SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the International Conference

Date: September 30

Beijing, China 2023

上合组织国家的科学研究：协同和一体化国际会议

参与者的英文报告

International Conference “Scientific research of the SCO countries: synergy and integration”

Part 1

2023 年 9 月 30 日。中国北京
September 30, 2023. Beijing, PRC

Proceedings of the International Conference
“Scientific research of the SCO countries: synergy and integration” - Reports in English

(September 30, 2023. Beijing, PRC)

ISBN 978-5-905695-82-7

这些会议文集结合了会议的材料 – 研究论文和科学工作者的论文报告。 它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。
作者对所引用的出版物，事实，数字，引用，统计数据，专有名称和其他信息的准确性负责

These Conference Proceedings combine materials of the conference – research papers and thesis reports of scientific workers. They examine technical, juridical and sociological aspects of research issues. Some articles deal with theoretical and methodological approaches and principles of research questions of personality professionalization.

Authors are responsible for the accuracy of cited publications, facts, figures, quotations, statistics, proper names and other information.

ISBN 978-5-905695-82-7
©Scientific publishing house Infinity, 2023
©Group of authors, 2023

CONTENTS

MEDICAL SCIENCES

TECHNICAL SCIENCES

PHYSICAL AND MATHEMATICAL SCIENCES

AGRICULTURAL SCIENCES

DOI 10.34660/INF.2023.30.34.275

顿涅茨克人民共和国创业发展的战略方向
STRATEGIC DIRECTIONS OF ENTREPRENEURSHIP DEVELOPMENT IN THE DONETSK PEOPLE'S REPUBLIC

Polovyan Aleksey Vladimirovich
Doctor of Economic Sciences, Associate Professor, Director
Institute of Economic Research

Sinitsyna Karina Igorevna
Candidate of Economic Sciences, Head of Department
Institute of Economic Research

Stelmakhova Natalia Valeryevna
Research Officer
Institute of Economic Research

抽象的。 为了商业实体的运作，需要有利的经济环境。 文章提出了中小企业发展的行动领域，包括资源、实体部门、体制、金融、创新、基础设施、市场和人力资本等各个领域的行动，为开展业务和发展该地区创造有利条件。 。 实施行动领域中拟议的活动将有助于实现中小企业发展的战略目标。 提出了到 2033 年顿涅茨克人民共和国中小企业发展的目标指标值。

关键词：发展方向、创业、战略方向、区域、中小企业。

Abstract. *For the functioning of business entities, a favorable economic climate is needed. The article suggests areas of action for the development of small and medium-sized businesses in various areas of action to create favorable conditions for doing business and developing the region: resources, real sector, institutional, financial, innovation, infrastructure, markets and human capital. The implementation of the proposed activities in the areas of action will allow achieving the strategic goals for the development of small and medium-sized businesses. The values of target indicators for the development of small and medium-sized businesses in the Donetsk People's Republic by 2033 are presented.*

Keywords: *development directions, entrepreneurship, strategic directions, region, small and medium-sized businesses.*

Introduction

The entry of the Donetsk People's Republic into the Russian Federation opens up new prospects for the development of small and medium-sized businesses. However,

in the unique institutional environment characteristic of the Donetsk People's Republic, standard government programs may be ineffective. Consequently, an urgent task arises - the development of our own strategic documents that would reflect the characteristics of this industrial region and development directions.

Purpose of the study

The purpose of the study is to develop strategic directions for the development of small and medium-sized businesses in the Donetsk People's Republic.

Research results and discussion

The development of entrepreneurship should become one of the key goals of improving the institutional environment of the Donetsk People's Republic during the transition to the standards of the Russian Federation, taking into account the regulatory guillotine.

The most effective and promising form of small and medium-sized businesses are professional service companies, which are characterized by: a high level of entrepreneurial culture, the use of project management, the principles of teamwork, continuous education, advanced training and self-improvement of employees, flexible forms of employment, personalization of products and services, innovation, ability to effectively interact with both partners and competitors.

