended to use the passive voice when it is more important to emphasize an action (an object/ an event/ a process) than the person doing the action.

And thirdly, the abstract to a scientific article is characterized by the use of certain phrases, expressions and clichés presented in the table below.

Table1. Phrases, expressions and clichés typical for the abstract to a scientific article

The purpose/ aim of this paper. is/ was to investigate/ to propose/ to offer an explanation ...
The aim of this study was ... to explain/ to offer a solution to the problem/ to argue/ to explore ...
The present paper is aimed at ...
The present investigation focuses on/ deals with/ is concerned with/ is devoted to the problems of / considers what factors influence...
Our objective is to explain/ to analyze/ to examine/ to verify/ to describe/ to study/ to show/ to present/ to specify/ to improve our knowledge of ...
Special attention is/ was paid to ...
A quantitative model is presented ...
This article presents a new approach/ proposes a new methodological framework ...
Recent experimental results concerning ... are presented were observed and studied ...
It was found.....
The results of this study suggest/ indicate/ show/ confirm
It is concluded that ...

Teaching writing abstracts to scientific articles assumes the employment of various teaching techniques, such as: *identification, comparison, correlation, transformation, expansion, filling the gaps, reconstruction and completion.*

To develop writing skills conforming to the norms and stereotypes of scientific discourse, the following *preparatory exercises* aimed at analysis and imitation of model papers are suggested:

- identifying information elements to reconstruct an abstract as a section of a paper;
- reconstructing a deliberately deformed rhetorical structure of an abstract;
- logical regrouping of information elements of an abstract;
- using gap-filling exercises to use phrases, expressions and clichés typical for the abstract to a scientific article;
- comparing several examples to show the variation in rhetoric structure of an abstract;
- identifying cohesion means (pronouns, conjunctions, markers, repetitions);
- analyzing grammatical features (tenses, articles, passive constructions);
- identifying key lexical phrases which are representative of the rhetorical structures of an abstract.

Conclusion

In this paper an attempt has been made to clarify the rhetorical structure of an abstract to a scientific article. Much attention was given to identifying its lexical and grammatical features being the most important. Phrases, expressions and

clichés typical for the abstract to a scientific article were proposed. Some teaching techniques and classroom activities were described. These techniques and activities can be useful for university English language teachers who are charged with responsibility of designing specialized courses at Master students' foreign language education level.

References

1. Day R.A., Gastel B. How to write and publish a scientific paper. Westport, Conn.: Greenwood Press, 2006, 302 p.
2. Glasman-Deal H. Science research writing for non-native speakers of English. London: Imperial College Press, 2010, 257p.
3. Korolyova L.Yu. Diskursivnyj podhod k obucheniyu anglijskoj ekonomicheskoj leksike (nauchnaya stat'ya) [The discursive approach to teaching English Business vocabulary]. Voprosy sovremennoj nauki i praktiki. Universitet im. V.I. Vernadskogo, 2016, 1(59), pp. 153-158. (Rus.)
4. Voyakina E.Yu. Osobennosti prepodavaniya professional'noj leksiki budushchim specialistam [Peculiarities of teaching vocabulary for specific purposes to future specialists]. Voprosy sovremennoj nauki i praktiki. Universitet im. V.I. Vernadskogo, 2016, 1(59), pp. 141-146. (Rus.)

КАК НАПИСАТЬ АННОТАЦИЮ К НАУЧНОЙ СТАТЬЕ: ОБУЧЕНИЕ МАГИСТРАНТОВ

Т. В. Мордовина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: tvmordovina76@mail.ru

Аннотация. Целью данного исследования является анализ риторической структуры аннотации, как части научной статьи, её лексических и грамматических особенностей, которым необходимо обучать магистрантов. В исследовании рассматриваются некоторые техники обучения и задания, которые могут быть использованы для обучения английскому языку в университете на этапе магистратуры. Актуальность исследования заключается в том, что магистрантам, как начинающим ученым, необходимо проводить и публиковать свои научные исследования в форме статей. Этим обуславливается необходимость развития их навыков научного письма, в соответствии с нормами и стереотипами научного дискурса.

Ключевые слова: аннотация, лексико-грамматические особенности, подготовительные упражнения, риторическая структура, техники обучения.

Translation Activity in the Context of Vitagenic Learning

O. N. Morozova

Tambov State Technical University, Tambov, Russia
e-mail: morozova-on@mail.ru

Abstract

The article analyzes the vitagenic experience of the interpreter influenced by the implementation of indirect bilingual communication. The process of translation is not only as an elementary change of codes of one language to another, but as a complex type of speech activity, which has its own motive, purpose, and patterns. The author pays special attention to the description of interlanguage transformations specifics that affect the equivalence of translation.

Key words: translation; vitagenic factors; vitagenic experience; communication act; transcoding; analysis and synthesis of statement.

The consolidation of all human sciences, such as sociology, psychology, ethnography, physiology, communication and information theory, led to the conversion of linguistics to speech. New sciences, such as psycholinguistics, sociolinguistics, ethnolinguistics arose on their basis. It became obvious that it was impossible to study speech in isolation from the person speaking as a representative of a certain culture, a certain social group and as an individual with his own subjective traits and his own vitagenic experience. Language is always inseparable from man, who, in its turn, cannot exist separately from his subjective judgments and subjective perceptions.

All people have a "vision" of the world peculiar only to them and reflecting in different ways surrounding reality in the language. The reality of different people, their vitagenicity, does not completely coincide. The national originality of not only formal, but also the semantic structures of various languages explain a certain motive and goal, from the complex interaction of which the text meaning or statement is born in the understanding of the author of the text. Whatever the specific goal, he always seeks to influence the interpreter of the text in one way or another, regulating his behavior in the broadest sense of the word (consciousness, motives, actions, etc.).

In the process of speech synthesis, the thought takes on a concrete form, i.e. the text, as it were, goes from thought to text. When choosing a form, it is necessary to take into account both purely subjective, extralinguistic considerations (goals of a speech act) and objectively existing norms of speech behavior. In addition, some other vitagenic factors also affect the situation of verbal communication.

The interpreter's activity specificity lies in the fact that he goes from text to meaning, analyzes the received text in order to extract meaning from it. At the same time, in the interpreter's speech activity, in his understanding of the text meaning, subjective factors of a vitagenic nature also play a significant role:

background knowledge about the speech subject and the existing vitagenic experience.

The speech situation plays an important role both in the activities of the author of the text and its interpreter. Firstly, the speech situation is important in that it affects in a certain way the formation of the motive and the purpose of its expression, as well as the choice of the form in which the thought is clothed. Secondly, the speech situation essence lies in the fact that he seeks and finds in it additional, vitagenic actualizers of meaning, i.e. the speech situation helps him to interpret the text correctly, sometimes even filling in certain gaps in his linguistic and vitagenic experience. The creation of a text in the target language, carried out by the interpreter, is semantic in nature, since the translator realizes when generating speech not his own, but “someone else's” thought.

An accurate description of the psychological and physiological processes of the utterance analysis and synthesis is a very difficult task, since the work of the brain cannot be directly observed. However, one thing is clear: translation is a complex thought process that cannot be considered in isolation from the whole process of bilingual mediated communication, which begins with the moment the author generates the original utterance in the original language and ends with the moment the recipient perceives the utterance in the target language. In other words, the results of the translator's activity can be assessed only in relation to and interdependence with the speech activity of other two participants in the communicative act.

The problem of translation cannot be reduced only to the technical replacement of a text in one language with a text in another language, i.e. to primitive recoding at the level of language units meaning. In this case, one could consider that the theory of translation is not a science at all and that it is enough to know two languages, “codes” and the rules of linguistic recoding, rules for the transition from one code to another, in order to make a transfer. However, this is not the case, since the rules for transcoding in translation presuppose not only taking into account linguistic meanings, but also their interaction with the vitagenic experience of communicants. The translator not only translates the text of the source language into the target language, but also the value system of one culture into the value system of another culture, taking into account their specific vitagenic experience. Without it this specificity, difficulties in understanding increase significantly, both for linguistic reasons and for reasons of a vitagenic nature. This is especially obvious when translating advertising texts.

For example, Pepsi has literally translated into Chinese the main advertising slogan “Live up! You are in the Pepsi Generation”. For the Chinese, the slogan has acquired an unexpected sound “Pepsi” will make your ancestors rise from the graves”.

In Latin America, ticket sales for American Airlines plummeted dramatically after the genuine leather seats were installed in aircraft, prompting a massive “Fly in Leather!” advertising campaign. Americans understood correctly the call to “fly

in leather”, but for Latin American passengers it literally sounded like an obscene sentence “Fly naked” [1].

In the course of his work, a translator must not only take into account these difficulties, but also be able to overcome them.

The general theory of translation, used for any combination of languages, is designed to reveal the interaction of all the factors characterizing the process of bilingual communication, the universal problems that the interpreter faces, and the ways to overcome them, in other words, to determine the general laws of translation process.

For example, the need to comply with the target language norms has been emphasized long. It is believed that the more persistent the translator's desire to preserve the structure of a foreign language, the worse he will convey the style of the original.

Translation results observations, however valuable these observations may be, are not enough to solve a number of issues related to the translation process as a special kind of human activity. The translation process is an objective reality, so it can be investigated. The fact that in any human activity subjective and objective factors are in close interaction is not an obstacle to the study of this activity objective law. However, the science of translation should not be confused with the science to translate. The science of translation, or what is commonly called the art of translation, is the ability to find the right solutions in translation. In some cases, they can be typical, in others - non-trivial, but they should always be adequate. This skill also depends to a large extent on subjective factors, on the translator's abilities and whether he has his own vitagenic experience. Accordingly, if translation as a process has its own general laws, then these laws can be studied scientifically, that is, by the science of translation.

If the translation transformations of the text in the source language into the text in the target language depended only on the internal laws of each language, then a comparative analysis of two languages, a purely linguistic task, would suffice in order to solve all translation problems. But the equivalent interlanguage transformations that the translator is forced to resort to have specific features that depend not only on linguistic factors and norms of the target language.

Today, the problems of translation theory go beyond the traditionally understood linguistics, which deals with the study of language at the level of the system, the norm of usus.

The question of defining the theory of translation into an independent science of linguistic direction or considering it as a linguistic discipline is of fundamental importance, since in either case the theory of translation has its own subject and object, which do not fully coincide with either modern linguistics or other linguistic disciplines.

References

1 Avsharov A.G. Reklamnyj tekst kak ob'ekt perevoda: jetniceskij i lingvokul'turnyj aspekty // Russkij jazyk i kul'tura v zerkale perevoda. Materialy II mezhdunarodnoj nauchno-prakticheskoj konferencii. M.: Vysshaja shkola perevoda MGU, 2010, pp. 17-22. (Rus)

2 Voyakina E.Yu. Osobennosti prepodavaniya professional'noj leksiki budushchim specialistam [Peculiarities of teaching vocabulary for specific purposes to future specialists]. Voprosy sovremennoj nauki i praktiki. Universitet im. V.I. Vernadskogo, 2016, 1(59), pp. 141-146. (Rus)

ПЕРЕВОД В КОНТЕКСТЕ ВИТАГЕННОГО ОБУЧЕНИЯ

О. Н. Морозова

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: morozova-on@mail.ru

Аннотация. В статье проанализировано влияние витагенного опыта переводчика на осуществление опосредованной двуязычной коммуникации. Перевод рассматривается не только как элементарная смена кодов одного языка на другой, а как сложный вид речевой деятельности, со своими мотивом, целью и закономерностями. Особое внимание уделяется определению специфики межъязыковых трансформаций, влияющих на эквивалентность перевода.

Ключевые слова: перевод; витагенные факторы; витагенный опыт, коммуникативный акт; перекодирование; анализ и синтез высказывания.

The System of Distance Learning at Kazakhstan Universities

D. L. Nurpeissova*, A. D. Damiev

Karaganda technical university, Karaganda, Kazakhstan

*e-mail: Dina_1708@mail.ru

Abstract

The article deals with the basic concepts, models and characteristic features of distance learning. The authors raise the problems associated with the need to concretize the conceptual apparatus, identify the advantages and disadvantages of distance learning. The positions on the inclusion of distance technologies in the educational process and the positions on the full transition to distance learning are reflected.

Keywords: education, distance learning, distance technologies, quality of education, applied bachelor's degree, student, content, educational technologies, limited opportunities, mixed distance educational technologies.

Modern higher education in Kazakhstan today is increasingly paying attention to the possibilities of using various information transfer technologies in the educational process. In this regard, one of the priority areas in the work of universities is the creation and continuous expansion of the system of distance learning for students. The methodology of applying this system in educational institutions of all levels of professional education in Kazakhstan is supported by a number of approved regulatory legal acts and laws.

The article presents an analysis of the differences between distance education and full-time and part-time forms of education. The characteristic features of distance learning of students are analyzed. Today the development of the higher professional education system is largely determined by the evolution of information transfer technologies. The formation of this field of knowledge sets priority courses in the work of universities, one of which is the creation and constant expansion of the system of distance learning for students.

Distance learning is widely used today in all forms of education in universities, and its application is supported by a number of approved regulations and laws of Kazakhstan. It is believed that progress in distance learning may undermine the position of traditional full-time student education. However, distance learning is not capable of completely replacing full-time education today.

Distance learning is understood as a new configuration of education, which exists on a par with full-time and part-time forms.

The main differences between distance education and full-time education are the following:

- the mode of training of students is built according to the place of residence or work;
- the schedule of the educational process changes in accordance with the course of study and can be sufficiently free in open education, or tied to a limited number

of control points (passing exams, online sessions with a teacher), or to group classes, or to laboratory work on equipment, which may even be remote;

- contacts with the teacher are established through telecommunications. The main differences between distance education and distance learning are the following:

- constant contact with the teacher, the ability to quickly discuss emerging issues with him, as a rule, using telecommunications;

- the possibility of organizing discussions, general work on plans during the study of the educational course;

- transfer of theoretical materials to students in the form of printed or electronic textbooks, which allows you to either completely abandon the installation sessions with the arrival at the university, or significantly reduce their number and duration. The distance learning form reflects the general laws of pedagogy, pedagogical psychology, didactics and private methods, which determines the presence of all components (goals, objectives, content, methods, organizational forms, teaching tools), but they are implemented by specific means of Internet technologies that differ from traditional teaching tools.

In accordance with the regulatory documents, the main distance education technologies are: case technology, Internet technology, telecommunications technology, while a combination of the main types of technologies is allowed.

Some authors point to the prospects of using the project method, role-playing and business games, situational analysis, and differentiation of learning based on hypertext technologies as pedagogical technologies of distance learning.

The characteristic features of distance learning can be called:

- flexibility- students work with the educational material at a comfortable time, in a convenient place, at an independently determined pace;

- modularity -any modular course forms a holistic concept of a specific subject area, which allows you to create a curriculum that meets the needs of a particular student from a set of independent courses-modules;

- financial efficiency: the conditional low initial cost of training is guaranteed due to the orientation of distance learning technologies to a large number of students, as well as due to the most effective use of training areas and technical means, for example, on weekends and holidays;

- a new role as a teacher-he/she acts as a tutor. It is assigned such functions as coordinating the cognitive process, correcting the course taught. It builds a personal educational trajectory for students, assists in the performance of various types of certification works, and contributes to the solution of academic and personal problems related to learning. For the educational process with the introduction of distance learning technologies, asynchronous interaction of its participants is characteristic - specialized quality control of education: remotely organized exams, interviews, project work, and computer testing systems are used as forms of control;

- introduction of specialized technologies and learning tools: under the technology of distance learning, we will understand a set of methods, forms and means of interaction with the listener in the process of independent, but controlled development of a certain set of knowledge;

- reliance on modern means of broadcasting educational information. In the correspondence form of education, electronic distance learning technologies are used, which makes it possible to increase the availability and quality of students' education. The organization of the educational process at the faculty today has the following simplified structure:

- by e-mail to students will be sent detailed training program, a list of recommended books and information about the teachers, guiding their learning, it is an electronic educational-methodical complex (the curriculum, the schedule of educational process, work programs of disciplines, electronic textbooks on training courses, e-workshops, problem books, manuals, assignments, to laboratory, to tests, papers and projects, test materials for quality control of learning material, guidelines for the study of the discipline and the organization of control and monitoring);

- the possibility of using additional literature and other electronic materials that can be placed on the server, with remote access, is agreed upon;

- weekly: sending out materials, including the presentation of the material, topics, recommendations for working with literature, questions and exercises for self-testing, answers to students' questions, control questions, answers to which must be sent to the teacher, analysis of answers to questions from the last lesson;

-receiving materials by e-mail if you have your own access to the network or printing them out at the access point to the network, as well as issuing them to students, independent work on a given topic, preparing and sending e-mail answers to the teacher's questions, as well as your own questions that require the teacher's help;

- in the course of training, several milestone tests are performed, which are then sent to the teachers for verification.

Thus, the use of distance learning technologies is a priority course in the work of universities and opens up new aspects of the use of pedagogical technologies.

References

1. Rules of the organization of the educational process on remote educational technologies. Order of the Minister of Education and Science of the Republic of Kazakhstan dated June 5, 2019, No. 259.

2. Voznesenskaya E.V. Distancionnoe obuchenie – Istoriya razvitiya i sovremennye tendencii v obrazovatel'nom prostranstve [Distance learning – the history of development and modern trends in the educational space]. Nauka i shkola, 2017, no. 1, pp. 115-124. (Rus)

3. Shabanov A.G. Distance learning in the conditions of continuous education: problems and prospects of development [Distancionnoe obuchenie v usloviyah nepreryvnogo obrazovaniya: problemy i perspektivy razvitiya]. Moscow, 2009, 284 p. (Rus)

4. Omarova S.K. Modern trends in education in the era of digitalization [Sovremennye tendencii v obrazovanii v epohu cifrovizacii]. Pedagogy. Questions of theory and practice, 2018,

1(9), pp. 79-82. (Rus)

5. ST RK 34.017-2005. Information technologies. Electronic edition. Electronic educational publication.

6. Korolyova L.Yu., Voyakina E.Yu. ESP teaching strategies based on language learners' beliefs. *Yazyk i kultura*, 2015. Issue 2 (30). Pp. 146-162.

7. Mordovina T.V., Voyakina E.Yu. To the problem of the discourse competence formation. *Prepodavanie anglijskogo yazyka v professional'nom kontekste: soedinyaem kul'tury cherez granicy: materialy 4 Mezhdunar. nauch.-prakt. konf. 2019*. Pp. 38-44.

8. Voyakina E.Yu., Korolyova L.Yu., Gunina N.A. Developing law students' communicative competence: the ESP perspective (in English). *Voprosy sovremennoj nauki i praktiki. Universitet im. V.I. Vernadskogo*, 2020, 3(77), pp. 137-147.

СИСТЕМА ДИСТАНЦИОННОГО ОБУЧЕНИЯ В ВУЗАХ КАЗАХСТАНА

Д. Л. Нурпеисова*, А. Д. Дамиев

Карагандинский технический университет, Караганда, Казахстан

*e-mail: Dina_1708@mail.ru

Аннотация. В статье рассматриваются основные понятия, модели и характерные особенности дистанционного обучения. Авторы поднимают проблемы, связанные с необходимостью конкретизировать понятийный аппарат, выявляют достоинства и недостатки дистанционного обучения. Отражены позиции по включению дистанционных технологий в образовательный процесс и позиции по полному переходу на дистанционное обучение.

Ключевые слова: образование, дистанционное обучение, дистанционные технологии, качество образования, прикладной бакалавриат, студент, содержание, образовательные технологии, ограниченные возможности, смешанные дистанционные образовательные технологии.

Allusion Techniques in the Modern Socio-Political Discourse

E. Yu. Voyakina

Tambov State Technical University, Tambov, Russia

e-mail: voyackina.elena@yandex.ru

Abstract

The paper deals with the allusion phenomenon as an element of intertextuality in the socio-political discourse. The discourse concept is analyzed. The main aspects of the socio-political discourse are mentioned. The most wide-spread sources for allusion in the socio-political discourse highlighting all spheres of activity (economy, culture, politics, health, etc.) are presented.

Keywords: allusion, headline, intertextuality, socio-political discourse.

In the age of communication and information technologies discourse plays a very important role in the intercultural space and human life being not only a means of communication, but also a way of life. The socio-political discourse describing the processes, characters and realities of the modern socio-political reality is constantly updated reflecting the latest trends. Therefore, the texts appearing on the pages of newspapers, magazines, as well as in radio broadcasts and on television, are a source for analyzing the ongoing linguistic changes and the changing picture of the world.

The concept of socio-political discourse, as well as the term “discourse” itself, remains the subject of discussion for a wide range of researchers. The emergence of the discourse concept is associated with the name of Z. Harris, an American structuralist who introduced this term in 1952 [4]. Modern discourse research is carried out in an integrated manner drawing on data from related science areas (Chernyavskaya, 1999; Galperin, 1981; Karasik, 2004; Moskvina, 2005; etc.).

Speaking about the socio-political discourse in relation to the modern society, it is represented as one of the institutional discourse types. The specificity of the socio-political discourse is manifested in integration with other types of discourses in the modern world. This type of discourse has a number of aspects that define it:

1) a functional aspect that performs an informative function and participates in the formation of public opinion;

2) the reference aspect suggesting that socio-political texts are intended for the general public and cover various areas of activity (economics, politics, health care);

3) the communicative aspect that distinguishes professionally oriented texts;

4) the linguistic aspect that includes concepts such as ways of presentation, brevity and expressiveness, basic knowledge;

5) the pragmatic aspect that covers assessment, focus, visual campaigning and advocacy.

The socio-political discourse can be presented in various genres, both written (political reviews, articles) and oral (interviews, negotiations, etc.). This paper is devoted to written (printed or electronic) popular science articles on socio-political issues.

The modern socio-political discourse is the process of creating texts in conjunction with socio-cultural, psychological and pragmatic factors, purposeful social action, including the interaction of people and the cognitive mechanisms of their consciousness. A feature of socio-political discourse at the present stage is its mediation by the mass media. The material of this study is texts of an economic nature, not of a media, but of a popular science style, in which the characteristics of economic events and phenomena are given by people with special education and training (analysts, economists, scientists).

In the analyzed British and American publicistic socio-political texts, allusions were encountered primarily in the headlines of newspaper articles in order to attract the reader's attention. The main communicative intentions of this discourse type are informational and persuasive which are evident in the headlines. Whereas the headline (article title) is part (sub-style) of newspaper functional style, therefore it is part of the newspaper discourse. V.E. Chernyavskaya confirms this point of view highlighting four obligatory structural and compositional components in the structure of the newspaper text: title, introduction, main part and conclusion [1, p. 42].