The development of innovation and investment infrastructure to support small and medium-sized businesses in the Donetsk People's Republic should be carried out not only through government funding, but also through large businesses - potentially the largest consumer of goods and services of small and medium-sized enterprises. This will increase the adaptability of large companies to market needs and create an effective system of subcontractual relations with small and medium-sized businesses and, most importantly, attract small and medium-sized businesses to the production sector.

The target vision for the development of small and medium-sized businesses in the Donetsk People's Republic is to increase the share and role of business entities, incl. innovative entrepreneurship.

The strategic goal of the development of small and medium-sized businesses in the Donetsk People's Republic is the creation of an institutional environment that provides favorable business conditions for business entities and the development of the region.

In this regard, it is necessary to note the strategic directions of action for the development of entrepreneurship:

1. Resources:

- ensuring equal access, stability and transparency of rules for handling natural resources for entrepreneurs;

- focus on low-waste, energy- and resource-saving use of natural resources at all stages of the production process, from the extraction of natural raw materials to the release of final products;

- focus on the protection and reproduction of natural resources (for example, reproduction of forest resources, increasing soil fertility, etc.).

2. Real sector of the economy:

- in the Donetsk People's Republic, at least one facility of the following types must exist and operate: industrial site (a territory intended for the placement of production facilities, provided with the necessary transport, energy, engineering and other infrastructure), industrial park, technological park, business incubator, center cluster development (shared use center, prototyping center);

- обеспечение доступности инфраструктуры для предпринимателей;

- стимулирование обновления основных фондов предпринимателями.

3. Institutional environment:

- improving the quality of public services provided to business entities (creating a single window for business registration, reducing the time required for processing documents and the number of necessary procedures);

- improving the quality of control and supervisory activities in the territory of the Donetsk People's Republic in relation to business entities (creation of a unified register of inspections, increasing the efficiency of control and supervisory activities while reducing the number of inspections, reducing the excess burden in the form of fines for business entities; monitoring the practice of unreasonable application of antimonopoly rules in in relation to business entities);

- simplification of tax reporting for entrepreneurs using cash register equipment; creation of a new taxation regime, providing for the automatic transfer of information on sales to the tax authorities; exemption from the obligation to submit reports, as well as payment of a single payment from revenue, including insurance premiums;

- ensuring the planning and implementation of activities for the development of entrepreneurial initiative, taking into account the characteristics of socio-economic development in the municipalities of the Donetsk People's Republic;

- promotion of state policy to support entrepreneurship (development of a strategy for the development of entrepreneurship; increasing the level of awareness of entrepreneurs about support measures and programs);

- creation and development of structural units for entrepreneurship development in all municipalities;

- intensifying the work of the Council for the Development of Entrepreneurship and attracting business representatives to its work.

4. Financial sector:

- legislative support for the protection of investors' rights and government guarantees;

- activation of the investment portal;

- ensuring maximum inclusion of business entities of the Donetsk People's Republic in federal support programs;

- development of a set of measures to support attracting investments for the implementation of projects of business entities;

- ensuring the implementation of the most complete set of support mechanisms (financial, infrastructural, social, export support);

- providing simplified access in electronic form for business entities to support measures, services and services of organizations of infrastructure for the development of entrepreneurship and the sale of goods and services;

- development of alternative sources of financing for entrepreneurial initiatives (crowdfunding, venture financing, government lending to startups, etc.);

- increasing the availability of leasing instruments for entrepreneurs.

5. Innovation sphere:

- assistance in technology transfer;

- encouraging the use of advanced technologies or technologies whose distribution in the relevant industry does not exceed 25%, as well as providing support for the commercialization of scientific developments;

- stimulating the implementation of lean manufacturing principles at enterprises;

- stimulation of innovative entrepreneurship; creation of a republican register of patent holders and innovative projects for the purpose of their further promotion;

- support for the implementation of innovative projects of business entities;

- creation of a system for proactive preparation of permits for the use of new innovative products and materials.

6. Infrastructure:

- expansion of the list of online services of the Bank;

- creation of a system of electronic data exchange between government authorities and business entities affecting the procedures for registering a business, submitting reports, applying for extracts, certificates, etc.;

- creation of a digital platform focused on information support for production and sales activities of small and medium-sized businesses;

- creation of a single virtual entry point for entrepreneurs (in the form of a portal for registering legal entities), with the help of which an entrepreneur will be able to completely go through the process of registering an enterprise and registering for tax purposes without a personal visit to the tax office. On such a site it is necessary to provide a function for automatically generating standard constituent documents;

- creation of a single entry point for entrepreneurs and investors in the form of an organization operating on the “one window” principle and coordinating interdepartmental and intradepartmental interaction to obtain a construction permit.

- creation of a single virtual entry point for entrepreneurs and investors, ensuring the receipt of construction permits in electronic form;

- creation of a single Internet portal where the applicant would have the opportunity to receive the service of registering property rights in a completely electronic form;

- creation of an online service “electronic residence”, which provides access to government services and special programs of a particular country in the absence of actual citizenship.

7. Markets:

- conducting diagnostics of entrepreneurship development on a regular basis (with the formation of a public report);

- stimulating the expansion of interaction between business representatives of the Donetsk People’s Republic and leading global and Russian transnational companies;

- ensuring clear and transparent plans for the purchase of goods from entrepreneurs by state corporations and enterprises;

- promoting contracting, expanding the involvement of business entities in the contract system in the field of procurement of goods, works, services to meet state and municipal needs;

- encouraging all public sector enterprises of the Donetsk People’s Republic to purchase goods from local producers;

- development of foreign economic relations, creation of conditions for promoting products produced by business entities to regional and foreign markets.

8.Human capital:

- availability of a forecast of the needs of the labor market of the Donetsk People’s Republic for specialists in various fields for a period of at least 7 years, based on a study of the needs of investors and a forecast of socio-economic development;

- restoration and development of the vocational education system, reorientation of some school graduates to receive high-quality professional specialized education;

- development of a system of educational programs for business entities, including special short-term retraining programs;

- attracting entrepreneurs to the Donetsk People’s Republic;

- stimulating the development of new forms of flexible employment within the labor market.

The target state in the direction of the entrepreneurship ecosystem is characterized by a set of indicators for achieving goals, for which ranges of values are determined for the target dates of the planning period, according to Decree of the President of the Russian Federation dated 05/07/2018 No. 204 “On national goals and strategic objectives of the development of the Russian Federation for the period until 2024 of the year” [1] and the passport of the national project “Small

and medium-sized businesses and support for individual entrepreneurial initiative", approved by the presidium of the Council under the President of the Russian Federation for strategic development and national projects, protocol No. 16 dated December 24, 2018 [2] (Table. 1).

Table 1

Values of target indicators for the development of small and medium-sized businesses in the Donetsk People's Republic by 2033

Indicators	Until 2026 (forecast value)	Until 2029 (forecast value)	Until 2033 (forecast value)
Share of innovative small and medium-sized businesses implementing innovative projects in the total number of small and medium-sized businesses	0,4%	0,9%	1,5%
Share of small and medium-sized businesses in GRP	23,4%	27,9%	32,5%
Share of exports of small and medium-sized businesses, including individual entrepreneurs, in the total volume of non-resource exports	3%	6%	10%
Number of people employed in small and medium-sized businesses, including individual entrepreneurs, per 1000 people.	50	100	170
Number of self-employed citizens who have registered their status taking into account the introduction of a special tax regime for the self-employed, per 1000 people.	3	8	16

The goal is to achieve Russian average values in the Donetsk People's Republic by 2033.

To achieve the target vision for the development of small and medium-sized businesses in the Donetsk People's Republic, it is necessary to "integrate" into the national project "Small and Medium Business and Support for Individual Entrepreneurial Initiatives" of the Russian Federation [2].

Software for the implementation of strategic objectives to create an institutional environment that provides favorable business conditions for business entities and the development of the region, stated in the strategy, provides for the development and implementation of the Republican program for the development of small and medium-sized businesses, which includes a number of flagship projects: "Digital Residence ", "Support for investment projects", "Preferential business lending", "Digital platform for small and medium-sized businesses", etc.