The first two components (title and introduction) carry the most important communication load. Due to their close logical and semantic connection, the title and the introductory part can be considered as a single introductory unit that attracts the greatest attention of readers [10]. They are helped by the variety of stylistic, intertextual elements used by the authors.

Intertextuality and its features

Due to intertextuality, different texts can interact and be correlated with each other; there is a network of mutual references between them. Intertextual elements are those elements that can be placed in intertextual theory. There are a lot of interpretations of the term “intertextuality”, but at its core intertextuality is “the absorption or transformation of another text” [1, p. 26], and this is connected either with a mixture of statements and texts, or with the derivation of one text from another.

V.P. Moskvina trying to isolate the term “intertextuality” writes that “many authors understand intertextuality as a literary device, as a path or stylistic figure, a method of constructing a literary text; however, intertextuality is not a device, and the associative basis for the methods of application citation, allusion, paraphrasing and other forms of intertext, which do not always become ambiguous, and, therefore, none of the interpretations are incompatible” [8, p. 54].

Allusion as an element of intertextuality

There are various forms and methods of including intertextual elements in journalistic and literary contexts. Allusion as an element of intertextuality is

understood as one of the most frequently used intertextual elements. This interpretation leads to unwanted encounters of allusions to metaphor, allegory, trope, paronomasia, pun, alliteration. Many Russian linguists regard allusion as a stylistic figure that contains either a quote or a reference to a literary, historical, mythological, religious or political situation, fact, or personality, recorded in written sources or in colloquial speech.

According to B.M. Gasparov, allusion borrows only certain elements of the preposition, and the entire preposition or line preposition is correlated with the new text present in the latter implicit [3, p. 39]. Thus, in order to understand the allusive text, the recipient must have some basic knowledge. The background knowledge of the addressee should include knowledge about the main signs of allusion; otherwise, it will not be able to achieve adequate decoding.

Allusion as an example of intertextuality in journalistic socio-political texts refers to some other texts, events, characters, etc. Allusion is hidden information that is based on the ability of language units to generate associative and connotative meanings. The allusion technique lies in its identification and interpretation. The concept of allusion facilitates its relevance and structure which consists of representatives and transformants. In socio-political texts there are allusions hinting at biblical, literary, historical and other events, characters, etc. The assessment of the situation, the opinion and views of the author are expressed through the allusion.

The allusion in this kind of texts is also used to attract the attention of the reader. Failure to understand the allusion is a loss of meaning, but in fact it does not significantly affect the clarity of the text. On the one hand, such texts may seem incoherent, since the coherence of the text can be disrupted due to the entry into its cognitive structure of alien elements belonging to a completely different field of knowledge and, at first sight, unrelated to the immediate subject matter of the text. The recipient facing with such a text must activate in his memory another mental sphere, from which the alien element originates, in order to adequately perceive and decipher the text. On the other hand, such texts have more pragmatic power, influencing the recipient.

The most wide-spread sources for allusion come from the Bible, myths, literature, historical events, popular songs, films, advertising, works of art, etc. Here are some literary allusions in the headlines and texts of newspapers and magazines:

A Man Without a Mask (The Guardian, 2006, No. 5): an allusion to the name of the famous novel by A. Dumas “The Man in the Iron Mask”;

Around the World in 80 Tastes (The Times, 2006, No. 23): a hint of “Around the World in 80 Days” by Jules Verne;

Robinhood Founder Wants to Trade Shares for Free (Businessweek, 2016-06-04): a transformed allusion to Robin Hood, the legendary hero of English folklore.

But the leader, and this is quite clear, remains the works of William Shakespeare, especially his most staged tragedy of Hamlet: *To cure or not to cure*

(The Sunday Telegraph, 2003, No. 12); *To test or not to test COVID-19: that's the question?* (Forbes, 2020-05-05); and many others.

Quite often, biblical and mythological allusions can be found in headlines and articles: *The Fed we trust* (The Times, 2004, No. 3) can be compared to “the God we trust”;

China is the promised land for South African winemakers (Reuters - Life, 2016-05-25): South African wine technology is being sold to China as something valuable and promised, as the land of Israel was promised by God to Abraham, Isaac and Jacob.

In addition, in newspapers and magazines, journalists can use many references to various phenomena in the cultural sphere (historical events, famous people, musical works, films, etc.): *We Will Shock You* (The Daily Telegraph, 2013, No. 21) is the title of a famous song that we will show you by the British rock band Queen underlined by barbarism.

In the headline “*China at Risk – China's Great Wall of Self-Isolation*” (Businessweek, 2016-06-04) the authors refer to the name of the world’s famous Chinese landmark – the Great Wall, which was built to protect China from anomalies, while in the article the US Secretary of Defense Ash Carter comments on China's actions at the global defense forum in Singapore.

Empirical analysis of newspaper and magazine article headlines from both American and British sources shows that about 30% of them contain biblical, mythological, literary or historical allusions. Most often, authors resort to allusions in the headlines concerning socio-political, economic or cultural life aspects. In addition, it should be noted that pure allusion, direct quotation is rarely used. Often, authors resort to various lexical and grammatical transformations necessary for a more vivid presentation of the article in the header. The frequency of using allusions in the headlines of articles on cultural, political and economic topics is higher than in the headings of articles on sports. The use of the names of characters and famous people as an allusion is common in nature, as it is better perceived by different kinds of readers. Allusions to biblical stories and events can indeed be intended for a limited number of educated people.

In conclusion, being a striking element of intertextuality, allusion has different sources highlighting all spheres of activity (economy, culture, politics, health, etc.). Allusion can be found in short news, news articles, editorials, analytical articles, commentaries, obituaries and perform a number of functions, including the formation of public opinion. Linguistically, it can be of different types. The signs of allusions mentioned above have their manifestations in linguodidactics or methods of teaching English and the formation of skills of all types of speech activity (reading, listening, speaking and writing).

References

1. Chernyavskaya V.E. Intertekstual'noe vzaimodejstvie kak osnova nauchnoj kommunikacii [Intertextual interaction as a basis of scientific communication]. St. Petersburg, 1999. (Rus)

2. Galperin I.R. Stilistika anglijskogo yazyka [Stylistics of the English language]. Moscow, 1981. (Rus)
3. Gasparov B.M. Yazyk, pamyat', obraz: lingvistika sushchestvovaniya yazyka [Language, memory, image: linguistics of language existence]. M.: New literary review, 1996. (Rus)
4. Harris Z. Discourse analysis. Language, 1952.
5. Karasik V.I. Yazykovej krug: lichnost', koncepty, diskurs [Yazykovej krug: lichnost', koncepty, diskurs]. M.: Gnozis, 2004, 390 p. (Rus)
6. Korolyova L.Yu., Mordovina T.V. Comparative analysis of word-formation models in Russian and American political slang. Research Result. Theoretical and Applied Linguistics, 2020, 6(1), pp. 73-83.
7. Morozova O.N., Kazhanova Z.N. Lingvisticheskie i ekstralingvisticheskie aspekty perevoda [Linguistic and extralinguistic aspects of translation]. Filologicheskie nauki. Voprosy teorii i praktiki, 3(45), P. III. Tambov, Gpamota, 2015, pp. 129-132. (Rus)
8. Moskvina V.P. Stilistika russkogo yazyka [Stylistics of the Russian language]. Volgograd: Peremena, 2005, 149 p. (Rus)
9. Nikul'shina N.L., Gunina N.A. Obuchenie leksicheskomu aspektu professional'nogo obshcheniya v ekonomicheskom kontekste [Training lexical aspects of professional communication in an economic context]. Vestnik TSTU, 2013, 19 (3), pp. 724-727. (Rus)
10. Ter-Minasova S.G. Yazyk i mezhkul'turnaya kommunikaciya [Language and intercultural communication]. Slovo, 2000, pp. 371-375. (Rus)

ПРИЕМЫ АЛЛЮЗИИ В СОВРЕМЕННОМ ОБЩЕСТВЕННО-ПОЛИТИЧЕСКОМ ДИСКУРСЕ

Е. Ю. Воякина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: voyackina.elena@yandex.ru

Аннотация. В статье рассматривается феномен аллюзии как элемент интертекстуальности в общественно-политическом дискурсе. Анализируется концепт дискурса. Отмечены основные аспекты социально-политического дискурса. Представлены наиболее распространенные источники аллюзии в социально-политическом дискурсе, освещающие все сферы деятельности (экономика, культура, политика, здравоохранение и др.).

Ключевые слова: аллюзия, заголовок, интертекстуальность, социально-политический дискурс.

Non-Verbal Aspects of Cross-Cultural Communication

E. Yu. Voyakina*, I. E. Ilyina

Tambov State Technical University, Tambov, Russia

*e-mail: voyackina.elena@yandex.ru

Abstract

The article analyzes non-verbal aspects of cross-cultural communication and their hierarchical structure. The main factors of communication characterizing the representatives of various linguistic and cultural communities are described. Non-verbal means of communication are considered from an ethnocultural point of view. The socially-determined nature of non-verbal communication and the norms of social interaction are taken into account. The conclusion about the close interconnection of non-verbal aspects in the framework of cross-cultural communication is drawn.

Keywords: kinesics, communicative situation, communicative failure, intercultural communication, non-verbal communication, non-verbal component, socio-cultural component.

The communicative nature of speech activity predetermines its bilateral character. Human speech activity is designed to transfer some specific amount of information to another person who is supposed to respond by receiving this information. Thus, a mutual speech process arises where co-operation, assistance and complicity are viewed as important components.

Speech communication involves a complex set of personal funds, including non-linguistic funds, which plays an important role in the communication process. Being historically the first form of human communication, non-verbal communication is a type of interaction between people without verbal means which allows not only to diversify and complement verbal communication, but also to replace it in some situations. The necessary information can be obtained not only through linguistic, i.e. verbal, means of communication, but also using non-verbal tools which sometimes become the only possible means of communication.

Non-verbal communication is determined by the social norms of society. Excessive and friendly gestures are unlikely to be appropriate in the official circumstances; rather, communicants will use special non-verbal means. And only thanks to involuntary gestures we can determine the real intention of the sender and the recipient, as well as their true emotional state.

The study of cultural aspects, various forms of verbal and non-verbal communication methods contributes to the optimal communication process. Communication is an integral part of any person, therefore the verbal interaction is the most important factor in the process of successful socialization. However, communication presupposes knowledge of a particular culture which includes not only verbal, but also non-verbal means.

Nowadays non-verbal communication has become the subject of research in both traditional and developing linguistic areas such as semiotics, pragmalinguistics, sociolinguistics, psycholinguistics, etc. In modern linguistics the trend towards the study of the correlation between the language and the kinetic phenomena that accompany speech is increasing. Therefore, the study of non-verbal means of communication, which refers to kinesics, i.e. the science of gestures, gesture movements and gesture systems, has been put into the spotlight of linguists. To identify any completed (having a certain structure, method of execution and sustainable value) and independent gesture movement we will refer to the term “kinema” given by E.M. Vereshchagin and V.G. Kostomarov [11].

Clarifying the relationship between personality and culture, “it is impossible to understand the formation of the individual in isolation from the culture of the social community. A desire to understand the inner world of a Russian or an Englishman, a Pole or a Frenchman, one should study Russian or English, Polish, French culture, respectively” [11].

The sociocultural component of foreign language teaching on the basis of which knowledge about the realities, customs, traditions of the country, as well as knowledge and skills of communicative behavior in acts of verbal communication and the skills of verbal and non-verbal behavior are included in the content of the national culture. Speaking of national culture, the communicative behavior of native speakers is distinguished between verbal and non-verbal behavior.

The set of norms and traditions in communication reflecting the recommended rules of communication that have developed in society due to historical traditions, rituals, social situations, including facial expressions, gestures, postures of communicating, is called a non-verbal component of behavior.

The structure of the non-verbal component is represented in the aggregate of three plans that make up its hierarchy: the expression plan (exponential plan), the translation plan, and the content plan (intensive plan) [1].

The expression plan for the non-verbal component is represented by various non-verbal means of manifesting the meanings of the intersubjective interaction. These include: phonation, kinesics, proxemics (along with tactile communication), postures, etc.

Kinesics consists of facial expressions, mimics, gestures, postures, visual communication (eye movements, glances). According to J. Rösch and V. Kes, gestures are used to illustrate, underline, indicate, explain or interrupt, which means that they cannot be isolated from verbal communication. Gestures are determined by the structure of the human body, but they are developed and concretized in interpersonal and social relations. On the one hand, expressions of surprise, despair, anger, anxiety, pleasure and contempt are approximately the same in all countries and in all cultures. On the other hand, an understanding of their meaning depends on acquaintance with the communicative system of this particular culture [8].

The most revealing cases are when people who speak different languages resort to the help of kinesics. Gestures at the same time become the only possible means of communication performing a purely communication function. In addition, gestures are often used when verbal expressions would be considered socially unacceptable.

In the process of communication, the important information is viewed as *positonic activity*. The psychodynamic characteristics and personal characteristics of a man are clearly manifested in the specificity of poses as well as in the dynamics of their changes. Cognitive tonic expressions of the personality character serve as the visible language through which nonverbal dialogue takes place.

Visual communication deserves special attention in this regard as it “often performs a contact-regulatory function” [2]. A look accompanied by a gesture or a nod of the head can mean a change in communicative roles in the dialogue.

Proxemics defined as the distance between communicants for various types of communication often includes tactile communication (touching, patting the addressee on the shoulder, etc.). Proxemic means perform a variety of communicative functions. The body position of the addressee is determined by the relation to the addressee, the social status of the addressee, the gender of the addressee, etc.

Some scholars refer non-verbal means of communication to *the power and action components of communication* [2, 6, 9]. The action components are the actions of the communicants that accompany the speech. For example, in response to the addressee’s request to do something, the addressee can perform the required action (e.g., turn off the light). Non-verbal actions can alternate with verbal actions in the process of communication. However, the nature of such non-verbal actions is purely practical.

Inherently non-verbal components are the image, cultural phenomena, etiquette formulas, etc., as well as the objective or situational world [3]. But, nevertheless, phonation, kinesics and proxemics are of the greatest importance, since these non-verbal components are “most closely connected with the communicants themselves” [3: 5].

The content plan of non-verbal components is represented by its communicative-functional (pragmasemantic) structure [2]. It is comparable with the plan of the content of the statement [7: 8-11] and discovers all the basic components of the semantic and communicative-pragmatic structure.

The translation plan allows the cocommunicants to encode and decode the meanings of non-verbal actions. This plan is composed of numerous ethnic and social factors that determine the communicative situation. With the help of these factors, it is possible to adequately determine the meaning of nodding from the Russians and Bulgarians or giving honor at a military school.

Nonverbal means have ethnocultural specifics which can be one of the serious obstacles in communication between multilingual and multicultural communicants [5].

According to A.A. Leont'ev, the difference in the organization, functions and methods of mediating communication processes is inherent in representatives of different linguistic and cultural communities and depend on the following factors:

- factors related to cultural tradition;
- factors related to the social situation and social functions of communication;
- factors related to ethnopsychology in the narrow sense, i.e. with the features of the course and mediation of various mental processes and activities;
- factors associated with the presence in the thesaurus of a given community of certain special reactions, concepts, etc., i.e. with specifics of denotation;
- factors determined by the specifics of the language of a given community [3].

Non-verbal communication is determined by the social norms of society. Excessive and friendly gestures are unlikely to be appropriate in the official circumstances; rather, communicants will use special non-verbal means. And only thanks to involuntary gestures we can determine the real intention of the sender and the recipient, as well as their true emotional state.

Freedom of choice of verbal and non-verbal means and their language equivalents is to some extent limited, although it is not always amenable to sufficiently clear regulation. The choice of certain linguistic or non-linguistic resources is determined by many factors, including social aspects, sometimes reinforcing each other and sometimes acting in the opposite direction. The dominant function in the speech behavior is played by the social roles of communicants. A group of components falling into the general category of “participant in a communicative act”, i.e. sender, recipient, addresser, addressee, audience, is identified. Non-verbal means and their language manifestation may indicate the social status of the communicant:

They shook hands with fashionable low swoop [Fitzgerald].

Shaking hands with a low grip was fashionable among students at Princeton University in the early twentieth century. Therefore, this kinema verbalized by the expression “to shake hands” and the definition “with fashionable low swoop” indicates the social status of the participants in the dialogical discourse and the duration of the action [4: 91].

The presence of an association with a certain social stereotype, which is established due to non-verbal means of communication and in written speech due to the language manifestation of non-verbal behavior, is noted, e.g. the military have a special dressing and gait like raising their legs high when walking while sailors waddle, etc.

The norms of interaction also have a socially-determined character. This includes all the specific behaviors that accompany speech, e.g. a speech utterance in a given situation cannot be interrupted and communicants resort to non-verbal means of communication or, on the contrary, we can interrupt as much as we like to speak only in a whisper (e.g. during the church ceremony).

Some of the listed speech components are somewhat heterogeneous: there are components that are social in nature (e.g. participants in a speech act and the relationship between them) and components that acquire social significance only in the context of such social determinants of speech behavior as a social situation, social status, circumstances, role relationships, etc. The importance of all these speech aspects in the analysis of the social determination of verbal and non-verbal behavior seems doubtless.

A number of gestures coincide in different cultures. This includes various components of the main typical communicative situations such as: greeting, meeting, farewell, surprise, gratitude, joy, sadness, etc. For example, when greeting, people usually shake hands in both Russia and Germany.

Some gestures do not match in execution with the same meanings. So, the German gesture “threaten someone with a finger” has a discrepancy with the Russian gesture: the hand is bent at the elbow, the palm is turned toward the addressee, the index finger is extended, the rest are bent, the hand makes short jerky movements from left to right, while in the Russian version the palm is turned edge to to the addressee and the hand moves back and forth.

Some gestures with the same execution do not coincide in the meanings. The German gesture of “clicking fingers” is associated with attracting attention which is sometimes used at school by students in order to attract the attention of a teacher. In the Russian tradition this gesture has the meaning of annoyance, error or difficulty in finding the right word or answer.

Some gestures may differ in different cultures, ignorance of which can lead to communicative failure. All non-verbal means of communication from the ethnocultural point of view was divided N.G. Bazhenova into four groups:

- non-verbal means coinciding or similar in execution, sphere of use and transmission of the meaning;
- non-verbal means coinciding or similar in execution, but detecting a discrepancy in their meanings and sphere of use;
- nonverbal means coinciding in meaning and scope, but different in performance;
- non-verbal agents specific for this culture [2].

Ethnocultural features of non-verbal communication affect the communication process. There are a number of kinemas that have a fixed socio-cultural significance and are characteristic of a particular ethnic system of non-verbal means. It is precisely this kind of non-verbal means that are used in dialogical discourse to emphasize the nationality of the communicants.

Non-verbal manifestations of some emotional state can also have both general elements similar to different cultures and a special character. Tears are an almost universal sign of sadness, however, cultural norms pay attention to these forms of reactions determining when, how and for how long you should cry. Laughter is a fairly common sign of joy and satisfaction. However, contempt and a mocking attitude are often also expressed with the help of laughter.

Everything related to relations between people, as a rule, presupposes clear norms that are binding on all members of a given culture, therefore emotions directed at others to a greater extent than self-centered emotions are influenced by culture. Emotions directed at others are characterized by more significant intercultural differences. Self-centered emotions, as they serve as a means of transmitting information about personal relationships, are also subject to the regulatory influence of culture. Thus, the usual reaction in a state of sadness is crying, but special rules establish under what circumstances, to what extent and for how long a person can cry.

Adequate knowledge of non-verbal language includes not only the ability to use its gestures as elements of a non-verbal semiotic code, but also knowledge of the language manifestations of each of the gestures. A good command of the natural language as one of the components implies not only the ability to use language nominations as elements of a verbal semiotic code, but also the ability to recognize the gestures behind them by language manifestations.

When considering semantic substantial types of non-verbal means of communication, it becomes obvious that they always mean something correlating with some referent of the objective or potential world and attributing certain properties to it. Non-verbal means of communication localize the act of communication providing the orientation function of the interlocutors with respect to the communicative situation (deictic component), define various ways of their own implementation as a contribution to the cooperation of communication participants (cooperative component), express certain emotional relations of communicants to the depicted state of affairs and its assessment (expressively evaluation component), and help determine the focus of the statement (focal component).

The structure of the non-verbal component consists of three plans: exponential, translational and contensive, which lie at the heart of the means of the language manifestation of gestures and can be presented either from three sides at the same time, or from any one. The means of non-verbal communication hide a large amount of information, including the deep cultural layer which reflects the speaker's mentality and the intellectual operations performed by him.

Thus, a good command of the natural language implies not only the ability to use language nominations as elements of a verbal semiotic code, but also the ability to recognize the gestures behind them by language manifestations. The conducted analysis allowed us to state that even generally recognized gestures can easily change their meaning or acquire additional meanings. In this regard it is also important to note that different gestures can be compatible, e.g. the use of concomitant gestures, which can significantly affect the whole communication process.

References

1. Aristov S.A. Neverbal'nye komponenty kommunikacii [Nonverbal communication components]. Tver': TGU, 1998. (Rus)
2. Bazhenova N.G. Neverbal'noe obshchenie v obuchenii francuzskomu yazyku [Non-verbal communication in teaching French]. Inostrannye yazyki v shkole, 1998, No. 3, pp. 8-11. (Rus)
3. Bogdanov V.V. Rechevoe obshchenie: pragmaticheskij i semanticheskij aspekty [Speech communication: pragmatic and semantic aspects]. L., 1990, 88 p. (Rus)
4. Bruneau T.J. Communicative silences: Forms and functions. The Journal of Communication, 1973, No. 23, pp. 41-53.
5. Gunina N.A. Ispol'zovanie pragmaticheskikh tekstov dlya razvitiya navykov professional'nogo obshcheniya na inostrannom yazyke v vuze [Pragmatic Texts for the development of communication skills in a foreign language in non-linguistic university]. Problemy lingvistiki i lingvodidaktiki v neyazykovom vuze. Sbornik tezisov Rossijsko-kitajskoj nauchno-metodicheskoy konferencii. M.: Izd-vo MGTU im. N.E. Baumana, 2017, pp.184-186. (Rus)
6. Korolyova L.Yu. Diskursivnyj podhod k formirovaniyu slovoobrazovatel'noj kompetentsii [The discursive approach to word-formation competence development]. Voprosy sovremennoj nauki i praktiki. Universitet im. V.I. Vernadskogo, 2018, 3(69), pp. 114-120. (Rus)
7. Nikul'shina N.L., Mordovina T.V. Aspekty obuchenija inojazychnoj nauchnoj pis'mennoj rechi v vysshej shkole. Monografija. [Aspects of teaching foreign language scientific writing in higher education. Monograph]. Tambov: Izd-vo FGBOU VPO «TGTU», 2014, 160 p. (Rus)
8. Pohepcov G.G. Molchanie kak znak [Silence as a sign]. Analiz yazykovyh sistem: Istorija logiki i metodologii nauki. Kiev, 1986, pp. 78-83. (Rus)
9. Saville-Troike M. The place of silence in an integrated theory of communication. Perspectives on Silence. Univ. of Illinois, 1985, pp. 125-141.
10. Susov I.P. Pragmaticheskie struktury vyskazyvaniya [Pragmatic utterance structures]. Yazykovo obshchenie i ego edinicy. Kalinin, 1986, pp. 7-11. (Rus)
11. Vereshchagin E.M., Kostomarov V.G. Yazyk i kul'tura: Lingvostranovedenie v prepodavanii russkogo yazyka kak inostrannogo. Metodicheskoe rukovodstvo [Language and culture: Linguistic and regional studies in teaching Russian as a foreign language. Methodical guide]. M.: Russkij yazyk, 1983. (Rus)

НЕВЕРБАЛЬНЫЕ АСПЕКТЫ МЕЖКУЛЬТУРНОЙ КОММУНИКАЦИИ

Воякина Е. Ю.*, Ильина И. Е.

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: vojackina.elena@yandex.ru

Аннотация. В статье анализируются невербальные аспекты межкультурной коммуникации и их иерархическая структура. Описываются основные факторы коммуникации, присущие представителям различных лингвокультурных сообществ. Рассматриваются невербальные средства коммуникации с этнокультурной точки зрения, а также социально-нормативный характер невербального общения и нормы социального взаимодействия. Делается вывод о тесной взаимосвязи невербальных аспектов в рамках межкультурной коммуникации.

Ключевые слова: кинесика, коммуникативная ситуация, коммуникативная неудача, межкультурная коммуникация, невербальное общение, невербальный компонент, социокультурный компонент.

La Sociolinguistique Comme Méthode Efficace De Recherche Sur La Publicité Virale

I. A. Yurina

Université technique d'état de Tambov, Tambov, Russie

*e-mail: irina.yurina68@gmail.com

Résumé

L'étude est réalisée dans le courant de la sociolinguistique et de la linguistique cognitive. L'objectif est d'identifier et d'analyser la spécificité du concept de «publicité virale» à l'aide d'une méthode de questionnaire sociolinguistique, en comparant la perception de ce concept par deux groupes de répondants différents. Cette méthode semble pertinente pour acquérir des connaissances sur la langue et, en particulier, sur la perception linguistique de la publicité virale en traitant diverses questions et tâches avec les locuteurs natifs eux-mêmes. Dans le contexte de l'étude de la promotion de la publicité virale, les hashtags sont l'un des sujets de recherche les plus importants. Un certain nombre de contradictions ont été identifiées dans la perception de la publicité virale et dans l'utilisation des hashtags par divers groupes de répondants, ce qui fournit un matériel important pour d'autres études sociolinguistiques.

Mots - clés: publicité virale; sociolinguistique; concept; questionnaire; analyse de contenu, hashtag.

Le développement actif des technologies numériques entraîne actuellement une croissance constante de la part de la publicité sur Internet sur le marché de la publicité russe et mondiale. Selon les résultats des trois trimestres de l'année 2020 en Russie, la part de la publicité sur Internet est stable au premier rang, dépassant la télévision, la radio, la publicité imprimée et extérieure [1]. Étant donné que cette tendance se poursuit depuis quelques années, des études sur les différents types et aspects de la publicité sur Internet semblent pertinentes. L'un des outils publicitaires les plus prometteurs en termes de marketing efficace est la publicité virale. L'étude de ses caractéristiques linguocognitives, à notre avis, a une grande valeur pratique pour améliorer l'efficacité d'une telle publicité.

Le terme "publicité virale" est interprété comme une technologie de communication utilisant une forme particulière d'exposition, modélisée de manière à diffuser un médiatexte émotionnellement expressif sur les réseaux sociaux dans le but de résoudre des problèmes de marketing [2]. Ainsi, ce type de publicité a été appelé viral en raison de la manière dont il se propage, semblable à la propagation du virus.

Les capacités cognitives d'une personne jouent un rôle important dans la perception de la publicité virale. Dans un contexte de surcharge d'informations, qui est observée aujourd'hui dans les réseaux sociaux, les actions qui nécessitent de la concentration et de la charge mentale, réduisent la probabilité de réponse. Autrement dit, le contenu de la publicité virale doit être aussi simple que possible, ne nécessitant pas de concentration. En ce qui concerne le texte, on peut supposer

qu'il devrait également être simple, familier, compréhensible, contenant des cadres connus (situations stéréotypées). Soit la vidéo et le texte doivent être si uniques et attrayants qu'une personne est prête à dépenser ses ressources mentales pour comprendre cette publicité.

En raison du fait que la "viralité" de la publicité est difficile à prédire, chaque fois qu'elle est influencée par un nouvel ensemble de facteurs, l'utilisation de méthodes de recherche sociolinguistiques et l'étude des caractéristiques linguocognitives de la publicité virale semble être l'une des méthodes de recherche les plus prometteuses.

La sociolinguistique est une discipline scientifique née à la jonction de la linguistique, de la sociologie, de la psychologie sociale et de l'ethnographie. Elle étudie un large éventail de problèmes liés à la nature sociale de la langue, à ses fonctions sociales, au rôle joué par la langue dans la vie de la société, de sorte que les méthodes de sociolinguistique sont une synthèse des procédures sociologiques et linguistiques.

À titre d'exemple de l'étude sociolinguistique de la publicité virale, nous citerons le questionnaire en ligne que nous avons mené auprès de 100 répondants. L'étude sociolinguistique a été menée pour étudier la perception des utilisateurs des réseaux sociaux de la publicité virale, en comparant la perception linguocognitive de ce phénomène par deux groupes de locuteurs de langues différentes – le russe et le français.

L'étude que nous avons mentionnée a été réalisée sous la forme d'un questionnaire via le service Survey Monkey sur Internet. Deux groupes cibles de 50 personnes – russophones et francophones – ont été choisis comme objet de l'étude. Les deux groupes sont des représentants de la communauté d'affaires travaillant dans le domaine de la création et de la promotion de services, des clients potentiels et des créateurs de publicité virale. Ces deux groupes ont été choisis pour comparer les caractéristiques linguistiques de la publicité virale qu'ils considèrent comme réussie et comparer les hashtags qu'ils utilisent.

La question pour les répondants russophones était la suivante: "Imaginez que vous êtes le propriétaire d'une agence de voyage spécialisée dans le Tourisme régional (visites dans la région de Tambov). Vous avez préparé une vidéo originale de la foire Pokrovskaya et souhaitez la lancer comme une publicité virale. Votre objectif est que la vidéo gagne rapidement en popularité, si possible, devient virale. Quels hashtags utiliseriez-vous dans la description de votre vidéo originale sur la foire Pokrovskaya?" Pour les francophones "Imaginez que vous soyez le propriétaire d'une agence de voyages spécialisée dans le tourisme dans votre pays. Vous avez préparé une vidéo originale sur l'un des endroits intéressants et vous voulez l'exécuter comme une publicité virale. Quels hashtags utiliseriez - vous dans la description de votre vidéo?"

La majorité des répondants russophones (87%) et francophones (56%) ont indiqué qu'ils utiliseraient principalement des hashtags géographiques et le nom

d'un lieu ou d'un événement particulier. C'est-à-dire que les premières associations sont extrêmement claires et démontrent une pensée concrète.

En deuxième place dans les deux groupes de répondants – hashtag utilisant le mot “Tourisme” (38% chez les russophones et 40% chez les francophones) ou son équivalent anglais “voyage”.

Cependant, plus loin, la perception linguocognitive est influencée par le pays dans lequel réside le répondant, ses traditions culturelles, ses modèles, son contexte culturel.

Les répondants russophones ont souvent utilisé des hashtags indiquant un faible coût, un avantage (#traiter #vente #acheterpascher), on voit le désir de vendre et de promouvoir. Un peu moins d'un tiers de représentants de ce groupe fait usage de hashtags, désignant le divertissement et demandant à voir (#depainetdejeux # tuneverraspasçanullepart # regardertoutlemonde), et parlant d'émotion de l'événement (#dufondducœur #joie #bonheur). Dans leurs réponses, il y avait de l'humour.

Les francophones utilisent plus souvent (16%) des hashtags qui désignent la valeur culturelle du voyage, l'unicité du patrimoine culturel à voir dans le voyage (culture, patrimoine). Le divertissement est également important pour eux (14%), mais il y a une spécificité de la transmission linguistique de ce sujet à l'aide du mot découverte, qui signifie l'occasion pour le voyageur de découvrir quelque chose de nouveau. Un autre groupe de hashtags assez souvent utilisé chez les francophones (14%) sont les mots désignant le plat national, la nourriture, la cuisine nationale. Cela coïncide avec la perception des français en tant que gourmets, amateurs de bonne cuisine, c'est important pour eux et en voyage.

Ainsi, nous voyons qu'une situation stéréotypée similaire à partir de deux positions différentes est définie différemment sur le plan linguistique, bien qu'il y ait beaucoup de similarités. Les hashtags utilisés par les deux groupes appartiennent aux mêmes catégories (balises géographiques, balises de titre, balises indiquant l'action et le type de vidéo – voyage, Tourisme), mais des différences évidentes et significatives sont dues à la grande influence du contexte culturel. Ainsi, en créant une publicité virale, il est nécessaire de prendre en compte l'ensemble des caractéristiques linvocognitives des consommateurs. L'utilisation de la méthode sociolinguistique pour étudier le public et mieux planifier une campagne publicitaire virale nous semble efficace.

Références

1. Ob"em reklamy v sredstvakh ee rasprostraneniya v yanvare-sentyabre 2020 goda [About advertising in the means of its distribution in January-September 2020]. Assotsiatsiya kommunikativnykh agentstv Rossii. 2020. URL: https://www.akarussia.ru/knowledge/market_size/id9399 (Accédé le 12.12.2020)

2. Starovojt M. V. Lingvisticheskie osobennosti tekstov virusnoj reklamy [Linguistic features of viral advertising texts]. Filologicheskie nauki. Voprosy teorii i praktiki, 2016, 8 (62), P. 1, pp. 62-68. (Rus)

3. Scheglova I.V. Rossijskaya sotsiolingvistika segodnya [Russian sociolinguistics today]. Vestnik Severnogo (Arkticheskogo) federal'nogo universiteta. Seriya: Gumanitarnye i sotsial'nye nauki, 2017, No. 5, pp. 138-144. (Rus)

4. Ugo Roux. Communication virale dans la publicité au sein des espaces numériques: Approche critique et expérimentale du phénomène. Sociologie. Université de Toulon, 2016. URL: <https://tel.archives-ouvertes.fr/tel-01368883/document> (Accédé le 12.12.2020)

СОЦИОЛИНГВИСТИКА КАК ЭФФЕКТИВНЫЙ МЕТОД ИССЛЕДОВАНИЯ ВИРУСНОЙ РЕКЛАМЫ

И. А. Юрина

Тамбовский государственный технический университет, Тамбов, Россия

**e-mail: irina.yurina68@gmail.com*

Аннотация. Исследование выполнено в русле социолингвистики и когнитивной лингвистики. Целью являются выявление и анализ специфики концепта «вирусная реклама» с помощью социолингвистического метода анкетирования на примере сравнения восприятия данного концепта двумя различными группами респондентов. Данный метод представляется актуальным для получения знаний о языке и, в частности, о языковом восприятии вирусной рекламы через обращение с различными вопросами и заданиями к самим носителям языка. В контексте изучения продвижения вирусной рекламы одним из значимых предметов исследования являются хештеги. Был выявлен ряд противоречий в восприятии вирусной рекламы и использовании хештегов различными группами респондентов, что предоставляет обширный материал для дальнейших социолингвистических исследований.

Ключевые слова: вирусная реклама; социолингвистика; концепт; анкетирование; контент-анализ, хештег.

The Role of International Communication in the Context of Globalization

D. V. Buslaev*, M. K. Popova, O. A. Glivenkova

Tambov State Technical University, Tambov, Russia
e-mail: buslaev.dima2011@yandex.ru; olga-glivenkova@rambler.ru

Abstract

The article deals with the role of international communication in the context of globalization. It is emphasized that the process of globalization leads to the emergence of new views and values.

Keywords: homogenization, globalization, international communication, world community, paradigm, modern globalization.

Globalization is a process of global economic, political, cultural and religious integration and unification. Modern globalization is a multi-level process. It contains an interaction of objective trends in the development of society as a complex system characterized by a certain dynamic of the movement of material goods and cultural achievements.

Intercultural communication in the context of globalization is a complex multi-faceted phenomenon with respect to which each science of the social and humanitarian cycle forms its own theoretical and methodological approaches as well as identifies a specific problem field.

The most important feature of the development of the modern world is globalization. Globalization means changing the paradigm of social interactions that has been formed in modern society. The "East-West" paradigm is losing its paramount importance. These concepts are not geographical, they are civilizational and geopolitical concepts including in the East not only the countries of Asia but also the entire non-Western parts of the world. This phenomenon is qualitatively different from the growing intensity and significance of two - and multi-cultural ties.

Globalization is a characteristic feature of the processes of changing the structure of the world economy which is understood as a set of national economies linked to each other by the system of international division of labor, economic and political relations through the integration in the world market and close interweaving of the economy on the basis of transnationalization and regionalization. On this basis it brings about the formation of a single global network market economy — geo-Economics and its infrastructure, the destruction of national sovereignty of States that have been the main actors in international relations for many centuries.

The growing shortage of non-renewable natural resources on the planet (as you know, Russia is one of the exporting countries of such resources unlike other members of the former G8 countries and other applicants for participation in the development of

the policy of this structure). Non-renewable natural resources include not only natural gas, oil, metals and minerals but also drinking water. Lake Baikal contains about 20% of the earth's drinking water reserves.

The development of international cooperation in this area involves the use of effective technological and economic mechanisms based on an internationally recognized legal framework designed to ensure timely and effective solution of the social problems that our country has faced over the past decades. The 1982 United Nations Convention on the Law of the Sea has now provided for the peaceful division of the continental shelf of coastal states. Its area is known to be about 30 million square kilometers of which about 7 million square kilometers were ceded to Russia. A special Commission of the United Nations is discussing the possibility of preserving the existing order while extending the dividing line deep into the ocean for a distance of up to 350 miles. According to scientists of the Institute of Oceanology of the Russian Academy of Sciences it is necessary to divide both the slopes of the World ocean and their foothills. These geologically complex expanses contain not only bioresources but also huge reserves of minerals and hydrocarbons. Agreement on these issues will require comprehensive political and diplomatic efforts by Russia to ensure its national interests and simultaneously develop the latest technologies based on advanced scientific ideas. The intensity of global interconnections contributes to the rapid spread of political, social, and especially economic life as well as the types of culture, knowledge, and values that are perceived as the most effective or simply optimal for meeting personal and social needs across the world. The process of cultural homogenization and attempts to dominate one culture are opposed not only by national cultures but also by the peculiarities of the entire communication system. Being diversified, multi-modal and unstable this system remains difficult to administer that prevents the unification of cultural codes. It is more adapted to reflect different interests and values [3].

In an effort to manage the ever-increasing flow of information it is necessary to develop a more adequate model of globalization that takes into account the interests of different countries and people. Attempts to unify cultural codes on the basis of a single tradition or value system are dangerous for the future of civilization since information without which it is impossible to develop civilization is based on the diversity of cultures, value systems, and visions of the world. A significant reduction in diversity can lead to stagnation and degradation of crops.

The alternative to globalization as Americanization is that the process of globalization should initially include the inevitability of cultural diversity and exclude the possibility of a clash of civilizations. In this context the principles of coexistence, synthesis, convergence and dialogue of cultures become relevant. Thus, we come to the conclusion that the expansion of the communication space globalization, on the one hand, creates new conditions for the interaction of national cultures and traditions, and on the other hand - new threats to the self-value of the same cultural traditions due to the strengthening of their unification. The strengthening of the concepts of “space”, “time”, “reality” under the influence of new computer technologies and the Internet led

to the “death of space”. We changed the way we perceive time and reality by introducing virtual reality along with objective reality. The stages of formation and development of communicative media tools show the reasons for the emergence of qualitatively new forms of communication and ways of interaction in the communicative space.

The essence of the problem is that the non-linearity of meaning transmission is becoming more and more recognized and the number of scenarios, interpretation and interpretation of information transmitted in the process of communicative interaction is increasing.

The modern world is becoming more and more global. One of the characteristic features of globalization is the interaction of both individuals and individual civilizations. Relations between civilizations acquire a special status. Intercultural communication occupies one of the Central places in the study and assessment of the current state of human society, when it is especially important to determine the optimal boundaries between globalization and the preservation of socio-cultural pluralism, between terror and tolerance.

The development of communication media transformed not only the spatial, but also the temporal organization of social life which had a significant impact on both the context of perception and the interpretation and understanding of the content of communication; the emergence of speech, writing, printing, Telegraph, radio, modern electronic means of transmitting, storing and processing information, and, finally, the emergence of computers and the global Internet which was crucial for the formation of an open global world.

The process of globalization leads to the emergence of cultural forms, new values, patterns of behavior and activities and the averaging of world needs. Due to the increasing interdependence of business processes of organizations and the globalization of competition in world markets, local cultures (national, business, organizational) enter into a kind of interaction which blurs the boundaries between their own and other cultures. As a result of the process of integration of individual ethnic cultures into a single world culture based on the principles of development of means of communication, economic relations, social transformations, and so on, culture is being globalized. In cross-cultural communication, all this is reflected in the expansion of contacts between state institutions, social groups and individuals from different countries and cultures, the adoption of cultural values and changes in the cultural environment as a result of migration.

The trend of leveling the interests of national states and distinctive cultures that accompanies globalization should be regulated or minimized by implementing certain optimal measures (at the level of interstate agreements). Awareness of the importance of cultural and historical factors in communication processes, knowledge and adequate reconstruction of the norms of verbal and non-verbal behavior. Problems of communication and discourse contributes to the success of cross-cultural communication, since the communication process involves mutual understanding and mutual adaptation of the interlocutors.

In order to recognize yourself as an integral part of interaction you need to change the approaches to teaching foreign languages, country studies, and communication theory and move from theoretical knowledge to practical courses, destroying erroneous cultural stereotypes.

The comparison of languages and cultures reveals not only the general, universal, but also the specific, national and original phenomena which is due to differences in the history and achievements of peoples. Intercultural communication deals with mutual understanding and agreement which means: to understand someone else's language and at the same time to be understandable when communicating in a foreign language. The inability to find a dialogue in the twentieth century led to the fact that the vast majority of conflicts were of a national nature.

In order to avoid all misunderstandings, it is necessary to have fundamental knowledge about a particular culture and the interaction between cultures.

References

1 Glagolev V.S. Mezukul'turnaya kommunikaciya v usloviyah globalizacii [Intercultural communication in the context of globalization]. Prospect, 2015, No. 2, 231 p. (Rus)

2. Glebov G.I., Milaeva O.V. Sovremennye mezhdunarodnye otnosheniya. Uchebnoe posobie. [Contemporary international relations. Textbook]. Izd. Penz. gos. Un-ta., 2010, 98 p. (Rus)

3. Kirabaev N.S. Globalizaciya i mul'tikul'turalizm [Globalization and multiculturalism]. Izdatel'stvo RUDN, 2005, 332 p. (Rus)

4. Ol'shanskaya A.B. Rasshirenie kommunikativnogo prostranstva i razvitie chelovek [Expansion of communication space and human development]. Duhovnaya situaciya vremeni, MGSU, 2005, No. 1-2, 2005, pp. 234-240. (Rus)

РОЛЬ МЕЖДУНАРОДНОЙ КОММУНИКАЦИИ В УСЛОВИЯХ ГЛОБАЛИЗАЦИИ

Д. В. Буслаев*, М. К. Попова, О. А. Гливенкльва

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: buslaev.dima2011@yandex.ru

Аннотация. В статье рассматривается вопрос, связанный с ролью международной коммуникации в условиях глобализации. Подчеркивается, что процесс глобализации ведет к появлению форм взглядов, новых ценностей.

Ключевые слова: гомогенизация, глобализация, международная коммуникация, мировое сообщество, парадигма, современная глобализация.

Accounting and Audit of Output and Sales of Finished Products

Davino Ngua Edjang Obono

Tambov State Technical University, Tambov, Russia

e-mail: Wrybronze2015@gmail.com

Abstract

The article outlines one of the important problems for economists, i.e. accounting and audit of the release and sale of finished products. Finished goods are part of the inventory held for sale. Finished products are products and semi-finished products that are completely finished by processing, corresponding to the current standards or approved technical conditions, accepted by the warehouse or by the customer.

Keywords: accounting, audit, finished goods release, enterprise, analysis, production volume, verification, calculations.

E.S. Sergushina notes that «finished products» are goods and products that are completely finished processing in the organization goods and products must meet the requirements of standards and specifications, and must be accepted by the technical control service. All products are issued with acceptance documentation and delivered to the finished product warehouse [2].

S.A. Boronenkova notes that "finished products are delivered from production to the warehouse on the basis of acceptance invoices and acts". Keeping records of manufactured products in warehouses is carried out at the places of storage. A characteristic feature of accounting for manufactured products is that accounting for quantity and cost are independently determined by the accounting units of the organization [3].

Thus, the sale process completes the cycle of economic assets of the enterprise, which allows it to fulfill its obligations to creditors and reimburse various production costs [4].

Next, we will consider the organization of accounting for finished products, works, and services in JSC KF TAKF. In accordance with the organization's accounting chart of accounts and instructions for its use, the active account 43 "Finished products" is intended for summarizing information about the availability and movement of finished products.

Synthetic accounting of costs for manufacture of products (works, services) at JSC KF TAKF is conducted on accounting accounts in accordance with the working plan of accounts: 20 "Main production", 23 "Auxiliary production", 26 "General current expenses". The account 20 "Main production" in the context of structural divisions (places of cost formation) reflects the costs directly related to the production (performance) of works (services).

Direct expenses directly related to production, performance of works and provision of services are credited to the account 20 "Main production" at the

expense of inventory accounting credits, settlements with employees for remuneration, accounts with various debtors and creditors, etc. [4]

Then, we analyzed the production and sale of finished products at the JSC KF TAKF enterprise for 2017-2019.