Conclusions

Thus, in order for the sphere of small and medium-sized enterprises in the Republic to become the basis for the development of the regional economy, it is necessary to create an appropriate institutional environment that provides favorable conditions for doing business by entities in this sphere, which can be ensured through the implementation of selected areas to achieve the Russian average indicators in the future.

References

1. On the national goals and strategic objectives of the development of the Russian Federation for the period until 2024: Decree of the President of the Russian Federation dated May 7, 2018 No. 204. URL: http://www.kremlin.ru/acts/bank/43027 (date of access: 06/03/2023).

2. Small and medium-sized businesses and support for individual entrepreneurial initiatives: Passport of the national project. Approved by the Presidium of the Council under the President of the Russian Federation for Strategic Development and National Projects (Protocol dated December 24, 2018 No. 16. URL: https://base.garant.ru/72185938/ (date of access: 06/03/2023).

DOI 10.34660/INF.2023.27.35.276

确定区域经济发展优先事项的工具

TOOLS FOR DETERMINING PRIORITIES FOR THE DEVELOPMENT OF THE REGION'S ECONOMY

Polovyan Aleksey Vladimirovich
Doctor of Economic Sciences, Director
Institute of Economic Research

Kravets Elena Olegovna
Candidate of Economic Sciences, Associate Professor
Donetsk State University

抽象的。 提出的假设是研究利用新地区的潜力在制裁压力条件下确保俄罗斯联邦技术主权的可能性。 开发了一个用于确定区域经济发展优先事项的工具包，该工具包基于矩阵法，可以识别有前途的高科技产品（具有较高附加值）及其基础技术，并且还 经过测试，可以将俄罗斯联邦生产的商品分为四类，并确定其中哪些商品的生产可以选择作为顿涅茨克人民共和国发展的优先事项。 文章中获得的结果可能会引起科学界研究人员和政府机构代表的兴趣。

关键词：区域经济、发展优先权、技术主权、科学方法论、产品复杂性、矩阵。

Abstract. *The hypothesis put forward is to study the possibility of ensuring the technological sovereignty of the Russian Federation under conditions of sanctions pressure using the potential of the new region. A toolkit has been developed for determining priorities for the development of the regional economy, which is based on the matrix method and makes it possible to identify promising high-tech goods (with higher added value) and the technologies underlying them, and it has also been tested, which made it possible to divide goods produced in the Russian Federation into 4 groups and among them determine the production of which goods can be chosen as a priority for the development of the Donetsk People's Republic. The results obtained in the article may be of interest to the scientific community of researchers and representatives of government agencies.*

Keywords: *regional economy, development priority, technological sovereignty, scientific and methodological approach, product complexity, matrix.*

Introduction

Growing geopolitical uncertainty and the threat of global trade conflicts raise questions about the degree of interdependence of world economies. A debate is

emerging about the extent to which states can and should remain independent with respect to critical technologies. A conflict emerges between the desire for technological sovereignty within a country and the dominant economic model in which global specialization and the global division of labor, combined with open trade, promote the well-being of all countries.

In modern conditions of instability and sanctions, the Russian Federation focuses on ensuring its own technological sovereignty. In this context, the question arises about using the potential of newly annexed territories, especially industrial regions. For example, the Donetsk People's Republic, as an industrial region, has the potential to be transformed and used to ensure technological sovereignty. This region has the necessary infrastructure, qualified personnel and other resources, which makes it possible to consider it as a potential source for restoring interrupted technological chains due to sanctions.

This approach requires identifying priority directions for the development of the economy of the Donetsk People's Republic and developing appropriate tools to achieve these goals.

The theoretical basis in the context of determining priorities for the development of the regional economy is formed by the works of foreign scientists: A.P. Thirlwall [1], N. Lane and T. Kalil [2], A. Mendelow [3], etc.

Despite close attention to the problem of determining priorities for economic development, a reference instrument has not currently been developed. In addition, the issue is updated by the need to ensure technological sovereignty at the state level and activate the economy of a new industrial region.

Purpose of the study

The purpose of the study is to develop a toolkit for determining priorities for the development of the regional economy, which will ensure technological sovereignty under the ongoing policy of import substitution.