Table 1-Dynamics of output and sales of finished products of the enterprise

Год	Volume of output, thousands rub.	Growth rate, %		Volume of sales of finished products, thousands rub	Growth rate, %	
		basic	chain		basic	chain
2017	1908891	100	100	1896334	100	100
2018	1772115	92.83	92.83	1756988	92.65	92.65
2019	1682372	88.13	94.94	1645468	86.77	93.65

Analyzing the data in the table, we can see that there is a reduction in both the volume of output and the volume of sales of finished products at JSC «KF» «TAKF». Compared to 2017, the volume of production in 2018 decreased by 7.17%, and in 2019 by 11.97%. In 2019, compared to 2018, the volume of output decreased by 5.16%.

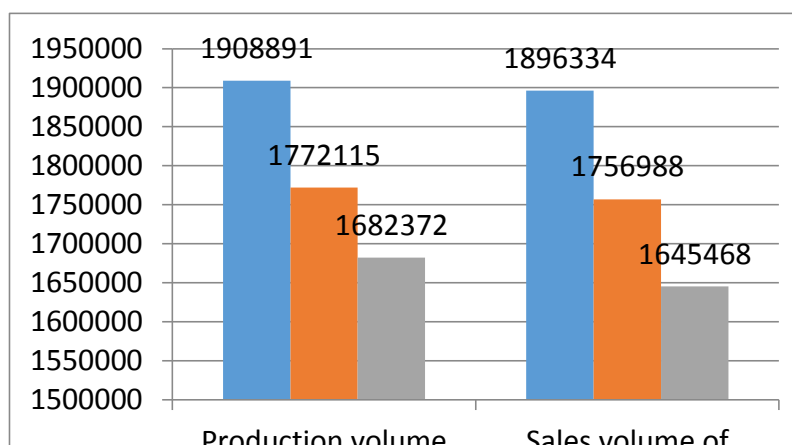


Fig. 1. Dynamics of output and sales of finished products, thousand rubles

It should be noted that in General, there were no violations of the law during the audit at the enterprise of JSC KF TAKF. All documents confirming transactions are reliable and reliable. There are no complaints about keeping records at the enterprise. Comparison of accounting for product balances with actual identified shortages within the limits of natural loss rates. The cost of treatment is indicated in full and is reflected in accordance with the legislation of the Russian Federation.

To improve accounting of finished products, works, services JSC KF TAKF proposed: to update the regulatory framework of accounting policies, as necessary measures for the improvement of accounting of finished products, works, services offers an inventory of finished products, because accounting is designed to timely and accurately reflect all changes that occurred in the composition of economic means and sources of their formation, in economic processes and their results; it is

also recommended to review the assessment and reflection of costs associated with the production of products that are not processed, but represent a finished product for sale.

References

1. Polozhenie po buhgalterskomu uchetu "Uchet tovarno-material'nyh zapasov" PBU 5/01: [Regulation on accounting «Accounting for inventories» PBU 5/01], Order of the Ministry of Finance of Russia dated 09.06.2001, No. 44n. (Rus)
2. Sergushina E.S., Vechkanova E.A., Morozkina A.V., Sergushina S.E. Analiz finansovo-hozyajstvennoj deyatel'nosti stroitel'nyh organizacij v sovremennyh usloviyah [Analysis of financial and economic activities of building organizations in modern conditions]. Scientific and methodological electronic journal Concept, 2018, No. 4, pp. 171-175. (Rus)
3. Boronenkova S.A. Ekonomicheskij analiz [Economic analysis]. M.: Finance and Statistics, 2016, 318 p. (Rus)
4. Erokin L.I. Buhgalterskij uchet i analiz: uchebnoe posobie [Accounting and analysis: textbook] M.: Forum, Infra-M, 2014, 495 p. (Rus)

УЧЕТ И АУДИТ ВЫПУСКА И РЕАЛИЗАЦИИ ГОТОВОЙ ПРОДУКЦИИ

Давино Нгуа Эджанг Обоно

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: Wrybronze2015@gmail.com

Аннотация. В статье излагается одна из важных проблем для экономистов, это учет и аудит выпуска и реализация готовой продукции. Готовая продукция является частью материально-производственных запасов, предназначенных для продажи. Готовая продукция – это изделия и полуфабрикаты, полностью законченные обработкой, соответствующие действующим стандартам или утвержденным техническим условиям, принятые на склад или заказчиком.

Ключевые слова: учет, аудит, выпуск готовой продукции, предприятие, анализ, объем производства, проверка, расчеты.

The Military Mobilization Campaign in the Tambov Region in the Initial Period of the Great Patriotic War

T. A. Deev

Derzhavin Tambov State University, Tambov, Russia
e-mail: Timofei.Deew@yandex.ru

Abstract

The purpose of this article is to analyze the actions and measures taken by the leadership of the Tambov region at the beginning of the Great Patriotic War. Special attention in the study is paid to the creation of military units formed from the residents of the region, the implementation of the plan for conscription from the reserve of citizens fit for military service. The author, using archival documents, traced the main course of events.

Key words: aviation and chemical construction, anti aircraft defense, municipal committee, the Red Army, society for the promotion of defense, Volga military district.

After the German attack on the USSR and the declaration of war on our country, in the European part of the country, according to the decree of the Presidium of the Supreme Soviet of the USSR, the mobilization of the male population was announced. The Tambov region, which was part of the Orel Military District, was also included in the mobilization process. In war time conditions, it was also necessary to attract all able-bodied people in the rear areas to create fighter and partisan detachments to fight saboteurs and saboteurs.

The following tasks were assigned to the region: "... ensuring timely implementation of state mobilization plans and rapid restructuring of the region's economy to meet the needs of the front" [the author's translation] [1].

In addition, in all localities of the region, the process of conscription was accompanied by a surge of patriotism.

For example, in Michurinsk, according to the first secretary of the Michurinsk City Committee of the CPSU (b) A. G. Boikov: "The rallies were held with great political enthusiasm. At these meetings, the workers, expressing their hatred for the warmongers, expressed complete determination, extraordinary patriotic enthusiasm and faith in the complete victory of the socialist fatherland against the predators of bloody fascism" [the author's translation] [2].

In addition, at the end of June in the Injavinsky district, the process of attracting the male population to the ranks of the Red Army was also successful. It should be noted that during this period, the Komsomol members were simultaneously recruited to various military schools.

In the Poletaevsky district, the campaign for the recruitment of young men was held without significant violations. Moreover, a significant amount of transport was requisitioned for the needs of the front.

In almost all districts of the region, all attempts related to evasion of service in the red army, sabotage and deterioration of discipline in the ranks of military service were stopped in the bud.

It is necessary to focus on those units and formations that were formed in the Tambov region and took an active part in the battles with the Nazis. So, within a few months, several rifle divisions were created, which went to the defense of Moscow. These were the 323th, 325th, and 331th rifle divisions. In addition, the 233th tank brigade was formed in the region.

Speaking about the number of young people who left for the front in the first months of the war, according to the researcher V. L. Dyachkov, only “[i]n 1941, during the first six months of the war in the region, about 220 thousand people were called up in the Red Army – half of the total military conscription” [the author’s translation] [3].

Also, a considerable number of residents of the region who went to the front showed miracles of heroism. Born in Morshansk, Junior Lieutenant P. T. Kharitonov was one of the first to become a hero of the Soviet Union at the beginning of the war.

In the winter of 1942, in order to strengthen training in the field of military personnel, the commander of the Volga military district S. A. Kalinin ordered to create a machine-gun and mortar school in Morshansk.

The order contained the following: «By February 25, 1942, in the city of Morshansk, to form a machine-gun and mortar school according to state No. 19/67 with a number of cadets of 2500 people. The formation of the school should be entrusted to the Morshansky district military committee. According to the outfits of the district at the expense of conscripts born in 1922-1923, cadets as well as communists and Komsomol members called up by the party - Komsomol mobilization” [the author’s translation] [4].

Thus, the military mobilization campaign that took place between mid-June 1941 and the end of March 1942 was fully implemented. During this period, more than 200,000 thousand people entered service, tank brigades were created, numerous people's militia units were created, and work was successfully carried out in the region to combat saboteurs. On the other hand, there were cases of desertion, non-appearance in military enlistment offices, but the number of such people was insignificant. Besides, many people were conscripted with target of building of defensive lines.

References

1. Bredihin V.E. Tambovskaja oblast' v gody Velikoj Otechestvennoj vojny [Tambov region during the Great Patriotic war]. Tambov: Izd-vo Tamb. gos. tehn. un-ta, 2007, pp. 5. (Rus)
2. D'jachkov V.L. Armejskij prizyv i voinskie poteri Tambovskoj oblasti v gody Velikoj Otechestvennoj vojny: chislo, vozrastnaja i social'naja struktura [Army conscription and military losses of the Tambov region during the Great Patriotic War: number, age and social structure]. Vestnik TGU, 2006, No.4, pp. 97. URL: <https://cyberleninka.ru/article/n/arめyskiy-prizyv-i->

voinskie-poteri-tambovskoy-oblasti-v-gody-velikoy-otechestvennoy-voyny-chislo-voznrastnaya-i-sotsialnaya-struktura. (Rus)

3. No. 7 Dokladnaja zapiska pervogo sekretarja Michurinskogo gorkoma VKP(b) A.G. Bojkova pervomu sekretarju obkoma VKP(b) N.A. Loginovu o provedenii pervogo dnja mobilizacii v g. Michurinske. 23 ijunja 1941 g. Sov. Sekretno. [No. 7 report of the first secretary of the michurinsk city committee of the cpsu(b) A. G. Boykov to the first secretary of the regional committee of the CPSU (b) N. A. Loginov on the first day of mobilization in Michurinsk. June 23, 1941. Top Secret]. CDNITO, F. 1045, Op. 1, D. 2076, L. 136, 137. URL: <http://gaspito.ru/images/materials/TiGP/pdf/0103.pdf> (Rus)

4. No. 149 Prikaz komandujushhego vojskami PriVO S.A. Kalinina o formirovanii pulemetno-minometnogo uchilishha v g. Morshanske 19 fevralja 1942 g. Sov. Sekretno.[No. 149 Order of the commander of the privo troops S. A. Kalinin on the formation of a machine-gun and mortar school in Morshansk on February 19, 1942.] Top Secret. GATO, F. R-5297, Op. 1-s, D. 6, L. 15, 16. Podlinnik. Ssylka na jelektronnyj resurs: <http://gaspito.ru/images/materials/TiGP/pdf/0103.pdf> (Rus)

ВОЕННО-МОБИЛИЗАЦИОННАЯ КАМПАНИЯ В ТАМБОВСКОЙ ОБЛАСТИ В НАЧАЛЬНЫЙ ПЕРИОД ВОВ

Т. А. Деев

Тамбовский государственный университет имени Г.Р. Державина, Тамбов, Россия
e-mail: Timofei.Deew@yandex.ru

Аннотация. Цель данной статьи состоит в анализе действий и мер, осуществляемых руководством Тамбовской области в начале Великой Отечественной войны. Особое внимание в исследовании уделяется созданию воинских частей, формируемых из жителей региона, выполнение плана по призыву из запаса граждан годных к военной службе. Автор, используя архивные документы, проследил основной ход событий.

Ключевые слова: Горком, Осоавиахим, ПриВО, ПВО, РККА.

The Role of Forensic Accounting and its Connection with Taxation System in Iraq

E. A. Kirichenko¹, Israa Shihab Ahmed Ahmed²

Tambov State Technical University, Tambov, Russia

¹*e-mail: kiriya.elena@gmail.com*, ²*e-mail: israasha77@gmail.com*

Abstract

The objective of this study was to investigate the role of forensic accounting in restraining the tax evasion in Iraq. The major findings of the study include a necessity of the application of forensic accounting in introducing tax reforms in Iraq. Educational institutions and universities should also include modules on forensic accounting in their curriculum. It also recommends simplifying direct taxes, increasing non-oil revenues from indirect taxation, and strengthening tax and customs administrations.

Keywords: accounting standards, taxation, oil revenue, audits.

Introduction

Forensic accounting, also called investigative accounting or fraud audit is a merger of forensic science and accounting. Forensic accounting requires the accountant to possess investigative skills in order to examine into a company's financial statement. It has now been accepted as a practice for accountants to develop such business skills so that they are capable of investigating cases of fraud, embezzlement of funds and theft of assets. Forensic accountants are often seen as "forensic auditors" who "investigate" on behalf of accounting firms and government agencies and participate in court trials. In Iraqi context, forensic accounting involves investigation of its various revenue sources which, other than oil, are taxes and revenue from state-owned enterprises. In the current scenario in Iraq, oil revenue, which constituted more than 90% of total fiscal revenue, has suddenly fallen down, causing a sharp increase of the budget deficit from 6% of GDP in 2013 to 14% in 2017; increase of public debt from 31% of GDP in 2013 to 67% in 2017; and a fall in foreign exchange reserves from \$78 billion in 2013 to \$45 billion in 2017[4]. The exposure of the economy to the fall in oil prices has highlighted the very low level of non-oil tax revenue, and hence Iraq feels the need to increase it through other sources such as taxation. The total tax-to-GDP ratios in Iraq has historically not exceeded 1 percent, a very low share of the economy compared to the average ratio in the MENA region where it is more than 10 times [1]. In 2005, when the Iraqi government introduced a few direct and indirect taxes, including the income tax on both Iraqi and non-Iraqi tax residents, as well as corporate income tax rate increased to a flat rate of 15%, there was no robust monitoring system to ensure a proper compliance of the taxation system. So far the taxation system in Iraq was governed under the Federal Income Tax law, Law no. 113 of November 22, 1982, as amended in 2003 (the Federal Income Tax Law).

All enterprises registered in Iraq are required to prepare and submit audited financial statements in accordance with Iraqi Uniform Accounting Standards (UAS) which are audited by an Iraqi statutory auditor [3]. Hence in Iraq there has been a lack of appropriate forensic accountancy experts that might ensure implementation of robust financial auditing with the prerequisite objectives and procedures. Forensic accounting is a science that studies financial statements and reports of forensic experts having a knowledge of accounting, auditing, and relevant aspects of judicial laws [4]. We might define tax evasion as an attempt of a taxpayer not to pay the due taxes totally or partly by following ways and methods that contradict the taxing system provisions, i.e by cheating and fraud. There are various factors that lead to tax evasion including the instability of political and legal system of a nation for instance, the complicated tax and bureaucratic procedures of taxation department; the lack of control and incompetency of the investigation authorities; and last but not the least, the taxpayers' frustration of not receiving benefits against the taxes paid. The methods of tax evasion include not presenting tax statements or increasing the expenses in order to get exemptions; non registration at the income tax authority even after having high income; non-disclosure of taxable income and other activities; non deliverance of tax deductions from workers' incomes and nonpayment of social security contributions. Iraq, in general, has two accounting systems: one for government directorates (non-profit organizations), namely a governmental accounting system for which the Ministry of Finance is responsible, and the second is Unified Accounting System (UAS) for profit organizations, for which the Board of Supreme Audit (BSA) is responsible. However, the control of all expenditures is managed by the Ministry of Finance and Board of Supreme Audit which follows a comprehensive auditing system. They also present the government's annual financial reports to parliament. It is primarily aimed at reviewing and evaluating the results of the implementation of revenue policies and plans. This type of forensic accounting is done in accordance with internationally-recognized accounting standards and principles. At the grass root level, Iraq also practices a legislative as well as forensic accounting framework. Both frameworks are exemplified in many incidents for instance while withholding taxes in contracts with foreign parties under instructions no. 2 of 2008, or in matters of upstream oil and gas contracts under Instructions no. 5 of 2011. However, there has been no specific legislation under the current forensic accounting system that would order a withholding on dividends, rents and royalties.

Problem Statement

In spite of several legal provisions, the forensic accounting system in Iraq has failed to deliver the desired results. This would be because taxes do not play a significant role in providing financial resources to the state of Iraq and are mainly used as an effective method to create disparities in income levels of the citizens, which are the objectives of the tax laws in Iraq. A forensic system fails to exist in Iraq due to increased dependence on oil revenues and exemptions of income taxes

for all Iraqi governmental employees. It is also due to the complex tax laws in Iraq and the lack of appropriate public accountability management system. There is a lack of transparency in the public sector financial management regulatory framework and a poor coordination between the public accountability institutions with no clear allocation of roles and responsibilities. The problem was also aggravated due to the lack of any latest written documentation as the existing documented accounting framework of Iraq dates back to 1940's with only minor amendments.

Moreover, not all the Iraqi officials are familiar with the accounting concepts and standards. Not much attention has been paid in the recent times and this study seeks to fill this gap in the literature by exploring the need for accountability of government revenues, and in particular taxes.

The main objectives of this study are:

1. To ascertain whether the forensic accounting concept with all its goals and mission is competent enough to resolve crimes such as tax evasion.
2. To examine the applicability of forensic accounting in limiting tax evasion in Iraq.
3. To identify the most modern methods that can be followed by the Iraqi tax officials to combat tax evasion.

Findings and Results

The BSA Law (1990) had promulgated certain accounting regulations in Iraq based on accepted international standards. The findings also indicate that forensic accounting was not the method mandated by the external auditors to detect tax evasion cases. Additionally, the findings also suggested that there were no governmental officials trained in forensic accounting.

The study also observed that in spite of an institutional framework, there existed a lack of capacity in public accountability institutions and a lack of clarity in the financial management regulatory framework. There was a poor coordination between the public accountability institutions owing to their unclear allocation of roles and responsibilities [2]. The Iraqi government had though recognized the need for greater clarity and consistency in public accounting and had given priority to setting up a public sector accounting framework in Iraq. The status of taxation in Iraq was also studied during the course of this research. Table 1 shows that government revenues are derived from direct taxes, indirect taxes and oil revenues.

Table 1. Revenue status in Iraq

	1 997	20 08	2 012	2 017	Percentage of GDP
Direct Taxes	4 1%	0.6 6%	2 %	2 %	5%
Indirect Taxes	9. 7%	0.3 7%	0 .5%	0 .7%	6%
Oil revenue	4 9.8%	98. 97%	9 7%	9 7%	95%

The table reveals that taxes do not play a significant role in the financial resources of Iraq. The decrease in tax revenue, as a percentage of total revenue, during the past two decades (as shown in Table 1) and subsequent to the economic sanction imposed on Iraq in later years is due to increased dependence on oil revenues and exemptions of income taxes for all Iraqi governmental employees.

Taxes in Iraq include personal and corporate income taxes, excise taxes, and tariffs. Other tax revenues include social contributions-such as payments for social security and hospital insurance grants, and net revenues from public enterprises. The government can discharge its duties only if sufficient resources are available. Forensic accounting is an important tool to ensure that the state receives the required income.

Conclusion, Suggestions and Implications

The study reveals that there is an urgent need to make amendments in the current laws dealing with taxation and revenue management systems. The Iraqi government can also formulate new accountability and enforcement agencies at the regional level in order to meet local as well as international challenges. The creation of new accountability institutions would help in streamlining and forensic monitoring the taxation procedures.

References

1. International Monetary Fund (IMF) (2017). Program Note: Iraq. URL: <http://www.imf.org/external/np/country/notes/iraq.htm>
2. Deloitte. Doing business guide: Understanding Iraq's tax position Deloitte and Touche Management Consulting. W.L.L., 2017.
3. Ministry of Finance (2016). Annual reports, 2008, 2011, 2015, 2016 (Estimated Budget), Ministry publications, Baghdad, Iraq, 2016.
4. Okoye, E.I., Gbegi, D.O. Forensic accounting: A tool for fraud detection and prevention in the public sector. International Journal of Academic Research in Business and Social Sciences, 2013, 3(3), pp. 2222-6990.

РОЛЬ СУДЕБНОЙ БУХГАЛТЕРИИ И ЕЕ ОТНОШЕНИЯ С НАЛОГОВОЙ СИСТЕМОЙ ИРАКА

Е. А. Кириченко^{1*}, Исраа Шихаб Ахмед Ахмед²

Тамбовский государственный технический университет, Тамбов, Россия

¹*e-mail: kiriya.elena@gmail.com*, ²*e-mail: israasha77@gmail.com*

Аннотация. Целью этого исследования было изучить роль судебной бухгалтерии в предотвращении уклонения от уплаты налогов в Ираке. Основные выводы исследования включают необходимость применения судебной бухгалтерии при проведении налоговых реформ в Ираке. Образовательные учреждения и университеты также должны включать в свои учебные программы модули по судебной бухгалтерии. Также рекомендуется упростить прямые налоги, увеличить не нефтяные доходы от косвенного налогообложения и укрепить налоговую и таможенную администрацию.

Ключевые слова: стандарты бухгалтерского учета, налогообложение, нефтяные доходы, аудит.

The Concept and Essence of Territory Marketing (The Example of the Tambov Region)

K. G. Kravchenko

Tambov State Technical University, Tambov, Russia
e-mail: kkg_97@mail.ru

Abstract

The article provides a definition of the concept of “territory marketing” and its subjects. The prerequisites for the emergence of territory marketing are considered, and also a classification of consumer groups of territory marketing is given. The strategy of socio-economic development of the Tambov region was considered as an example of using territory marketing.

Keywords: marketing, territory marketing, regional marketing, economy.

One of the founders of marketing as a science F. Kotler defined marketing as a type of human activity aimed at meeting needs and demands through exchange [1].

The main goals of marketing are to make a profit by providing those goods and services to the consumer that best meet their needs and improve the quality of life.

Currently, there are many different areas of marketing that cover a variety of areas of human activity, one of which is the marketing of territories.

The emergence of territory marketing as a separate direction of marketing is associated, first of all, with the development of market relations, which required a more detailed study of the needs and requirements of consumers through the systematization of methodological and territorial knowledge. This measure arose due to differences in the needs and demands of consumers depending on their territorial location, due not only to climatic, landscape and other geographical characteristics, but also to the socio-economic level of development of the territory, political situation and cultural characteristics of the population.

Territory marketing is an activity aimed at the development and implementation of measures that contribute to the satisfaction of the socio-economic interests of the territories, as well as consumers in which specific territories are interested.

Allocate types of marketing depending on the territory. So, there is marketing of the state, region, city, municipality, settlement and specific area. Thus, this marketing classification is due to the size of the territories.

Based on the definition of territory marketing and its classification, the following subjects of territorial marketing can be distinguished: manufacturers and suppliers of goods and services; consumers of goods and services; intermediaries; state and local government bodies; bodies of territorial administration; public associations and social movements; mass media.

The emergence of territory marketing as an independent direction of marketing is due to the need to form an instrument of regional and municipal economic policy to solve problems arising from the following reasons [2]:

- dissatisfaction of citizens with the activities of territorial bodies of state power and local self-government;
- growing competition in the market of territories between regions and cities;
- due to the federal budget deficit, financing of state programs and services aimed at meeting a number of citizens' needs is decreasing;
- corporate interests of the authorities are put above the interests of society;
- constant change in the social structure of society;
- availability of differentiation of demand in the market of services and goods.

Like any other type of marketing, territory marketing is targeted at different customer segments. F. Kotler identified the following groups of consumers of territories [3, p. 51-75]:

1. Visitors. This group includes consumers who have come to the territory for a specific purpose (business trip, tourism, etc.).

2. Local population. This group includes people permanently residing in a specific area. This group includes professional workers, entrepreneurs, investors, retirees, etc.

3. Business and industry. This group includes enterprises of heavy and light industry, assembly plants, etc.

4. Export Markets. This group includes consumers from other territories who export goods and services.

The main goal of territory marketing is to improve the quality of life of the population of a particular area and increase its competitiveness in comparison with similar territories. An example of this is the Strategy of Socio-Economic Development of the Tambov Region until 2035. This concept provides a description of the main geographical and socio-economic indicators, as well as a list of the main problems of the region, on the basis of which a plan for the development of the region is developed.

The strategic goal of the socio-economic development of the Tambov region is to achieve leadership in the population's satisfaction with the quality of life and the environment on the basis of new industrialization, social modernization, comprehensive digitalization and effective government regulation. Proceeding from the named goal, one can single out the main position - the achievement of leadership in the satisfaction of the population with the quality of life and the environment [4].

According to a 2018 study by the Financial University, the life satisfaction rate among Tambov residents was 85%, which is a fairly high indicator (the average for Russia is 82%).

According to Ria Rating research, the Tambov Region took 32nd place in 2016, 34th in 2017, 40th place among the regions of the Russian Federation in 2018, and in 2019 its positions dropped to 43rd place, which shows negative social dynamics.

The rating of the regions of the Russian Federation in terms of quality of life for the first half of 2020, compiled by RBC, is a heat map with indicators in the

range from -1 to 7 (where -1.5-0 is a very low quality of life of the population, 0-2 is low, 2-3.5 is medium, 3.5-5.5 is high, 5.5-7 is very high). The Tambov region received 3.56 points in this rating, which made it possible to classify it as a region with a relatively high quality of life.

Comparing all the data of the ratings of the quality of life of the population of the Tambov region it can be noted that despite the relatively high indicators of satisfaction with the quality of life of the population of the region, they are characterized by negative dynamics.

Thus, the strategy of socio-economic development of the Tambov region acts as a marketing plan for the development of territories to improve the quality of life of the population. To achieve this goal, it is planned to digitize the provision of services to the population, which will optimize the process of processing information about the client and provide the service in full and in a short time (for example, creating an emergency response system in medical organizations when the health indicators of patients of risk groups are changed, recorded using individual electronic devices). Also, the Administration of the Tambov region as one of the priorities for the development of the region singles out stimulating the birth rate, increasing life expectancy, reducing unemployment, attracting investors and developing infrastructure. If all provisions of the Development Strategy of the Tambov Region are implemented by 2035, then it can be assumed that the Tambov Region will be able to take a confident position in the top 30 regions of the Russian Federation in terms of the quality of life of the population.

References

1. Kotler F. *Osnovymarketinga. Kratkiy kurs [Marketing Basics Short Course]* Moscow, Izdatel'skiydom Vil'yame, 2007, 656 p. (Rus)
2. Yergunova, O. T. *Marketing territorii [Territory marketing]*. Yekaterinburg: Izdatel'stvo Ural'skogo universiteta, 2017, 136 p. (Rus)
3. Kotler F., Jatusripitak S., Maescincee S. *The marketing of nations: a strategic approach to buiding national wealth*. New York: Free Press, 1997, 451 p.
4. *Zakon Tambovskoy oblasti O strategii sotsial'no-ekonomicheskogo razvitiya Tambovskoy oblasti do 2035 goda ot 04 iyunya 2018 goda № 246-Z [Law of the Tambov region On the strategy of socio-economic development of the Tambov region until 2035 dated June 04, 2018 No. 246-Z]*. URL: <http://docs.cntd.ru/document/550113760> (Accessed 10.12.2020). (Rus)

ПОНЯТИЕ И СУЩНОСТЬ МАРКЕТИНГА ТЕРРИТОРИЙ НА ПРИМЕРЕ ТАМБОВСКОЙ ОБЛАСТИ

К. Г. Кравченко

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: kkg_97@mail.ru

Аннотация. В статье приводится определение понятия «маркетинг территорий» и его субъектов. Рассматриваются предпосылки возникновения маркетинга территорий, а также приводится классификация групп потребителей маркетинга территорий. В качестве примера использования маркетинга территорий была рассмотрена стратегия социально-экономического развития Тамбовской области.

Ключевые слова: маркетинг, маркетинг территорий, региональный маркетинг, экономика.

The Impact of Constitutional Amendments on the Redistribution of Powers between Authorities

E. A. Kuznetsova, S. A. Frolov

Tambov State Technical University, Tambov, Russia
e-mail: kaesa5@yandex.ru, seif.saf@ramler.ru

Abstract

Changes in the redistribution of powers between the legislative, executive, and judicial branches are considered. The problem of mutual control of the government branches is touched upon. The most significant constitutional innovations that have occurred with state authorities are highlighted.

Keyword: power, state power, Constitution of the Russian Federation, redistribution of powers, public power, system of checks and balances, theory of separation of powers.

The urgency of this issue is related to the adoption of amendments to the Constitution of the Russian Federation. The significance of the event is determined not only from a legal point of view, but also from the need for an institutional analysis of the distribution of power in modern Russia. Therefore, our main goal is to assess the impact of constitutional amendments on the balance of power and on the theory of democracy in general. To achieve this goal, it is necessary to:

- 1) analyze the changes that have occurred in the redistribution of powers between the branches of government and state bodies;
- 2) predict the operation of the mechanism of checks and balances in the current conditions;
- 3) identify the relationship between concepts such as.

The object of the study is the constitutional reform of the state power system in Russia. The redistribution of powers between branches and bodies of state power is the subject of study.

Most researchers of the state structure of modern Russia agree that the pure classical model of separation of powers into three branches: legislative, executive and judicial does not correspond to reality. In fact, there are more branches of government, most often the presidential power is singled out as the fourth.

According to O.O. Mongush, at present, it is fair to say that there are five branches of government, each of which, as we see it, should be enshrined in articles 10 and 11 of the Constitution of Russia [1]. Disputes about the number of branches of government do not subside among researchers, the main thing to remember in these speculations about the distinguishing characteristics government branches. According to political and legal practice, there are two fundamental principles of separation of branches of government: first, the exclusivity of powers and independence in their implementation from other branches and authorities.

The rule of division of power between the legislative, executive and judicial authorities is essentially a fundamental rule of political proportionality, and the

degree of concentration of power in one of the branches is an unbalanced proportionality that reflects the specifics of the national-state and cultural-historical state of society.

Analyzing the recent amendments to the Constitution of the Russian Federation, D. Semushin gives a rather politicized assessment of the changes that have occurred in the relationship of various branches of government. Comparing the changes in the powers of the Government and the State Duma, he notes that against this solid background, the State Duma receives only a fraction of the “responsible Government” [3]. As a result, the Constitutional Court will get the most from the constitutional changes.

A review of the literature revealed problematic issues that require additional and objective study. In this article, we will consider the mechanisms of checks and balances between the branches of government and state bodies based on the analysis of the constitutional amendments of July 1, 2020. The separation of powers in the modern world is a universally recognized norm of a democratic state. A necessary condition for the development of democracy is the absence of concentration of all power "in one hand".

The foundations of the modern theory of separation of powers were laid in the modern era by famous philosophers T. Hobbes, J. Locke, Charles Louis Montesquieu, who argued that, on the one hand, the political process of separation of powers should be based on a social contract, becoming the founders of the “contractual” theory of the origin of the state. However, the implementation of this theory was seen in different ways. In the modern world, the “contractual” theory has found its practical implementation in the Constitution, the purpose of which is to regulate public relations by consolidating the principle of separation of powers used in a democratic regime.

Despite numerous studies of state authorities and the principle of separation of powers, they refrain from defining the branch of government.

Traditionally, it is considered that power is an opportunity, as well as the ability of certain subjects of social relations-the individual, class, state-to influence the will and behavior of individuals and their groups through such means as authority, tradition, coercion, etc.it is difficult to argue with this statement.

Today, there are three branches of government. The rule of division of power between the legislative, Executive and judicial authorities is essentially a fundamental rule of political proportionality, and the degree of concentration of power in one of the branches is an unbalanced proportionality that reflects the specifics of the national-state and cultural-historical state of society.

Looking at various scientific works, it seems that the prevailing view is that the presidential branch of government should be separate, along with the legislative, Executive and judicial branches. In addition, there is still an unresolved issue regarding the classification of banking authorities as branches of state power.

The main features of building a theoretical model of power sharing are the constitutional consolidation of exclusive powers and independence from other state

authorities. In a democratic state, a special mechanism of interaction between the branches of government is created, based on constant mutual control, which does not allow any one branch to assign all power to itself, exceeding its constitutional powers. This mechanism is called the system of “checks and balances”, which is aimed at protecting the interests of the state, society and the individual.

With the adoption of amendments to the Constitution of the Russian Federation, there was an institutional redistribution of powers between the branches of government. In the sphere of legislative power, the powers of the Federation Council have been expanded in terms of appointing and terminating the President of the Russian Federation, the Chairman of the constitutional Court of the Russian Federation and his Deputy, as well as the appointment of the Chairman of the Supreme Court of the Russian Federation and his deputies.

Thus, if we consider such interaction of the authorities under the prism of "checks and balances", we can talk about a certain influence of the legislative power on the judicial power.

An innovation in the powers of the Federation Council is to hold consultations on candidates proposed by the President for the positions of heads of Federal Executive bodies (including Federal Ministers) responsible for defense, state security, internal Affairs, justice, foreign Affairs, emergency prevention and disaster management, and public security. The powers of the State Duma have been supplemented with the approval of candidates for deputies and Federal Ministers on the proposal of the Prime Minister of the Russian Federation, with the exception of Ministers who are appointed on the proposal of the President after consultations with the Federation Council.

Thus, we can state that the State Duma has expanded its responsibility for approving the candidacies of the Prime Minister and Government Ministers. After approval, they are appointed by the President. The President cannot reject them. In this case, the direct influence of the legislative power on the formation of Executive bodies is traced.

Another significant innovation in the powers of the State Duma is the hearing of annual reports of the Central Bank of the Russian Federation. Earlier, the State Duma in relation to the activities of the Central Bank of Russia participated only in the appointment and dismissal of its Chairman. As we can see, the powers of the State Duma have become more significant, since the main Bank of the country will be required to report on the results of its work.

It is important to note that the exclusive right of the Central Bank of Russia to issue money is constitutionally established. The Central Bank exercises its functions and powers independently of Federal government bodies, state authorities of the Russian Federation's constituent entities, and local self-government bodies. A feature of the public law status of the Central Bank is reflected in the fact that, on the one hand, he is not a public authority, but, however, its powers in its political-legal nature related to the functions of

independent branches of state power, because their implementation involves the application of measures of state coercion.

Now the Federation Council and The State Duma have the right to exercise parliamentary control and send parliamentary requests to the heads of state and local self-government bodies. In this case, we can state a new form of interaction between the Supreme legislative body of the country and other state authorities and local self-government bodies.

Considering the judicial power from the point of view of the impact of constitutional changes, the constitutional Court, which becomes the Supreme arbiter, has received more significant privileges in possible disputes between the Executive and legislative branches when passing laws.

Significant changes have affected the Executive branch, which is generally managed by the President of the Russian Federation, and this wording has been supplemented by amendments to the Constitution. The Prime Minister organizes the work of the Government and is personally responsible for the exercise of powers by the Government of the Russian Federation.

The government of the Russian Federation manages the activities of Federal Executive bodies, with the exception of Federal Executive bodies whose activities are managed by the President of the Russian Federation. The procedure for forming the government of the Russian Federation has changed. One part of the Government, headed by the Prime Minister, is approved by deputies of The State Duma. The President "appoints" the other part of the Government after "consultations" with the Federation Council.

The main advantage of the President in relation to the responsibility of the Government is that only he "relieves from office". The latter makes the Prime Minister, his deputies and Ministers "responsible" to the President, not to The State Duma. On the side of the Executive power is the State Council in a new status, formed by the President of the Russian Federation based on the territorial principle of territorial development.

Thus, the appearance of a new authority indicates a shift in the balance of the "scales of power" in the direction of the executive branch. A very significant innovation in the Constitution is the concept of "public power", which should be understood as the power functions of state bodies and municipal self-government bodies that are part of a single system of "public power" and interact to effectively solve problems in the interests of the population living in the relevant territory.

In addition, according to the innovations, state authorities can participate in the formation of local self-government bodies, the appointment and dismissal of local government officials. Earlier, this right did not exist for state authorities. These provisions eliminate the existing contradiction of reality with the constitutional provisions.

The results show that the constitutional amendments affected every branch of government. The legislative branch has expanded its responsibility for approving the candidacies of the Prime Minister and Government Ministers.

In General, the amendments to the Constitution of the Russian Federation have had a noticeable impact on strengthening the role of the presidential power and shifting powers towards the Executive power. In the judicial branch, as previously noted, the constitutional Court has received significant privileges.

Summing up the research, it should be noted that all branches of government are closely interrelated, but each has exclusive powers. However, we believe that in modern conditions, in addition to the classical triad of branches of government: legislative, Executive and judicial, we should highlight the special powers of the Central Bank of the Russian Federation and the increasing role of municipal self-government bodies. The balance of power is preserved thanks to a key component of the principle of separation of powers – a system of checks and balances. Each state independently decides how to maintain a balance between the branches of government, based on the specifics of its development.

References

1. Mongush O.O. Modern approach to the interpretation of the principle of separation of powers in Russia [Symbol of science]. Political Sciences, 2019, No. 6, pp. 56-58. (Rus)
2. Sanzharevsky I.I. On the issue of concepts of a service and strong state and modern modernization of political management [Messenger bags], 2014, pp. 12-15. (Rus)
3. Semushin D. Cel' popravok v Konstituciyu - povysit' «obshchestvennuyu vlast'» v Rossii [The purpose of amendments to the Constitution is to improve the “public power” in Russia]. URL: <https://eodaily.com/ru/news/2020/01/23/cel-popravok-k-konstitucii-sovershenstvovanie-publichnoy-vlasti-v-rossii>. (Accessed 02.11.2020). (Rus)

ВЛИЯНИЕ КОНСТИТУЦИОННЫХ ПОПРАВOK НА ПЕРЕРАСПРЕДЕЛЕНИЕ ПОЛНОМОЧИЙ МЕЖДУ ОРГАНАМИ ВЛАСТИ

Е. А. Кузнецова, С. А. Фролов

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: kaesa5@yandex.ru, seif.saf@ramler.ru

Аннотация. Рассматриваются произошедшие изменения в перераспределении полномочий между законодательной, исполнительной и судебной властью. Затрагивается проблема взаимоконтроля ветвей власти. Освещаются наиболее значимые конституционные нововведения, произошедшие с органами государственной власти.

Ключевые слова: власть, государственная власть, Конституция РФ, перераспределение полномочий, публичная власть, система сдержек и противовесов, теория разделения властей.

The Role of the HR Management System in Marketing Research

A. Yu. Metalnikov, E. N. Popov

Tambov State Technical University, Tambov, Russia

email: ametalnikov@list.ru

Abstract

The article studies the problem of the influence of the HR management system in marketing research. Two approaches to evaluating the effectiveness of the influence of the HR management system on marketing research are presented. The conclusion about the role of the HR management system in marketing research is made.

Keywords: influence, marketing research, HR management system, role.

Currently, due to the growing competition in the market, more and more organizations have started to engage in market research. Therefore, new employees and departments dealing with this problem have started to appear in enterprises. Subsequently, many organizations begin to experience difficulties in financing these structures. In most cases, this is due to bad decisions of senior managers who did not provide for the introduction of additional links in the company's management structure.

In this article, we will find out whether the HR management system affects marketing research. The research includes three stages:

(1) At the first stage, we will consider the basic concepts of the personnel management system.

(2) At the second stage, we will consider the terminology of marketing research.

(3) At the third stage, we will study approaches to evaluating the effectiveness of the HR management system in marketing research.

In the scientific literature, the personnel management system is understood as a set of techniques and methods of influence by an enterprise on its employees in order to maximize their potential to achieve production goals. It includes the organization of work, i.e. recruitment, placement, monitoring labor activity, and the informal and socio-psychological nature, namely, adaptation and motivation of personnel, creation of favorable psychological climate of collective and so on [2]. At the enterprise, team management is an integral system, at the core of which is the relationships of various actions. If these links are broken, the organization's performance decreases, which can lead to sad results. Thus, it is necessary to build the most "flexible" management system that can change if necessary.

The term "marketing research" is considered by many authors of scientific papers as a systematic search, collection, analysis and presentation of data and information related to a specific market situation that an enterprise had to face [1]. In other words, the main purpose of the research is to identify effective ways to

conduct the company's market policy. Therefore, the results of the research have a strong impact on the operation of the enterprise as a whole, up to complete changes in the priorities of activity.

How did the personnel management system at the enterprise is affected by marketing research? To answer this question, we must consider several approaches to evaluating the effectiveness of this.

In [4], F. G. Pankratov and T. K. Seregina identified several methods for evaluating the impact of the personnel management system on marketing research in their scientific work.

In practice, the most common assessment methods are quantitative. One of its main advantages is its objectivity and the use of mathematical methods. A frequently used scoring method is the point system. Descriptive methods include group discussion and matrix system. Their positive side can be considered to be visibility. An example of an intermediate method is testing. Its main advantage is a combination of the strengths of quantitative and descriptive methods. But, as a rule, organizations do not use it because of the large number of costs.

Pankratov F. G., Seregina T. K. found out that the personnel management system directly affects marketing research. In their opinion, the more resources are invested in the management system, the more accurate the research becomes.

In our opinion, this is not entirely correct, because marketing research can be conducted not only in marketing departments, but also in other departments. Unfortunately, and not infrequently, research is done by people who have other job responsibilities. In this case, “infusing” resources only into the management system will not improve the quality of marketing research. Also, these methods describe only superficially the degree of dependence, without taking into account various criteria.

Therefore, J. M. Ivantsevich and A. A. Lobanov concluded that in addition to using the above methods, it is necessary to take into account a number of factors that affect the personnel management system and marketing research. These criteria are: economic efficiency of the system (performance indicators of the entire personnel management system and individual structural divisions; the cost of the program being evaluated per employee); indicators of the degree of compliance of the management system and the quality of marketing research; the degree of satisfaction of workers (wages; the situation in the work team); indirect indicators of employee performance (staff turnover; marriage; frequency of requests for transfer to other jobs; number of complaints; occupational safety and number of accidents; other indicators of labor quality).

These indicators and their combinations show the effectiveness of the management system and each structural unit. However, these criteria do not take into account the impact of marketing research conducted if it is carried out by another department or organization.

Another criteria were added by E. B. Figurnov - the difference in labor productivity levels, their ratio; saving the number of employees as a result of increasing output while increasing labor productivity [3].

The researchers agree that the personnel management system affects marketing research only indirectly. They concluded that even the criteria they named should be taken into account along with other factors that directly affect the performance of the enterprise.

Thus, we can say that the HR management system does not directly have a major role in marketing research. It is one of the parts of a whole group of criteria that influence the organization and the research in particular. Therefore, it is necessary to focus on other aspects of the company's activities, which will improve the quality of marketing research.

References

1. Bagiev G.L., Tarasevich V.M., Ann X. Marketing [Marketing]. M.: Economica, 2000, 372 p. (Rus)
2. Bogdanov Yu.N., Zorin Yu.V., Shmonin D. A., Yarygin V. T. Motivaciya personala [Personnel motivation]. Metody menedzhmenta kachestva, 2007, No. 11, 14 p. (Rus)
3. McDonald M. Strategicheskoe planirovanie marketinga [Strategic planning of marketing]. St. Petersburg: Peter, 2000, 430 p. (Rus)
4. Pankratov F. G., Seregina T. K. Kommercheskaya deyatelnost' [Commercial activity]. M.: Information and implementation center «Marketing», 2000, 267 p. (Rus)

РОЛЬ СИСТЕМЫ УПРАВЛЕНИЯ ПЕРСОНАЛОМ В МАРКЕТИНГОВЫХ ИССЛЕДОВАНИЯХ

А. Ю. Метальников, Е. Н. Попов

Тамбовский государственный технический университет, Тамбов, Россия
email: ametalnikov@list.ru

Аннотация. Рассмотрена проблема влияния системы управления персоналом в маркетинговых исследованиях. Представлены два подхода к оцениванию эффективности влияния системы управления персоналом на маркетинговые исследования. Сделан вывод о роли системы управления персоналом в маркетинговых исследованиях.

Ключевые слова: влияние, маркетинговые исследования, роль, система управления персоналом.

УДК : 657.4=11
ББК : У 052.20
0- 583

Economic Reading of Financial Statements

Oyono Ondo Fructuoso Oyono

Tambov State Technical University, Tambov, Russia
e-mail:virginiaeyan90@gmail.com

Abstract

The article outlines one of the important problems for economists, i.e. the ability to read numbers in financial statements. The relevance of the study lies in the fact that the economic reading of financial statements is one of the important problems for economists, statisticians and other categories of specialists. The purpose of this article is to study the economic reading of financial statements with an example at a specific enterprise OJSC KF TAKF.

Keywords: financial statements, balance sheet, liquidity, solvency, enterprise, calculations, economic reading.

Economic reading of financial statements involves understanding of the figures, distribution, change in financial resources and economic resources, as well as the financial condition of the enterprise for the reporting period. As a result of this reading, the information contained in the accounting statements, as well as in its forms, is recognized.

The relevance of the study lies in the fact that in the economic reading of financial statements is one of the important problems for economists, statisticians and other categories of people.

In any organization all accounting reports form the accounting and financial services. Their reports include not only the working results of the accounting department itself, but also the results of the entire organization's activities. The head of the enterprise, before signing the accounting statements submitted to him/her, must first make sure that the accounting statements are compiled, determine the level of economic condition of the enterprise by evaluating the balance sheet items and other forms and their changes for the year.

It should be noted that reading accounting reports for a competent analyst gives an idea of many factors of the company's activity and the level of work of its managers. In practice, there are several simple techniques that allow you to evaluate the work of the enterprise under study on its balance sheet quickly and effectively. This skill is extremely important for evaluating the possibility of obtaining loans or attracting investment. It should be understood that accounting statements are a kind of photograph of what the company has and the sources of its appearance. Accounting is tied to a specific time; it can be for quarter, semester, or annual. In the accounting statements, the balance is presented between the company's property (its assets), and from which sources of financing this property was formed (its liabilities or obligations) [1].