Research results and discussion

The proposed tools for determining priorities for the development of the regional economy are presented in the form of a matrix. The axes of the generated matrix are represented by the product complexity index, which is a quantitative expression of the complexity (knowledge intensity) of product production [4, p. 245; 5, p. 43], and the share of imports of goods in the volume of their consumption, which makes it possible to take into account the import dependence of the economy of the Russian Federation in the production of various goods. Boundary values have been established: according to the product complexity index [-3; 0] – simple (non-knowledge-intensive) goods; (0; +3] – complex (knowledge-intensive) goods; by the share of imports of goods in the volume of consumption: [0; 0.50] – goods with a low share of imports in the volume of consumption; (0.50; 1] – goods with a high share of imports in the volume of consumption. In this

case, consumption is understood as the volume of production (which is presented in the form of the indicator "Shipped goods of own production, performed works and services by own forces"), excluding exports and taking into account imports of goods. Quadrants of the resulting matrix as a result of the intersection of border axes indicators made it possible to form 4 groups of goods: a group of complex (knowledge-intensive) goods with a high share of imports (I); a group of simple (non-knowledge-intensive) goods with a high share of imports (II); a group of simple (non-knowledge-intensive) goods with a low share of imports (III); group complex (knowledge-intensive) goods with a low share of imports (IV).

Highlighted in red are goods in the production of which critical technologies are used, defined by Decree of the President of the Russian Federation dated July 7, 2011 No. 899 "On approval of priority directions for the development of science, technology and technology in the Russian Federation and the list of critical technologies of the Russian Federation" (with amendments and additions) [6] and which relate to components critical for industry, approved by the Minutes of the meeting of the Commission on the development of production of critical components No. 68/OV/12 dated 04/21/2022 (as amended by the Appendix to the Protocol No. KP-1 dated 10/07/2022 g.) [7].

Consequently, the resulting matrix for determining development priorities for the Donetsk People's Republic in the framework of ensuring the technological sovereignty of the Russian Federation contains 231 goods that belong to the corresponding group depending on the level of its complexity and the share of imports in consumption. Calculations of indicators are based on data for 2021.

When determining development priorities and possible specialization of the Donetsk People's Republic, it is necessary to rely on already existing production and identified export comparative advantages [8], as well as develop the production of goods of group I - complex goods with a high share of imports in the volume of their consumption in the Russian Federation (see Fig.1).

In the absence of the possibility of producing high-tech products (complex goods), it is possible to diversify the areas of specialization of the economy of the Donetsk People's Republic by developing the production of goods of group II - simple goods with a high share of imports in the volume of their consumption in the Russian Federation.

Also, if the production of goods from group IV has already been developed in the Donetsk People's Republic - a group of complex (knowledge-intensive) goods with a low share of imports - it is advisable to support the production of these goods and establish ways to promote them to other regions of the Russian Federation. The production of goods of group IV will allow accumulating funds for the development of production of goods of group I.

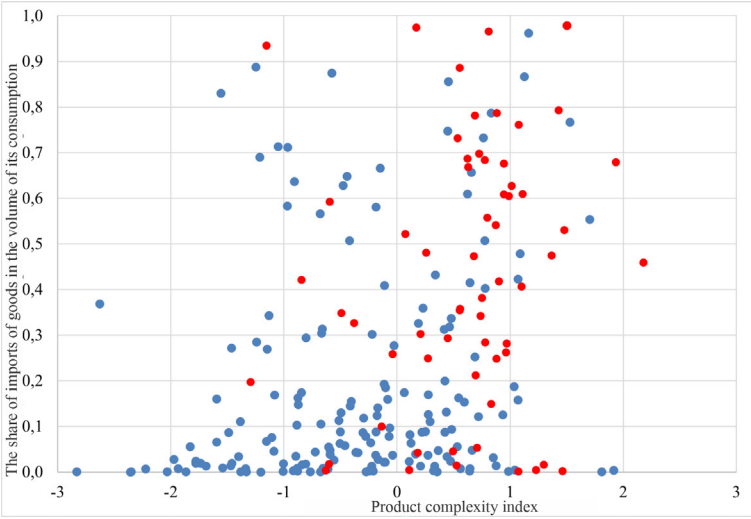


Figure 1. *Matrix for determining development priorities / possible specialization of the economy of the Donetsk People's Republic in 2021.*

When choosing development priorities/specialization, the region should focus on the development of production of goods in the manufacturing process of which critical technologies are used and which are critical components for industry.