It should be noted that the most important characteristic of the current economic situation of an organization is its ability to pay its various obligations in a timely manner. This ability, or liquidity, depends on the degree to which the amount of available payment resources corresponds to the amount of short-term debt obligations.

Analysis of the balance sheet's liquidity allows you to determine the degree of reliability of its asset, that is, the conversion of property into cash and the redemption of the balance sheet's liability by paying for fixed-term obligations. If the assets sold provide sufficient amounts to settle the obligations, the balance sheet will be liquid and the organization will be solvent.

The analysis of solvency (liquidity) is carried out in accordance with the 2nd section of the balance sheet asset, which reflects current assets that can be converted into means of payment and act as a source of repayment Short-term debt obligations are reflected in the 5th section of the balance sheet liability.

An economic reading of an organization's liquidity can be performed using relative indicators [2]:

1. Absolute liquidity ratio. This is the strictest measure of an organization's liquidity; it shows how much of its short-term loans can be repaid immediately, if necessary. It is defined as the ratio of cash and market securities to short-term liabilities. Theoretically, this indicator is considered sufficient if its value exceeds 0.2-0.25.

2. Intermediate liquidity ratio. This ratio determines the ability of an organization to repay short-term liabilities in cash, short-term investments, and settlement funds. An organization is considered liquid if the intermediate liquidity ratio exceeds 0.5.

3. Total liquidity ratio. It is defined as the ratio of current assets to current liabilities. This ratio shows the extent to which short-term accounts payable are secured by tangible working capital.

Table 1. Degree of coverage of obligations of JSC Company Confectionery firm TAKF 2017-2019

Grouping of assets (A) according to the degree of the face	2019	2018	2017	Group of liabilities (P) under St-Ni repaid	2019	2018	2017
A1	4682	11779	22016	P1	995186	922322	730802
A2	380033	353327	175005	P2	-	-	-
A3	340812	266471	235870	P3	2605	3717	4407
A4	1103070	1112261	1087693	P4	811335	798733	766838
Balance	1828597	1743838	1520584	Balance	1828597	1743838	1520584

The higher this value the greater the confidence in paying short-term obligations. When calculating this indicator, it is necessary to take into account the fact that it's too high value can also be unfavorable, which indicates an incorrect formation of finances in the organization and generally reduces the effectiveness of its activities [3].

Further, using the example of the company JSC KF TAKF, we will show the Degree of coverage of obligations of JSC Company Confectionery firm TAKF 2017-2019

Reading the company's liquidity analysis is the calculation of liquidity ratios [4].

1) Absolute liquidity Ratio-shows how much of the company's short-term liabilities can be repaid immediately with cash and short-term financial investments:

$$\text{To the absolute} = A1 / (P1+P2) > 0.2-0.5$$

2) coefficient of interim coverage (critical liquidity) - shows how much of the company's short-term liabilities can be repaid by mobilizing short-term DZ and short-term financial investments (CFR):

$$\text{To Crete. lick} = (A1+A2) / (P1+P2) > 0.7-1.$$

3) current liquidity ratio (current ratio), or working capital quota (working capital ratio) - shows the excess of current assets over short-term liabilities .

$$\text{To the tech. } \langle \text{hurl} \rangle = (A1+A2+A3) / (P1+P2) = > 2$$

Table 2. liquidity Ratios Of JSC Confectionery firm TAKF 2017-2019

Indicators	2019	2018	2017
The cubs.	0.01	0.01	0.03
Crit. likv.	0.4	0.1	0.3
Ktek. <url>.	0.7	0.7	0.6

Fig. 1 shows the dynamics of the liquidity ratios of JSC KF TAKF for 2017-2019.

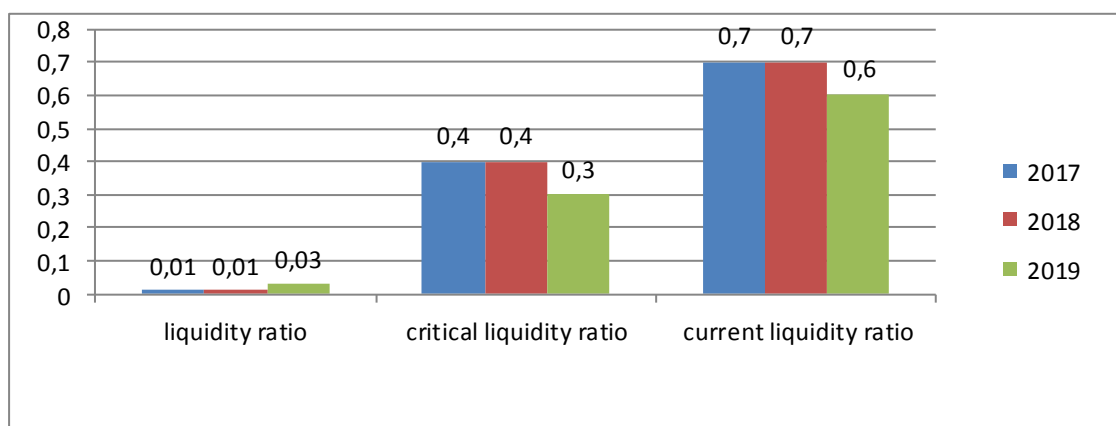


Fig. 1. Dynamics of liquidity ratios of JSC KF TAKF for 2017-2019

Thus, the liquidity ratios do not correspond to the standard value, which indicates problems with the solvency of the enterprise.

Based on the results of the analysis, it can be noted that the balance of the JSC KF TAKF 2016-2018 is solvent, but it is not absolutely liquid for 2018, as the first and fourth liquidity conditions are not met.

Thus, the problem of further improving the reading of accounting reports is constantly in the focus of attention of practitioners in Russia and abroad, which once again underlines its importance and relevance.

Note that for a deeper economic reading of financial statements, it is necessary to identify the causes and factors that affect the change in property status. As well as on the indicators of the financial condition of the enterprise, it is necessary to conduct an analysis of financial and economic activities at enterprises, and on this basis, develop recommendations for making management decisions to eliminate the identified shortcomings and improve the efficiency of using financial resources.

References

1. Abdugarimov I.T. Rol' i znachenie buhgalterskogo balansa dlja finansovogo upravlenija kommercheskimi predprijatijami [Role and significance of the balance sheet fort financial management of commercial enterprises]. Socio-economic phenomeno and processes, 2012. No. 11. (Rus)

2. Abdugarimov I.T. Monitoring i analiz sostojanija i dvizhenija. Uchet i analiz: uchebnoe posobie [Monitoring and analysis of the state and movement Accounting and analysis: textbook]. M.: Knorr, 2014, 405 p. (Rus)

3. Belaja M.A. Metod chtenija buhgalterskogo balansa [Method of reading the balance sheet]. Teht: direct Joung scientist, 2018, 3(107), pp. 470-472. (Rus)

4. Mikituho A.A. Sistema organizacii ucheta i analiza raschetnyh operacij predprijatija [System of organization of accounting and analysis of settlement operations of the enterprise]. Modern high-tech technologies, 2018, No.7-1, pp. 170–171. (Rus)

ЭКОНОМИЧЕСКОЕ ЧТЕНИЕ БУХГАЛТЕРСКОЙ ОТЧЕТНОСТИ

Ондо Эянг Фруктуосо Ойно

Тамбовский государственный технический университет, Тамбов, Россия

e-mail:virginiaeyan90@Gmail.com

Аннотация. В статье излагается одна из важных проблем для экономистов, это умение читать цифры в бухгалтерской отчетности. Актуальность исследования заключается в том, что в экономическое чтение бухгалтерской отчетности является одной из важных проблем для экономистов, статистов и других категорий лиц. Целью данной статьи является изучение экономического чтения бухгалтерской отчетности с примером на конкретном предприятии ОАО «КФ» «Такф».

Ключевые слова: бухгалтерская отчетность, бухгалтерский баланс, ликвидность, платежеспособность, предприятие, расчеты, экономическое чтение.

Integration of Commercial Companies into Mass Events in the City of Tambov

A. Petrenko

Tambov State Technical University, Tambov, Russia
**e-mail: nastasya-petrenko@inbox.ru*

Abstract

The purpose of this work is to prove the profitability of integrating commercial companies into events, to analyze the events of the city of Tambov and to identify ways of participation. The relevance lies in the need for companies to look for new ways to promote and fight for consumer loyalty in today's market.

Keywords: city events, sponsorships, events, customer loyalty, of commercial companies.

Commercial companies often resort to such a method of advertising as participation in urban mass events. It is worth figuring out whether it is worth integrating into events and considering the possibilities of companies within the events of the city of Tambov.

Advertising surrounds the consumer everywhere: on the way to work, in a store, in transport, an elevator, at home. He becomes more selective. If some time ago there was a bright billboard and memorable text, now several people out of a hundred will pay attention to such advertising. Therefore, participation in city events, which will be talked about, written and told about, becomes a paramount task for marketers and PR specialists of large and small companies. And for agencies, the development of original strategies is becoming a way to survive in a highly competitive advertising market.

Let me consider the concept of "event". Dr. Joe Goldblatt, Professor, defined the event as a unique time spent using rituals and ceremonies to meet specific needs. A.V. Shumovich interprets the concept as follows: an event is a type of human activity that involves the meeting and interaction of different people, limited in time and associated with the implementation of any common goals [1].

One of the ways to save budget, but still get a stream of potential customers, is to integrate into city events. These events are usually funded by the city administration and / or sponsors.

Sponsorship is a form of promoting the interests of an organization by supporting socially significant initiatives. The goal of sponsorship is to raise awareness of the brand, company, the disposition of the target audience and the general public towards it, improve its image or reposition it due to its association with positive values that are significant for many, and especially for the target audience. Unlike advertising and PR, it is perceived as less intrusive and therefore more "honest" form of communication. The main idea is that the sponsor "binds" himself to the object of sponsorship and thus tries to "transfer" to himself all the positive characteristics of the object C. and / or positive feelings associated with it [1].

One of the significant advantages is the coverage of the city event in the media. Journalists willingly cover such events in their publications. Members receive free publicity in regional news.

In Tambov, the “Calendar of Events of the Tambov Region” is annually formed and posted on the website <http://turtmb.ru/>. This list is formed on the basis of applications from the organizers. It includes both commercial and non-commercial events. The selection of events takes into account the quality of the organization, the availability of tourist infrastructure, a positive response among the population and tourists, and the demand for the event [2].

Consider the most significant events in the Tambov, according to the author, and the opportunities for organizations to participate.

The Lysogorsk Sledge Festival is one of the largest mass winter events held in the Tambov Region. The site covers 20 hectares of land, completely protected from the wind, with a large number of slides of varying difficulty, a stage and a huge number of various photo zones, cafes and other locations from partners and participants of the festival. Near the bustling city, people get a natural winter paradise for two days with a lot of entertainment and activities.

A company or brand gets many opportunities such as representation of the general partner on banners, social networks, promotional videos, establishment of its own nominations in the Creative Sleigh competition, a place for a point of sale and entertainment. In 2019, the Globus Automobile Group became the general partner. Marketers decided to exhibit the best-selling car brands, test-drive off-road vehicles, treat people to hot drinks and sweets, and put up two large photo zones.

“Maslenitsa” and “City Day” in the City Park of Culture. The Park of Culture and Leisure is a platform with phenomenal traffic, a rich creative program, a comfortable stage and an alley for organizing various actions and promotional events. It is possible to coordinate the work of the presenter, promoters, animators, set up a tent or pavilion, place a banner on a stage or skirt, place your own photo zones and other advertising structures.

The park's traffic on Shrovetide day is more than 30,000 people, and on City Day more than 50,000 people. This is the city's main platform for festivities. Participation options: placing a banner on the backdrop of the stage, placing a banner on the skirt of the stage, playground. Possibility of presenting gifts from the stage, holding a thematic competition, promotional text from the hosts. Additional options are possible: placing the logo on the event announcement banner, in the official group of the park, etc. Frequent partners are: TM “Sloboda”, TM “Nasha Ptichka”, “Rosbank”, TM “Tess” and others.

The largest event, in the opinion of the author, is the International Pokrovskaya Fair, which revives the historical, labor and cultural traditions of the Tambov region, shows the identity of rural areas, and establishes regional and international business contacts.

The history of the Pokrovskaya Fair in Tambov dates back to the 18th century. The fair got its name from the holiday of the Intercession of the Most Holy

Theotokos, which is special for the city: on this day in 1637, the temple was consecrated, which became the first in the fortress of Tambov. This event determined the time and the place of the fair – the weekend closest to the Intercession and the most picturesque area of the city of Tambov - the embankment near the Intercession Church, an area of 60,000 square meters [3].

The company receives free of charge a place for trading or advertising. Most of the companies in the city take an active part in this event. This is the most walkable area in the region. In 2018 and 2019, a large number of companies took part, some of them: “Zhupikov”, ТМ “Nasha Ptichka”, ТМ “LADA”, “KIA”, “MTS”.

Participation of companies in such events provides live communication with potential consumers, makes it possible to declare themselves, present a new brand or increase the recognition of an existing one. For a commercial organization, participation should be thoughtful and carefully prepared. [4] The main goal here is to create a positive impression, vivid and memorable emotions among potential consumers.

People go to the holidays voluntarily, so they don't feel like the marketing information is imposed on them from the outside. The positive emotions received at the event are transferred to the product or service, and consumer loyalty is formed. It is important to choose exactly the one that will be attended by the target audience of the company, as well as to define goals and objectives. In time and after the company gets the effect of word of mouth, a bright event, a pleasant memory, an occasion to share with friends and relatives.

References

1. Shumovich A.V. Velikolepnye meropriyatiya: tekhnologii i praktika event-management [Great events: technologies and practice of event-management] M.: Mann, Ivanov and Ferber, 2006. (Rus)
2. Pankrukhina A.P. Marketing: bol'shoj tolkovyj slovar' [Marketing: a large explanatory dictionary] M.: Omega-L. Ed., 2010. (Rus)
3. URL://turtmb.ru/ (Rus)
4. Bondarskaya T.A., Bondarskaya O.V. Marketing v upravlenii i razvitiiterritorii malogo goroda: perspektivy povysheniya kachestva zhizni naseleniya [Marketing in the management and development of the territory of a small town: prospects for improving the quality of life of the population]. Questions of modern science and practice. University named after I.V. Vernadsky, 2013, 2 (46), pp. 160-165. (Rus)

ИНТЕГРАЦИЯ КОММЕРЧЕСКИХ КОМПАНИЙ В МАССОВЫЕ МЕРОПРИЯТИЯ ГОРОДА ТАМБОВ

А. Петренко

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: nastasya-petrenko@inbox.ru

Аннотация. Цель данной работы доказать рентабельность интеграции коммерческой компаний в мероприятия, провести анализ событий города Тамбова и выявить способы участия. Актуальность заключается в необходимости компаний искать новые способы продвижения и бороться за лояльность потребителей на современном рынке.

Ключевые слова: городские мероприятия, спонсорство, события, лояльность потребителей, коммерческие предприятия.

Separate Factors Influencing Fraud in the Sphere of Compulsory Health Insurance

K. Y. Puzyreva

Tambov State Technical University, Tambov, Russia
e-mail: Kristina_68_036@mail.ru

Abstract

The healthcare system in Russia, built on the principle of compulsory medical insurance, suffers significant damage from fraud every year. A criminological study of fraud in the field of compulsory health insurance will help identify directions in the work to eliminate the causes and conditions for committing crimes. The article contains a description of the classic fraud scheme, which is an important step in the study of the determination of crime in the health care system in terms of insurance medicine

Keywords: fraud in the compulsory health insurance system, financing of medical organizations, false entries in medical records.

The current stage of the formation of Russian society is inextricably linked with the processes of the formation of the rule of law, which are inconceivable without a conscious criminal law and socio-economic policy aimed at ensuring the protection of the individual, society and the state from any crime [1]. Within the framework of such forms of policy, the issues of crime prevention in the field of compulsory health insurance deserve special attention. As the results of our research show, the situation with crime in this area requires close attention not only of law enforcement officials, but also of scientists, politicians and all concerned people in our society.

This situation has been especially acute in recent years. From the materials of various categories of criminal cases, let us single out the crimes associated with the detection of deliberately falsified entries in medical records. Moreover, it was precisely the measure of preventive digital control of the activities of health authorities that allowed the detection of this crime, namely, the appearance of a special service on the portal of public services, which allows you to check the list and cost of medical services provided to a citizen for a given period. In different regions of the country, a similar electronic service operates on the websites of territorial compulsory health insurance funds. Here are some data on the detection of such crimes. So, in the city of Saratov in 2019, according to patients' reports, mass false entries were found in the medical records of state healthcare institutions [2]. In Bashkiria, at the end of 2019, medical workers were brought to criminal responsibility for the notes found in the records of inpatients [3]. In Novgorod, a doctor was convicted in March 2020 for an addition of 7.4 million rubles [4]. In St. Petersburg, a general practitioner was sentenced to three years probation for false entries [5]. This list can be continued for a long time. However, the most important

thing for a person is not information about how law enforcement agencies investigate crimes committed and what percentage of their disclosure, but the presence of an appropriate system of measures to ensure the protection of his rights and freedoms from these crimes [6].

After all, as some authors point out, according to the estimates of specialists from the Institute for the Development of Public Health, three out of four medical institutions are registered [7].

Based on these and other data of our study, we can conclude that making deliberately false entries in the medical records of patients is becoming a common phenomenon in the Russian healthcare system. We believe that one of the reasons for these actions is the method of financing medical organizations for compulsory health insurance. For example, fraudulent actions of doctors and employees of medical institutions can manifest itself in invoicing for procedures that were not actually carried out, in writing off medications, and in drawing up documents for a patient's visit to a clinic [8]. This type of fraud is carried out by making false entries in medical records and receiving funds from insurance companies to pay for insurance claims. The insufficient effectiveness of preventive work on these crimes reflects not only the weakness of law enforcement or judicial authorities.

The problem is that the content of modern prevention, control or prophylaxis programs initially includes difficult-to-solve problems, where one goal is replaced by another larger one." [9]. Therefore, when creating a system of crime prevention measures in this area, it is required to understand the mechanism of committing these crimes, which is as follows. A medical organization operating in the system of compulsory health insurance (including private medical organizations) provides medical services to the population according to plans. Plans for medical organizations are allocated by setting the volume of medical care for the year. A case of medical care is registered through the maintenance of primary medical records.

When fraud is committed, "pseudo-patient" medical records are created or new records of received medical services are added to "real" patient records. Based on the data of the primary documentation based on the results of the period of work (more often than a month), a register of accounts is formed in accordance with the terms of the contract for the provision and payment of medical care the named contract is concluded between a medical organization included in a special register and an insurance company [10, art.39]. On the basis of the register of invoices and in accordance with the named agreement, the insurance company accepts and pays invoices. At the same time, the insurance company does not have the opportunity to check the difference between real and false information about the number of medical services provided, i.e. insurance cases. Insurance company, according to the financial security agreement [10, art. 38] receives earmarked funds to pay for medical care from the territorial compulsory health insurance fund.

When qualifying such acts, criminal cases are initiated either under Article 159 of the Criminal Code of the Russian Federation "Fraud", or under Article 159.5 of

the Criminal Code of the Russian Federation “Fraud in the field of insurance”.

Investigating the issues of criminal-legal assessment of these crimes, we believe that the social danger of these crimes lies not only in the distortion of statistical data on the number, types and volume of medical care provided to citizens, but also reduces the quality of management decisions made by senior officials of the state health system.

Based on the above, a conclusion should be drawn. In order for the concept of social conditionality of the sphere of compulsory health insurance to "fulfill all its functions, it becomes necessary to consolidate a special system of protective measures" [11]. For example, it is necessary to build a system of digital public control of all records in the compulsory health insurance system. We also propose to use the results of criminological research on this problem, which will allow us to theoretically comprehend the determinants and ways to reduce the latency of crime in the field of compulsory health insurance.

References

1. Zheludkov M.A. Obosnovaniye realizatsii sistemnykh zashchitnykh mer v mekhanizme preduprezhdeniya korystnoy prestupnosti [Justification of the implementation of systemic protective measures in the mechanism of preventing selfish crime]. Vestnik Volgogradskoy akademii MVD Rossii, 2014, No. 4 (31), pp. 47. (Rus)

2. Butenko T.V. Feykovaya meditsina: rossiyskiye bol'nitsy «lechat» patsiyentov bez ikh vedoma, osvvaivaya milliardy rubley [Fake medicine: Russian hospitals "treat" patients without their knowledge, spending billions of rubles]. URL: <https://nversia.ru/news/feykovaya-medicina-rossiyskie-bolnicy-lechat-pacientov-bez-ih-vedoma-osvvaivaya-milliardy-rubley-rasskazyvaem-pochemu-eto-proishodit-i-kak-proverit-svoyu-istoriyu-bolezni/> (Accessed 01.10.2020). (Rus)

3. Korshun S. V Bashkirii dvukh vrachey sudyat za pripiski [In Bashkiria, two doctors are tried for false entries]. URL: <https://otr-online.ru/news/v-bashkirii-dvuh-vrachey-sudyat-za-pripiski-138717.html> (Accessed 01.10.2020). (Rus)

4. Kamayev D. Vrach novgorodskoy chastnoy kliniki poluchil tri goda uslovno za pripiski po OMS na 7,4 milliona rubley [A doctor of a Novgorod private clinic received a three-year suspended sentence for false entries an compulsory health insurance for 7.4 million rubles]. URL: <https://vademec.ru/news/2020/03/06/vrach-novgorodskoy-chastnoy-kliniki-poluchil-tri-goda-uslovno-za-pripiski-po-oms-na-7-4-mln-rubley/> (Accessed 01.10.2020). (Rus)

5. Vrach-terapevt poluchila tri goda uslovno za pripiski v meditsinskikh kartakh. Zhenshchina vnesla lozhnyye svedeniya o prokhozhdenii dispanserizatsii 17 patsiyentov [The general practitioner received a three-year suspended sentence for the entries in medical records. The woman entered false information about the medical examination of 17 patients]. URL: <https://konkretno.ru/kriminal/106174-vrach-terapevt-poluchila-tri-goda-uslovno-za-pripiski-v-medicinskix-kartax.html> (Accessed 01.10.2020). (Rus)

6. Zheludkov M.A. Nekotoryye aspekty primeneniya ponyatiy «poterpevshiy», «zhertva», «zayavitel'» pri rassledovanii prestupleniy [Some aspects of the application of the concepts "victim", "victim", "applicant" in the investigation of crimes]. Chernyye dyry v Rossiyskom zakonodatel'stve. 2017, No. 1, pp. 68. (Rus)

7. Timofeyev A.V. Protivodeystviye prestupleniyam v sfere obyazatel'nogo meditsinskogo strakhovaniya [Counteracting crimes in the field of compulsory medical insurance]. Vestnik Sankt-Peterburgskogo universiteta MVD Rossii, 2019, No. 1 (81), pp. 165-170. (Rus)

8. Yepifanova Ye.V. Obshchestvennaya opasnost' prestupleniy v sfere meditsinskogo strakhovaniya [Social danger of crimes in the field of medical insurance]. Leningradskiy yuridicheskiy zhurnal, 2013, No. 4 (34), pp. 218-225. (Rus)

9. Zheludkov M.A. Novyy vzglyad na kontseptsiyu ob"yekta zashchity ot korystnykh prestupleniy protiv sobstvennosti [A new look at the concept of an object of protection against mercenary crimes against property]. Vestnik Voronezhskogo instituta MVD Rossii, 2011, No. 1, pp. 47. (Rus)

10. Federal'nyy zakon ot 29 noyabrya 2010 g. № 326-FZ «Ob obyazatel'nom meditsinskom strakhovanii v Rossiyskoy Federatsii» [Federal Law of November 29, 2010 No. 326-FZ "On Compulsory Health Insurance in the Russian Federation"]. Rossiyskaya gazeta, 2010, No. 274. (In Russ.) URL: <http://home.garant.ru>. (Accessed 01.10.2020). (Rus)

11. Zheludkov M.A., Kovalevskiy V.Ye. Soderzhatel'nyy aspekt kvalifikatsii obshchestvenno-opasnogo deyaniya pri nezakonnem proniknovenii na balkon chuzhogo zhilishcha [The substantive aspect of qualifying a socially dangerous act in case of illegal entry into the balcony of someone else's home]. Ugolovno-pravovoye vozdeystviye i yego rol' v preduprezhdenii prestupnosti: sbornik statey po materialam IV Vserossiyskoy nauch.-prakt. konf. Saratov, 2019, pp. 140. (Rus)

ОТДЕЛЬНЫЕ ФАКТОРЫ, ВЛИЯЮЩИЕ НА СОВЕРШЕНИЕ МОШЕННИЧЕСКИХ ДЕЙСТВИЙ В СФЕРЕ ОБЯЗАТЕЛЬНОГО МЕДИЦИНСКОГО СТРАХОВАНИЯ

К. Ю. Пузырева

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: Kristina_68_036@mail.ru

Аннотация. Система здравоохранения в России, построенная по принципу обязательного медицинского страхования, ежегодно терпит значительный ущерб от мошенничества. Криминологическое исследование мошенничества в сфере обязательного медицинского страхования позволит обозначить направления в работе по устранению причин и условий совершения преступлений. Описана классическая схема мошенничества, что является важным шагом по исследованию детерминации преступности в системе здравоохранения в условиях страховой медицины.

Ключевые слова: мошенничество в системе обязательного медицинского страхования, финансирование медицинских организаций, ложные записи в медицинских картах.

Choosing a Preventive Measure against Accused Minors or Suspects

Yu. A. Shepeleva

Tambov State Technical University, Tambov, Russia
e-mail: yshepeleva55@mail.ru

Abstract

The features of choosing a preventive measure against a minor suspect or accused are considered. The problem of imperfect legal regulation of this institution is touched upon, since certain difficulties arise when assessing the grounds for choosing preventive measures against a minor.

Keywords: preventive measures, confinement, supervision of a minor, minor suspect or accused.

One of the main problems of the modern Russian state is the high level of crime among teenagers. At present, the main goals and objectives of state policy in the interests of children, based on well-known principles and rules of international norms, are fixed and outlined in the Russian Federation. All justice systems ensure that the rights of the child are respected and effectively guaranteed, taking into account the principles set out in the Council of Europe recommendations on child justice, the child's age, the level of maturity and assessment of the state of affairs in criminal proceedings.

The current international legal acts regulating the administration of justice for minors are very humane regarding the application of preventive measures to them. It is clear from the provisions of the Beijing rules that pre-trial detention of minors should only be used as a last resort and for the shortest period of time. And the most optimal solution would be to leave the majority of minors at large during the preliminary investigation and trial in a criminal case.

Preventive measures are one of the sets of preventive measures of procedural coercion, consisting in the deprivation or restriction of freedom of the accused, and in exceptional cases – of the suspect.

In Russian criminal proceedings, among the preventive measures regulated by it, the following are applied to minors: recognizance not to leave; personal guarantee; supervision of a minor accused; prohibition of certain actions; bail; house arrest; detention.

The detailed regulation of preventive measures by the procedural law does not give a legally fixed definition, however, it distinguishes them among the measures of procedural coercion by special features: (1) the application of preventive measures is permissible only to persons who are charged, and as an exception, to persons suspected of committing a crime; (2) the content of preventive measures is that they restrict the personal freedom of the accused for a certain period, which is expressed in extreme cases by complete isolation from society (House arrest, detention), as well as freedom of movement and communication, performing certain actions.

It should be noted that the age characteristics of the adolescent period, although they cause less stability of the personality system, but they do not create a fatal inevitability of illegal behavior.

A special measure of restraint applied exclusively to juvenile suspects and accused persons is to be placed under supervision (Article 105 of the code of criminal procedure of the Russian Federation). In fact, Article 105 of the criminal procedure code of the Russian Federation provides for two preventive measures: a) supervision of a minor suspect or accused by parents, guardians, Trustees or other trustworthy persons, and b) supervision of a minor suspect or accused by officials of a specialized children's institution in which he is located.

Supervision of a minor suspect or accused person consists in ensuring that the specified persons behave properly: do not leave their permanent or temporary place of residence without the permission of the inquirer, investigator or court; appear at the appointed time at the summons of the inquirer, investigator or court; do not interfere in any other way with the criminal proceedings. Parents, adoptive parents, guardians, guardians or other trustworthy persons in the care of a minor suspect or accused give a written commitment to ensure the supervision and proper behavior of the teenager.

The most lenient form of choosing a preventive measure is a subscription not to leave and proper behavior is also considered the most popular measure of restraint in relation to juvenile suspects or accused. This measure of restraint is explained in the presence of a minor at the place of residence (temporary or permanent, regardless of registration) for the purpose of timely arrival at the call of an inquirer, investigator or court, as well as not to interfere with criminal proceedings. The use of bail does not require constant monitoring of the location of minors on the part of bodies of preliminary investigation; therefore, minors have the right for a short time to leave the place of residence, for example, to continue training or employment.

House arrest is an alternative to remand in custody, provided that the case requires the isolation of a minor, but given the identity of the minor offender and other grounds, it is possible not to apply the extreme measure of remand in custody. In addition, house arrest should be of a short-term nature, which will not have a negative impact on the development of the minor's personality. Some authors, such as G. V. Kostyleva, G. V. Muzhenskaya, believe that the house arrest of a minor as a preventive measure is generally undesirable, due to the fact that the teenager is undergoing training, restriction of the minor's freedom of movement will negatively affect his development

The most severe measure is detention, which is manifested in the isolation of a minor from society and placing him in a place of detention. Detention refers to measures of state coercion that restrict the rights and freedoms of citizens, including the right to freedom and personal integrity. This measure of restraint may be taken in a criminal case initiated, applied to a minor accused, and in exceptional cases may be applied to a suspect.

It is obvious that there are problems in this area that need to be addressed by making changes to modern legislation regulating the specifics of choosing preventive measures against minors accused and suspects. Based on the above, the following changes can be made to the code of criminal procedure of the Russian Federation.

- It is necessary to introduce a set of restrictions that could be applied to a person who has not reached the age of maturity by a court decision, except for the chosen preventive measure in Article 423 of the Criminal Procedural Code of the Russian Federation. These include the restrictions stated in paragraph “d” of P. 2 Article 90, P.4 Article 91 of the Criminal Code and P.1 Article 107 of the Criminal Procedural Code of the Russian Federation.

- It is expedient to change the title of Article 105 of the Code of Criminal Procedure of the Russian Federation into: “The recognizance *not to leave* and to behave in the proper way”. This rule should include restrictions that characterize the behavior of a minor suspect (accused) in addition to the general restrictions that are specified in article 102 of the criminal procedure code of the Russian Federation “The recognizance *not to leave* and to behave in the proper way”.

- It is necessary to prohibit visiting certain places of leisure and other places specified in the decision on the election of a preventive measure and restrict staying out of the house for a certain period of time.

Other types of restrictions should not be applied in this measure of restraint, since their application is meaningless, or they cannot be controlled.

References

1. Ugolovno-protsessual'nyy kodeks Rossiyskoy Federatsii [Criminal Procedure Code of the Russian Federation]. No. 174-FZ dated 18.12.2001 (red. 01.04.2019). Sobraniye zakonodatel'stva Rossiyskoy Federatsii, 2001, No. 52, part I, art. 4921. (Rus)
2. Davydov V.A., Yershov V. V. Ugolovno-protsessual'noye pravo (ugolovnyy protsess): uchebnyy [Criminal procedure law (criminal procedure): textbook]. M.: Yurayt, 2016, 373 p. (Rus)
3. Bogomolov V.P. Aktual'nyye problemy ugolovnogo sudoproizvodstva v otnoshenii nesovershennoletnikh [Actual problems of criminal justice in relation to minors]. Vestnik V.I. MVD Rossii, 2010, No. 2, pp. 27-30. (Rus)

ИЗБРАНИЕ МЕРЫ ПРЕСЕЧЕНИЯ В ОТНОШЕНИИ НЕСОВЕРШЕННОЛЕТНЕГО ПОДОЗРЕВАЕМОГО И ОБВИНЯЕМОГО

Ю. А. Шепелёва

Тамбовский государственный технический университет, Тамбов, Россия

e-mail: yshepeleva55@mail.ru

Аннотация. Рассмотрены особенности избрания меры пресечения в отношении несовершеннолетнего подозреваемого или обвиняемого. Затрагивается проблема несовершенства правового регулирования данного института, так как при оценке оснований для избрания мер пресечения в отношении несовершеннолетнего возникают определенные затруднения.

Ключевые слова: меры пресечения, заключение под стражу, присмотр за несовершеннолетним, несовершеннолетний подозреваемый, обвиняемый.

The Economics of E-Sport

A. A. Shitikov*, E. V. Yartsev, A. V. Mihaylova

Tambov State Technical University, Tambov, Russia

*e-mail: *sanya99510@gmail.com*.

Abstract

The article deals with the history of the development of e-sports and its economics. Earning, income and expenses questions are discussed.

Keywords: advertising contracts, e-sport, money, salary.

Introduction

The entertainment industry, which relatively recently in some countries (including Russia) did not even claim the right to be called an independent branch of the economy, today continues its rapid development, forming new independent directions within itself. In addition to the media and Internet resources, film and music industry that have strengthened their positions, more and more attention of investors is attracted by professional sports, namely well-known sports clubs and major competitions.

The commercial success in these areas is driven primarily by the cost of broadcasting rights. At the intersection of sports and entertainment, e-sports is gaining momentum, which is not considered as a sport we are used to, but as a separate new direction in the field of entertainment. This is due to its specificity and structure.

The history of the development of e-sports

E-sport began with small championships, held by friends in computer clubs. The first tournaments were without prizes, and if the prizes did appear, they were very small. However, soon after that, full-fledged tournaments began to be organized, with a relatively large prize fund, coverage on Internet broadcasts (streams), sponsors, and teams representing entire e-Sports organizations. The most powerful impetus to the development of the industry in 2011 was put by Valve, which decided to present its Dota 2 game within Gamescom by organizing a tournament among the top 16 teams with a prize pool of \$ 1.6 million - a lot of money for those times [1]. The CIS team Natus Vincere became the winners, the players received \$ 1 million for five players.

Since then, the popularity of e-sports has gained momentum, which has attracted investors. In 2018, the global e-sports attracted, according to Deloitte's estimates, \$ 4.5 billion in investments, 56% of which came from venture capital funds. The motivation for investors is clear: the video game industry is growing every year in all directions. According to Newzoo's Global Esports Market Report 2020, in 2019 the global e-sports audience reached 454 million people (+ 22% over the last year), and turnover - \$ 960.6 million (+ 10%). At the same time, the

industry receives 2/3 of its income from the sale of media rights and sponsors [2].

Tournament operators, as well as lighting studios, earn money mainly from sponsorship contracts. Major sponsors include the streaming platform Twitch, gaming device makers HyperX, Razor, SteelSeries, and even automotive giants Mercedes-Benz and Toyota. The latter cooperates with the Russian organization Winstrike.

In addition to all of the above, e-sports organizations that sign players are involved in the sale of branded merchandise. Some go even further - for example, Natus Vincere launched the production of their clothing line, together with the designer Lilia Litovskaya [3].

Earnings in e-sports

In e-sports, unlike traditional team disciplines such as football, 80-90% of tournament prize money goes to players, not clubs. As a rule, the winnings are divided proportionally between the team members; sometimes the captain gets a little more. Also, a small percentage of the prize money is paid to the coach and analyst (up to 5% to each). The maximum salary for a player in e-sports reaches \$ 35,000 per month. Only the best players receive such money, there are not many of them in the world. Top-level players can look forward to \$ 10,000 - \$ 15,000, starting \$ 2000 - \$ 5000 per month. In little-known organizations, they pay less - \$ 500 - \$ 1000. At the same time, there are no salary and transfer restrictions in the main disciplines of e-sports [2].

Club income

The cost-effectiveness of e-sports is still poor, with 95% of e-sports teams spending more than they earn. Many organizations are backed by investors, often venture capital funds. And the clubs are working to assess: - they think not so much about profit or self-sufficiency in the current moment, but about increasing turnover, investments in infrastructure. Their goal is to raise the price of the asset. The minimum partnership contract with a top e-sports club costs \$ 100,000 - \$ 200,000. You will have to pay \$ 1 million for the title sponsorship.

Club expenses

About half of an e-sports club's expenses are player salaries. 20-25% is spent on office maintenance and marketing, another 10-20% is travel costs, equipment, base rental, etc. Player transfer costs may vary depending on the club, market, and other circumstances, but usually do not exceed 15%.

So, in 2019, the turnover of the e-sports club Na'Vi, one of the most popular in the world, amounted to \$ 6 million. Large American teams that invest heavily in infrastructure (build home bases (bootcamps) on 3000 square meters) have a gross income that can reach \$ 20 million or more.

Conclusion

This article tells about the history of the development of e-sports and the domestic economy. The period from 2011 to 2020 is considered.

References

1. The International 2011. URL: <https://ru.dota2.com/2011/08/%C2%ABthe-international%C2%BB/>. (Accessed 27.12.2020)
2. Newzoo Global Esports Market Report 2020. Light Version. URL: <https://newzoo.com/insights/trend-reports/newzoo-global-esports-market-report-2020-light-version/> (Accessed 27.12.2020).
3. Navi launched own merch production and online store. URL: <https://navi.gg/read/text/4464-navi-zapuskayet-sobstvennoe-proizvodstvo-mercha-i-onlain-magazin> (Accessed 27.12.2020).

ЭКОНОМИКА КИБЕРСПОРТА

А. А. Шитиков*, Я. Е. Ярцев, А. В. Михайлова

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: sanya99510@gmail.com

Аннотация. В статье идет речь об истории развития киберспорта и его экономике. Обсуждаются вопросы заработка, доходов и расходов.

Ключевые слова: Деньги, зарплаты, киберспорт, рекламные контракты.

Investment Attractiveness of an Economic Subject: Theory and Methodology

N. V. Shlyannikova

Tambov State Technical University, Tambov, Russia
**e-mail: nady.oo@mail.ru*

Abstract

Today, attracting investments in the economic sector is the main issue of its existence and development. Thanks to them, new companies are created, and employment of the population increases, which allows the development and implementation of innovations, quality improvement and competitiveness of products, etc. For the current economic situation, attracting investment is a key task. The article discusses various points of view of scientists on the term "investment attractiveness" and presents methods for assessing investment attractiveness.

Keywords: investments, investment attractiveness, factors of investment attractiveness, investor, financial condition.

Introduction

Investments are the basis for the development of any economic system. Active investment activities of business entities allow them to conduct innovative activities, optimize the production process, increase production capacity, develop new markets and implement their strategic objectives, and a competently conducted investment policy of the state makes it possible to solve socio-economic issues most effectively and strengthen their position on the global geopolitical space.

The conditions that are emerging in the economy at the macro level give rise to the need to develop and implement measures to enhance the investment attractiveness of regions and look for new tools to increase competitiveness in the national and international markets [1]. Consequently, today the leading role in the implementation of the tasks of innovative development of Russia is assigned to the issues of increasing the level of territorial investment attractiveness. As the President of the Russian Federation V.V. Putin: "high quality vocational education and a flexible labor market, a favorable investment climate and modern technologies" [author's translation].

The concept and methods of assessing investment attractiveness

In modern economic theory, investment is understood as the investment of capital in all its forms in various objects with the aim of further increasing it or achieving a different economic or non-economic effect. It is worth noting that the potential ability of investments to generate income is provided only in the conditions of an effective choice of investment objects. In order to determine which object is the most acceptable for the purposes of a particular investor, it is necessary to assess its investment attractiveness.

The concept of investment attractiveness (IP) is one of the most complex concepts of modern economic theory and practice. The term investment attractiveness was introduced to determine the maximum efficiency of an investment decision. Many domestic and foreign scientists devoted their work to the study of this phenomenon. Among them, V.M. Anshina, I.A. Blank, V.V. Bocharova, A.G. Gilyarovskaya, M.N. Kreinin, E.I. Krylova, V.A. Moskvina, I.I. Roizman, F. Berger, J. Brigham, L. Gitman, T. Copeland, D. Morris, M. Scott, W. Sharp, etc.

According to V.V. Bocharov, investment attractiveness is the presence of an economic effect (profit) from investing money with a minimum level of risk.

The Council for the Study of Production Forces under the Ministry of Economy of the Russian Federation understands investment attractiveness as a system or combination of various objective features, means, opportunities that together determine the potential effective demand for investments in a country, region, industry, and enterprise [3].

I.A. Blank believes that the assessment of investment attractiveness for use when using the development strategy of the enterprise or investor is a strategy for the use of capital, which consists in the implementation and financial assistance using the development strategy of the enterprise.

Despite the fact that the works of many foreign and domestic scientists are devoted to the study of this concept and ways to improve it, there is still no single approach to its interpretation [4]. Everyone interprets the concept of IP based on the factors included in his assessment.

Today, domestic and foreign economic literature describes a variety of approaches to assessing the investment attractiveness of an enterprise, among which the main groups can be distinguished based on the factors included in the methodology for assessing it:

- 1) based solely on financial indicators (M.N. Kreinina, V.M. Anshin, A.G. Gilyarovskaya, L.N. Chainikova, L.V. Minko, L. S. Tishina);
- 2) based on financial and economic analysis, which takes into account not only financial, but also production indicators (V.M. Vlasova, E.I. Krylov, M.G. Egorova, V.A. Moskvina);
- 3) based on the ratio of profitability and risk (S.G. Shmatko, V.V. Bocharov);
- 4) based on a comprehensive comparative assessment (G.L. Igolnikov, N.Yu. Bryzgalova, V.A. Milyaev, E.V. Belyaev);
- 5) based on the cost approach, where the main criterion of the IP is the market value of the company and the tendencies to maximize its value. (A.G. Babenko, S.V. Nekhaenko, N.N. Petukhova, N.V. Smirnova) [2].

All of the above methods for assessing the investment attractiveness of an enterprise are intended mainly for strategic investors, whose purpose is not a short-term investment of capital to generate income, but the management of this enterprise and its operating activities in order to implement its strategic objectives and increase its value.

Conclusion

Since investments are tied not only to specific enterprises, but also to regions, industries and countries, the investor, when making a decision, must also have information about their investment attractiveness. Therefore, investment attractiveness is considered at various levels: at the macro level - the investment attractiveness of the country, at the meso level - the investment attractiveness of the region, the investment attractiveness of the industry, and at the micro level - the investment attractiveness of the enterprise. Despite the fact that the enterprise occupies a central place in the investment process, since it is it that is the direct object of investment, this influence is reciprocal, since the territories and industries, having their own investment attractiveness, in turn depend on the investment attractiveness of enterprises included in this industry in a specific geographic area.

In addition, in order to maintain their positions and achieve leadership, enterprises must constantly develop, use new technologies and expand their areas of activity. Additional investment in a company gives it new competitive advantages and, as a rule, is one of the main means of growth [4].

References

1. Buzova I.A., Makhovikova G.A., Terekhova V.V., ed. Esipova V.E. Kommercheskaya otsenka investitsiy [Commercial valuation of investments]. SPb.: Peter, 2004, 432 p. (Rus)
2. Vlasov M.M. Analiz modeley otsenki investitsionnoy privlekatel'nosti kak osnova upravleniya dannoy kategoriyey v predpriyatiyakh malogo i srednego biznesa v RF [Analysis of models for assessing investment attractiveness as the basis for managing this category in small and medium-sized enterprises in the RF]. Innovation and investment, 2014, pp. 55-56. (Rus)
3. Pyina S.A. Sushchnost' kategorii «investitsionnyy klimat» i kategorii «investitsionnaya privlekatel'nost'» [The essence of the category "investment climate" and the category "investment attractiveness"]. Young scientist, 2012, No. 5, pp. 153-157. (Rus)
4. Selikhova O.N. Investitsionnaya privlekatel'nost' [Investment attractiveness]. Economics, 2016, 6(15), pp. 45-48. (Rus)

ИНВЕСТИЦИОННАЯ ПРИВЛЕКАТЕЛЬНОСТЬ ЭКОНОМИЧЕСКОГО СУБЪЕКТА: ТЕОРИЯ И МЕТОДОЛОГИЯ

Н. В. Шлянникова

Тамбовский государственный технический университет, Тамбов, Россия

*e-mail: nady.oo@mail.ru

Анотация. Сегодня вовлечение инвестиций в экономический сектор является главным вопросом его существования и развития. Благодаря им создаются новые компании, и повышается занятость населения, они позволяют разрабатывать и внедрять инновации, улучшают качество и конкурентоспособность производимой продукции и т.д. Для современной экономической ситуации привлечение инвестиций является ключевой задачей. В статье рассмотрены различные точки зрения ученых на термин «инвестиционная привлекательность», описаны основные факторы, влияющие на нее. Также представлены методы оценки инвестиционной привлекательности и способы ее повышения.