The proposed tools for determining priorities for the development of the regional economy have a number of advantages: long-term and systematic monitoring of indicators ensures long-term testing, and, consequently, improvement of calculation methods; the selected indicators are characterized by a short period of their collection and regular frequency, which makes it possible to operate with data that is not outdated.

Conclusions

Testing of the proposed tools for determining the priorities for the development of the regional economy made it possible to establish that in the context of pursuing a policy of import substitution and ensuring the technological sovereignty of the Russian Federation as a whole, the Donetsk People's Republic can begin to specialize in the production of goods of group I - complex goods with a high share of imports in the volume of its consumption in the Russian Federation. Federation. In the absence of the possibility of producing high-tech products, it is possible to diversify the areas of specialization of the economy of the Donetsk People's Republic by developing the production of goods of group II - simple goods with a high share of imports in the volume of their consumption in the Russian Federation.

References

1. Thirlwall A.P. The balance of payments constraint as an explanation of international growth rate differences // Banca Nazionale del Lavoro Quarterly Review. 1979. Vol. 32 (128). P. 45–53.

2. Lane N., Kalil T. The National Nanotechnology Initiative: Present at the Creation // Issues in Science and Technology. 2005. Summer. P. 49–55.

3. Mendelow A. Environmental Scanning: The Impact of the Stakeholder Concept. Cambridge: MA, 1991. P. 407–418.

4. Hausmann R., Hidalgo C.A. The Atlas of Economic Complexity. Mapping Paths to Prosperity. Cambridge: Puritan Press, 2011. 364 p.

5. Lyubimov I.L., Ospanova A.G. How to make the economy more complex? Search for the reasons for the complication // Questions of Economics. 2019. No. 2. pp. 36–53.

6. Decree of the President of the Russian Federation "On approval of priority directions for the development of science, technology and engineering in the Russian Federation and the list of critical technologies of the Russian Federation" (revised and expanded) dated 07/07/2011 No. 899.

7. Minutes of the meeting of the Commission on the development of production of critical components dated 04/21/2022 No. 68/OV/12 (as amended by the Appendix to the Protocol No. KP-1 dated 10/07/2022)

8. Polovyan A.V., Sinitsyna K.I. Economic complexity as a tool for determining strategic directions of economic development // New in economic cybernetics. 2020. No. 1. pp. 123–140.

DOI 10.34660/INF.2023.53.82.277

现金管理作为内部公共财务控制体系的一个组成部分
CASH MANAGEMENT AS AN ELEMENT OF THE INTERNAL PUBLIC FINANCIAL CONTROL SYSTEM

Koloskova Ludmila Georgievna
Student
Finance University under the Government of the Russian Federation

注解。 文章对引入公共财务内部控制先进工具的前景进行了全面分析。 本文分析了缓存管理作为控制要素的本质特征。

关键词：国家内部金融控制、联邦财政部、缓存管理、数字平台、金融控制工具。

Annotation. *The article presents a comprehensive analysis of the prospects for the introduction of advanced tools of internal public financial control. The article analyzes the essential characteristics of cache management as an element of control.*

Keywords: *internal state financial control, Federal Treasury, cache management, digital platform, financial control tools.*

The issue of introducing new tools into the system of state financial control touches upon the procedures of borrowing instrumental approaches from other sectors of the economy. In addition, it seems possible to use the experience of applying elements of instrumental and methodological support from other functional areas of the Treasury of Russia. Further it is proposed to consider how the mechanism of "cache management" can be manifested in the functioning of the system of internal public financial control. Let us turn to the substantive characteristics of cache management.

Thus, the development of the cash management system has been an actual direction for the last twenty years. In practice, in the Russian Federation, the application of the innovation system was born as early as 1997 in an international bank located in the country. The first Russian bank to use this concept was Alfa-Bank in 2005. Since that period, cash management has been actively developing and improving the financial system [1].