Ключевые слова: инвестиции, инвестиционная привлекательность, факторы инвестиционной привлекательности, инвестор, финансовое состояние.

Formation of Accounting Reporting by Small Businesses in the Russian Federation

A. F. Talibova

Tambov State Technical University, Tambov, Russia
e-mail: 89537246377@yandex.ru

Abstract

The article discusses the features of the formation of financial statements by small businesses from the point of view of compliance with the requirements for disclosure of information. A method of reporting is proposed taking into account the specifics of the activities of small businesses and the interests of the main users of their financial statements.

Keywords: accounting, financial statements, small business, small businesses, reporting methodology, simplified reporting.

In the modern world, the economic activity of an organization, as well as its development, is based on correct financial and economic information. The completeness, timeliness and reliability of accounting and analytical information entering and leaving the organization have a great impact on the entire work of an economic entity. The function of accumulating information on the activities of an economic entity is entrusted to the accounting service, which collects such information and forms on its basis one of the most important sections of accounting - accounting (financial) reporting.

The definition of such a concept as accounting (financial) reporting can be considered in two senses: broad and narrow. In a broad sense, accounting (financial) statements are a set of documents that include data on the general financial and economic condition of the organization, suitable for the criteria of reliability and completeness. If we talk about this document in an abbreviated form, then this is a document that states the financial position and performance of an economic entity for the reporting period.

Accounting and tax registers are used for reporting in the organization. On their basis, interim reports are drawn up, from which at the end of the reporting period complete accounting (financial) statements are drawn up, i.e. annual. The main information forms of accounting (financial) statements are the balance sheet and the statement of financial results of an economic entity.

The balance sheet, being the main form of accounting (financial) reporting, is a document consisting of an asset and a liability. The main element of an asset and a liability is the balance sheet. Each article contains information about the property status of the company on the basis of data from accounting accounts [1].

The gradual transition of the Russian economy to market relations was associated with the process of the emergence and active development of entrepreneurship. Entrepreneurship is an important part of the market economy, because it is entrepreneurial activity that can ensure economic growth, as well as ensure the

production of a variety of products that can meet the needs of the population [2].

The role of small business in the economy of every country is very important. This is due to the specifics of its development, as well as its advantages, among which it is worth highlighting: high adaptability to an unstable external environment, flexibility and efficiency in making and implementing decisions, the presence of the prospect of starting activities in many industries with a relatively small initial capital, independence in the implementation of ideas the subject of entrepreneurial activity [3].

Currently, there is a problem of formation of financial statements by small enterprises in terms of compliance with the requirements for information disclosure.

In accordance with Order of the Ministry of Finance of Russia No. 66 dated 02.07.2010 No. 66n, small businesses that are not subject to the statutory audit requirement have the right to form simplified financial statements, which include only two forms — the balance sheet and the profit and loss statement.

Thus, the information contained in the forms of financial statements is consumed by different groups of users with different interests. To satisfy all the interests of various user groups, it would be necessary to include a sufficiently large number of indicators in various types of standard forms. This would make reporting cumbersome and too awkward to use.

When forming accounting statements, almost all small business entities face many questions that require competent decisions in this area. This concerns the choice of reporting forms. The list of standard forms containing a universal approach for all organizations, in our opinion, is not entirely correct for small enterprises with their own specific features and a special circle of reporting users. The use of simplified forms in the preparation of reports quite often leads to the need to use additional forms due to insufficient reflection in them of the results of the financial and economic activities of the organization.

When generating various reports for use by isolated users, small businesses should adhere to a certain sequence of generating reporting economic information. At the initial stage, it is necessary to determine the necessary information, grouped on analytical and synthetic accounts of the organization's accounting, and then, based on the information received, form internal and external accounting, and, in addition, tax reporting. Finally, using the prepared accounting statements and modifying the system data, statistical reporting is compiled [5].

It should be noted that the majority of small and medium-sized enterprises, namely more than 70%, use a simplified taxation system.

Financial accounting reports, formed by enterprises operating in a simplified taxation system, have a number of features, namely: reporting can be provided in a reduced volume; reporting may disclose less information or less detail; the reporting may not contain information about related parties; reporting may not be done by segment; the reporting may reflect on certain indicators, if they have a high level of materiality and the lack of information on these indicators may mislead interested users. It is worth noting that the abbreviated “format” of financial statements of enterprises applying the simplified taxation system, unfortunately, leads to the need to

“supplement” it in cases where the tax authorities conduct relevant desk and counter audits, as well as in the case of financial analysis and audit [6].

Thus, all of the above allows us to judge that many users of the financial statements of small businesses have problems associated with the limited information contained in the statements. This is primarily due to the compilation of simplified reporting by the majority of subjects using standard forms and a standard set of indicators. In this regard, a different form of the balance sheet was proposed, developed taking into account the specifics of the activities of small organizations, as well as an additional form of the cash flow statement.

References

1. Bessonova E.A. Buhgalterskij balans hozyajstvuyushchego sub"ekta kak osnova finansovo-ekonomicheskogo analiza [Balance sheet of an economic entity as the basis of financial and economic analysis]. Actual problems of accounting, analysis and audit. Materials of the X All-Russian Youth Scientific and Practical Conference with International Participation, 2018. (Rus)

2. Vinogradova N.I., Semerova O.S. Znachenie buhgalterskoj otchetnosti v sovremennyh usloviyah rynochnogo vzaimodejstviya [The value of financial statements in modern conditions of market interaction]. The value of financial statements in modern conditions of market interaction: Monograph. Kursk: Kursk Institute of Cooperation BUKER, 2019. (Rus)

3. Andreeva S.V. Metodologicheskoe obespechenie sovershenstvovaniya uchetoj deyatel'nosti malyh predpriyatij: differenciaciya podhodov [Methodological support for improving the accounting activities of small enterprises: differentiation of approaches]. International financial accounting, 2016. (Rus)

4. Vakhrushina M.A., Pashkova L.V. Uchet na predpriyatiyah malogo biznesa [Accounting for small businesses]. M.: University textbook, 2017. (Rus).

ОСОБЕННОСТИ ФОРМИРОВАНИЯ БУХГАЛТЕРСКОЙ ОТЧЕТНОСТИ СУБЪЕКТАМИ МАЛОГО БИЗНЕСА В РОССИЙСКОЙ ФЕДЕРАЦИИ

А. Ф. Талибова

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: 89537246377@yandex.ru

Аннотация. В статье рассмотрены особенности формирования бухгалтерской отчетности малыми предприятиями с точки зрения соблюдения требования по раскрытию информации, предложена методика составления отчетности, учитывающая специфику деятельности субъектов малого бизнеса и интересы основных пользователей их бухгалтерской отчетности.

Ключевые слова: бухгалтерский учет, бухгалтерская отчетность, малый бизнес, субъекты малого бизнеса, методика составления отчетности, упрощенная отчетность.

The Assessment of Factors Improving Cost-Effectiveness of Enterprises

M. A. Ulybysheva

Tambov State Technical University, Tambov, Russia
e-mail:marusya0712@mail.ru

Abstract

In the modern world, the economic market faces the problem of imperfection of cost-effectiveness of the production process, which leads to lower profitability and loss of credibility of the firm. The aim of this article is to consider the possibilities of increasing cost-effectiveness, profit, as well as the possibilities of efficient production.

Keywords: cost-effectiveness, efficiency, enterprise, growth factors, profitability.

In modern environment, enhancement of the efficiency of enterprises is a complex but important task. Many enterprises are not profitable, they are either not cost-effective or the profit is low. That is why increasing the rate of profitability, as well as increasing its own, is particularly important in the modern environment.

First and foremost, modern environment is an environment of market economy, which result in the need to improve the work efficiency in order to maximize profit while reducing the cost of productive activities, improving the competitiveness of finished products or services. The efficiency of equity use plays an important role in determining the financial performance of an enterprise.

Profitability refers to one of the main value figures of an enterprise's efficiency, which describes the level of impact of assets as well as the use of equity in production processes. The ratio between profit and current expenses or advanced cost substantiates the meaning of profitability. In any case, it is a characteristic of the profit from the sale of goods or the services, as well as the total return of a particular enterprise as a subject of economic activity. It should be noted that profitability indicators are defined by factors in a form of percentages, showing the share of profit in a particular currency unit of expenses; they also show the share of released production in the cost of itself [1].

The problem is about the limited resources of the enterprise or organization, and hence arising the question, which is about creating an operating environment in which maximum profits can be obtained at minimal cost. Different enterprises may receive the same profit, but the ways of doing that are always different. This fact is the main reason for the frequent use of profitability indicators, since their role in estimating the economic subject is enormous. This is due to the indicators of profitability are not limited and do not depend on the specificity and field of enterprises and organizations.

It is also worth noting that the ways, in which the internal and external conditions are implemented; meant to improve the efficiency of performance, are

described by the difference in the degree of action, possibility of usage and control. That is why, it is important for the management and management system of enterprises to continuously study and analyse the scope of work, the forms of control and the methods of improving the efficiency of activities at all stages of activity of the enterprise.

It is clear that enterprises are able and should continuously monitor the nature of resource use through the development, implementation of increasing efficiency programmes.

Profitability can be influenced by all kinds of factors. Some of them are directly related to the work of specific units, the productive usage of the resource base, the methods used and the introduction of scientific and technological progress.

At the same time, changing the level of any measurements of profitability depends on the economic and organizational as well as the technical aspects of the production and sale of products or the services. For that reason, in the process of cost-benefit analysis, it is important to identify the factors that influence the most on increasing or decreasing the profitability, as well as development of the necessary steps appropriate for the situation [2].

Any ways and methods of usage of factors that can increase profitability as well as the efficiency of the enterprise can be modestly presented as a combination of actions:

- increasing of the technical equipment of the production: this phase consists of the implementation of the latest technologies as well as the automation of all processes. The usage of new types of raw materials and materials, changes in the structure of the assortment and other characteristics of the output, as well as other factors that can increase the technical level of the enterprise can also be included in the increase of technical equipment.

- improving the organization of production and work processes: it is possible to reduce costs by increasing profit. It can be done by implementing changes in the organization of production processes, forms and methods of operation, if there is enhancement of production specialization. For example, by improving the management of processes, ways of reducing costs, optimizing the use of working capital, reducing transportation costs and other methods, the quality of production organization can be improved.

- changing the quantity and structure of products: such changes, if they are justified, reasonable and positive, can lead to a reduction of fixed costs, relatively reduce the depreciation and change the product nomenclature, its range and improve quality [3].

To sum up, it is concluded that indicator such as profitability contributes to the evaluation of the results of various management decisions. In doing so, managers need to take every possible way to improve the cost-effectiveness and profitability of an enterprise, as they determine the financial performance of enterprises and organizations.

References

1. Volkov O.I. Ekonomika predpriyatiya. Kurs lekcij [Волков О.И. Экономика предприятия. Курс лекций]. М.: INFRA-M, Publisher, 2015, 280 p. (Rus)
2. Kalashnik I.A. Effektivnost' raboty i rentabel'nost' [Profitability efficiency]. М.: Ekonomist, 2018, pp. 21-25. (Rus)
3. Zemlyanskaya S.V. Puti povysheniya rosta rentabel'nosti predpriyatiya [Ways to increase enterprise profitability growth]. URL: <http://ekonomika.snauka.ru/2020/03/16989> (Accessed 17 October 2020). (Rus)

ОЦЕНКА ФАКТОРОВ РОСТА РЕНТАБЕЛЬНОСТИ НА ПРЕДПРИЯТИИ

М. А. Улыбышева

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: marusya0712@mail.ru

Аннотация. В условиях современного мира на экономическом рынке возникает проблема несовершенства рентабельности производственного процесса, что ведет к снижению доходности и потере авторитета фирмы. Целью данной работы является рассмотрение возможностей повышения показателей рентабельности, увеличения прибыли, а также возможности эффективной работы производства.

Ключевые слова: рентабельность, эффективность, факторы роста, предприятие, прибыльность.

The Problems of State Protection of Cultural Heritage Objects

N. V. Yurina

Tambov State Technical University, Tambov, Russia
e-mail: unv-nasledie@mail.ru

Abstract

The article discusses the basic principles of state protection of cultural heritage objects (historical and cultural monuments) of the Russian Federation, as well as its goals and objectives. The subject of the study is the main directions of state protection of cultural heritage objects, as well as current problems in this area.

Keywords: state protection, objects of cultural heritage.

State protection of cultural heritage objects implies a wide range of measures (legal, organizational, financial, logistical, informational and other measures) taken by state authorities and local self-government bodies within their competence, aimed at identifying, recording, studying cultural heritage objects, preventing their destruction.

One of the main objectives of the State protection of cultural heritage is the preservation of cultural heritage objects in their historical environment for the benefit of present and future generations.

State protection of cultural heritage objects (historical and cultural monuments) is one of the priority tasks of the state authorities of the Russian Federation, state authorities of the constituent entities of the Russian Federation and local self-government bodies.

State protection of cultural heritage objects includes a variety of activities and actions, including:

- state registration of objects that have the characteristics of a cultural heritage object,
- the formation and maintenance of a register,
- and the conduct of historical and cultural expertise,
- development and establishment of protection zones, territory borders, objects of protection of cultural heritage objects;
- issuance of tasks and permits for carrying out works on the preservation of the cultural heritage object;
- setting the boundaries of the territory of cultural objects;
- development of items for the protection of cultural heritage objects;
- installation of information inscriptions and designations on cultural heritage sites, and other activities.

One of the current problems in the field of cultural heritage protection is the lack of user's cultural heritage objects, which leads to deterioration of the technical

condition, and sometimes to the loss of such objects.

A significant part of the cultural heritage objects that are in poor condition belong to the municipal property. And their preservation due to the scarcity of local budgets is a real problem for local governments. In this regard, the issue of attracting private investors to solve this problem is becoming more and more urgent.

In addition to the benefits established by current legislation in the sphere of preservation of cultural heritage, in the form of lower charges for using the facility, reduction of rent in the amount produced costs and expenses of necessary additional measures and incentive options investors. Such an additional measure may be the introduction of amendments to the legislation on the privatization of property in the form of a pre-emptive right of purchase by a person who has invested in the preservation of cultural heritage objects.

It is effective measures to stimulate potential investors that will allow them to involve in economic turnover cultural heritage objects that do not have a user (owner), as well as those that are in poor condition.

References

1. Federal'nyj zakon "Ob ob"ektah kul'turnogo naslediya (pamyatnikah istorii i kul'tury) narodov Rossijskoj Federacii" [Federal Law "On Objects of Cultural Heritage (Historical and Cultural Monuments) of the Peoples of the Russian Federation"]. No. 73-FZ dated 25.06.2002 (as amended 22.12.2020). (Rus)

ПРОБЛЕМЫ ГОСУДАРСТВЕННОЙ ОХРАНЫ ОБЪЕКТОВ КУЛЬТУРНОГО НАСЛЕДИЯ

Н. В. Юрина

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: unv-nasledie@mail.ru

Аннотация. Рассмотрены основные принципы государственной охраны объектов культурного наследия (памятников истории и культуры) народов Российской Федерации, а также ее цели, задачи. Предметом исследования являются основные направления государственной охраны объектов культурного наследия, а также актуальные проблемы в данной сфере.

Ключевые слова: государственная охрана, объекты культурного наследия.

Improving the Quality of Products (Services) of Commercial Organizations as a Solution of Crisis Situations

R. V. Zharikov, A. A. Al-Yawar *

Tambov State Technical University, Tambov, Russia
**e-mail: shriad@mail.ru, alyawarali74@gmail.com*

Abstract

The difficult economic situation is studied. It is pointed out that in recent years organizations have constantly encountered difficulties with the sale of products. Therefore, one of the most important tasks facing them is the task of identifying sales reserves, finding new consumers interested in the organization's products, and entering new sales markets. It is stressed that solving this problem requires a comprehensive analysis of all the organization's activities, starting with the purchase of raw materials and the development of the technological process to the shipment of products to the consumer. In this article factors affecting goods quality and the steps to overcome economic crisis are investigated.

Keywords: quality of products, quality assurance conditions, total quality management, quality improvement measure.

Introduction

The most important condition for the development of commercial organizations (CO) is the creation of an effective quality management system. Such systems are built when implementing various concepts of TQM (Total Quality Management – Global Quality Management) and implementing international quality standards ISO 9000. In fact, within the framework of these concepts, all aspects of the company's activities are managed, in which all its employees are involved. But still, a special part in the above systems is given to management of quality for products and services [1].

In the activities of commercial organizations, situations arise that require additional financial resources in comparison with the usual procedure for conducting business. This entails the need to spend additional funds, which may not be sufficient, or the organization will have to divert funds from other areas and areas of its activities, which may have a negative impact on the financial situation. This situation makes it expedient, and in some cases necessary, to form reserves [2].

A product quality improvement factor is understood as a reason, a specific driving force in the product creation process that can improve one or more product quality indicators. The condition for improving the quality of products is understood as the circumstances, situation, and environment in which the factor operates.

Quality assurance conditions include: the nature of the production process, its intensity, rhythm and duration; temperature, humidity and other environmental parameters in production premises; production interior and design; the nature of material and moral incentives used; the moral and psychological climate in the

production team; when deviations are detected, forces begin to act in the comparison and decision-making part. Either factors or conditions are used, or both are used simultaneously.

A product quality improvement measure is defined as an action or sum of actions that change the factors or the conditions under which the factor operates. Impact measures and their combinations depend on the nature and magnitude of quality deviations and on the effectiveness of various possible options for eliminating deviations. The concept of a quality management mechanism can only work if the management system has a clearly formulated and clearly defined improvement of quality plan. In essence, we are talking about managing within a given framework, i.e. about managing the process to ensure the established quality level.

Factors affecting the quality of products

Many factors affect the quality of products and which must be taken under consideration when there is an attempt to increase the quality of this product. They are:

- technical: type of manufactured products and serial production; state of technical documentation; quality of technological equipment, tooling, tools; state of test equipment; quality of measurement and control tools; quality of raw materials, raw materials, components.
- organizational: availability of materials, raw materials; maintenance of equipment, equipment; regularity and rhythm of work; organization of work with suppliers; organization of information support; scientific organization of labor, production culture; organization of food and recreation.
- economic: forms of remuneration; the amount of wages; bonuses for high-quality work; deductions for marriage; the ratio between quality, price and cost of production
- social: the state of educational work; selection, placement and movement of personnel; organization of studies; conducting competitions [3].

Increasing sales of commercial organizations

According to local and foreign experts, the quality of products is laid down in the design and technological documentation, and both should be evaluated accordingly.

It is necessary to start with the development of production of goods that are in demand, i.e. produce what someone will buy, and if this product is improved, the number of customers will grow, the economic indicators of the enterprise will be improved, and there will be ability to find funds for the implementation of the next stages of solving quality problems. However, the product that is in demand is most often a new product. Therefore, it is necessary to start by studying the demand in the market and taking it into account when creating and mastering the production of new products.

It is necessary to have a dealer, sales network, as well as distribution of goods and information about it. It is also important to minimize production costs. To this

end, it is necessary to recalculate everything, rebuild the material and technical base of the enterprise, give up everything superfluous, and restructure. Without doing this, you should not even start fighting for quality. Also, it is important to learn how to manage finances. First of all, it is necessary to normalize control over finances [4].

Conclusion

The conditions for improving the quality of products are understood as the circumstances, situation, and environment in which the factor operates.

Technical, economic, organizational, and social factors affect the quality of products.

The optimal risk management for any commercial organization should include a number of methods for treating crisis situations, starting with an analysis of internal and external factors of the economic entity to a periodic assessment of the amount of reserves with appropriate recording of data.

References

1. Moskvina V.A. Upravleniye kachestvom v biznese [Quality management in business]. M.: Finance and statistics, 2006, 384 p. (in Russ.)
2. <http://rbsys.ru/print.php?option=public&page=97> (Accessed 03.11.2020)
3. Kryukova N.A. Uchebno-metodicheskoye posobiye po mezhdistsiplinarnomu kursu «Teoreticheskiye osnovy upravleniya kachestvom tekhnologicheskikh protsessov, sistem upravleniya, produktsii i uslug» [Study guide for the interdisciplinary course “Theoretical foundations of quality management of technological processes, control systems, products and services”]. Togliatti: Publishing house PVGUS, 2016, 80 p. (Rus)
4. <https://www.cfin.ru/management/iso9000/qmanbook-3.shtml> (Accessed 03.11.2020)

ПОВЫШЕНИЕ КАЧЕСТВА ПРОДУКЦИИ (УСЛУГ) КОММЕРЧЕСКИХ ОРГАНИЗАЦИЙ КАК РЕШЕНИЕ КРИЗИСНЫХ СИТУАЦИЙ

Р. В. Жариков, А. А. Аль-Явар*

Тамбовский государственный технический университет, Тамбов, Россия
e-mail: shriad@mail.ru, alyawarali74@gmail.com

Аннотация. В последние годы организации постоянно сталкиваются с трудностями при реализации продукции. Поэтому одной из важнейших задач, стоящих перед ними, является задача выявления резервов сбыта, поиска новых потребителей, заинтересованных в продукции организации, выхода на новые рынки сбыта. Подчеркивается, что решение этой задачи требует всестороннего анализа всей деятельности организации, начиная от закупки и разработки технологического процесса, до отгрузки продукции потребителю. В данной статье исследуются факторы, влияющие на качество товаров, и шаги по преодолению экономического кризиса.

Ключевые слова: качество продукции, условия обеспечения качества, общее управление качеством, мера повышения качества.

Научное электронное издание

THE WORLD OF SCIENCE WITHOUT BORDERS

**PROCEEDINGS
OF THE 8th ALL-RUSSIAN SCIENTIFIC AND PRACTICAL CONFERENCE
(WITH INTERNATIONAL PARTICIPATION) FOR YOUNG RESEARCHERS**

February 12, 2021
Tambov

МИР НАУКИ БЕЗ ГРАНИЦ

**МАТЕРИАЛЫ
8-й ВСЕРОССИЙСКОЙ НАУЧНО-ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ
(С МЕЖДУНАРОДНЫМ УЧАСТИЕМ) ДЛЯ МОЛОДЫХ УЧЁНЫХ**

12 февраля 2021 года
Тамбов

Компьютерное макетирование Е. Ю. Воякиной
Тиражирование и упаковка Т. Ю. Зотовой

ISBN 978-5-8265-2331-5



Подписано к использованию 01.04.2021.
Тираж 100 шт. Заказ № 39

Издательский центр ФГБОУ ВО «ТГТУ»
392000, г. Тамбов, ул. Советская, д. 106, к. 14
Тел./факс (4752) 63-81-08.
E-mail: izdatelstvo@tstu.ru