In general, the category of cache management implies the management of client's financial flows using the system of banking technologies. Based on the con-

tent of the category, it can be assumed that the main consumer of such a service is commercial banks. However, the concept of cache management has been actively used in the activities of the Federal Treasury, being an innovative functional tool.

The Federal Treasury, as an executive authority, performs the functions of ensuring the federal budget, cash servicing of the budgets of the budgetary system of the country, and also carries out control activities for the conduct of operations with budgetary funds for those to whom they are brought, performing its functions in accordance with the legislation of the Russian Federation.

At present, cache management is an innovative tool that provides for the effective operation of the Russian Treasury, which carries out its activities to manage financial flows through a single treasury account. At the same time, it is important to distinguish between cache management in the implementation of banking and treasury directions. We can distinguish their main differences and similar functions [3]. For example, the main factors uniting both directions can be highlighted that they are aimed at improving the quality of service provision, introduction of innovative programs. Analyzing the distinctive aspects in the application of cache management, it can be noted that they are expressed in the fundamental objectives of each of the directions. If the banking sector seeks to increase the flow of clients and maximize income by expanding the range of services, the treasury system aims to improve the quality of operations management and budget liquidity.

Cash management includes key components that can improve bothbanking and treasury functions. For example, the system of cash management products includes the following (Fig. 1):

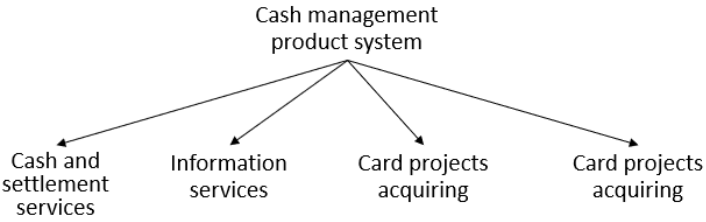


Figure 1. *System of cache management products*

The result of applying the system of cash management products is effective management of the liquidity position and acceleration of capital turnover.

Based on this specificity of the product system, it is worth noting that cache management can be considered as an automated product with a number of advantages, including regularity, uniformity, transparency, which are some of the fundamental principles of control implementation. It is these aspects involved in the implementation of cache management that contribute to the improvement of

financial flow management, thereby determining the improvement of service quality, including the control of financial flows as one of the elements of management.

The modern treasury model, taking into account international practices, currently has a number of challenges [2]:

- consolidation of financial resources on the treasury single account;
- maintenance of budgetary accounting of federal budget execution;
- provision of a system implementing a centralized basis for processing payments;
- improving the system used in the organization of operations in order to implement centralized accounting in the course of execution of the federal budget;
- implementation of financial planning procedures.

Thus, it can be noted that cache management plays a key role in the effective implementation of the Federal Treasury, as it represents the basis of its activities. The goal, which implies the interconnection between the two systems, is expressed in the realization of an improved mechanism for handling financial and budgetary flows passing through the single treasury account. Currently, there are several directions of cache management, which are implemented by the Russian Treasury (Fig. 2).

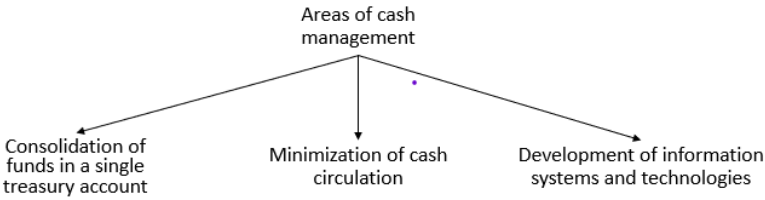


Figure 2. *Areas of cache management implemented by the Federal Treasury*

Analysis of Fig. 2 allows us to say that each direction implemented by the Treasury of Russia is aimed at ensuring optimization of payments using IT-technologies. This aspect provides for the improvement of the quality characteristics of cash services for the execution of budgets of the budgetary system of the Russian Federation, as well as improving the processes of electronic services, along with the improvement of mechanisms for the management and control of free balances of budgetary funds.

The purpose of introducing a cash management system is to reduce the volume of public debt and interest costs associated with it. At the same time, it seems necessary to create maximum concentration of the volume of cash on a single treasury account and to ensure placement of temporarily free cash to increase revenues.

In order to realize the main task, it is necessary to implement a number of measures. Thus, it is necessary to control and account for all receipts and funds;

to ensure timely and complete budget payments; to organize competent cash planning; to conduct active operations in the financial market.

At present, the implementation of the program for introducing cache management into the activities of the Federal Treasury is being actively pursued, which has already managed to produce certain results. An example is the established mechanism for the provision of interbudget transfers and budget credits to replenish balances on the accounts of the budgets of the constituent entities of the Russian Federation, as well as local budgets. The monitoring of obligations on cash servicing of budget execution is carried out, thanks to which the effective management of the daily balance on the single treasury account is organized and, in general, the operations of targeting of free cash balances are implemented. There is also an opportunity to generate additional income through operations in the financial market when targeting unused balances.

Thus, we can note the relevance of the introduction and improvement of cache management, capable of developing the treasury system, not only affecting the quality of service and realizing the objectives of the executive authority based on the specifics of its purpose, but also improving the system of internal public financial control over financial and budgetary flows.

Summarizing the above-mentioned, it should be noted that the borrowing of tools used by entities in other sectors of the economy is a promising direction of development of public financial control. Each brings its individual positive features that can automate and ensure the effectiveness of control functioning in the financial and budgetary sphere.

References

1. Ason T.A. Use of cache - management by Russian enterprises // Modern Scientific Research and Development, 2018. - № 4(21). - C. 75-83.

2. Katasonova E.V., To the issue of cache management in the Treasury of Russia // Voprosy student's science. 2019 №6 (34). - C. 108-111

3. Prokofiev, S.E. Russian cache management - one of the best world practices / S.E. Prokofiev; prepared by S. V. Martynenko. V. Martynenko // Budget, 2019. - № 1. - C. 42-46.

DOI 10.34660/INF.2023.53.84.278

国外组织金融网络安全的经验及其在俄罗斯条件下应用的可能性
FOREIGN EXPERIENCE IN ORGANIZING FINANCIAL CYBERSECURITY AND THE POSSIBILITY OF ITS APPLICATION IN RUSSIAN CONDITIONS

Rogozhin Alexey Nikolayevich
student
Financial University under the Government of the Russian Federation, Moscow, Russia

注解。 本文描述了信息安全问题。 它讲述了俄罗斯和外国如何应对网络攻击、加强保护要求。 据透露，组织机构免受网络攻击的防护能力不高，这对俄罗斯银行业造成了不良影响。

关键词：外国、网络安全、网络攻击、组织、技术、银行、经济、网络风险。

Annotation. *This article describes the problems of information security. It tells how Russia and foreign countries cope with cyberattacks, tightening protection requirements. It was revealed that the protection of organizations from cyber-attacks is not high, which has a bad effect on the banking sector in Russia.*

Keywords: *foreign countries, cyber security, cyber-attack, organizations, technologies, banks, economy, cyber risks.*

"Nowadays communication technologies have a significant impact on all spheres of society including the economy Information and communication technologies present business structures with new opportunities to realize the latest algorithms of economic activity" [1, c. 86]. But the development of digitalization more and more often makes us think about digital security.

The Russian President often says: "The digital economy is not a separate industry, in fact, it is a way of life, a new basis for the development of the public administration system, economy, business, social sphere, and the entire society," he noted. - The formation of the digital economy is a matter of national security and independence of Russia, competition of domestic companies" [2].

Note that this topic also concerns the global economy. Now Russia is deeply considering this problem. This article will discuss issues related to cybersecurity: the experience of foreign countries in this area and Russia's attitude to cybersecurity. First, let's give concepts of the main terms related to our topic.

Cyberspace is a cumulative virtual environment built on the behavior of people and services on the Internet with the help of technologies and networks. Money, virtual currency, virtual atrocities, etc. are the essence of cyberspace [3, p. 29].

The collection of information, which includes all the meanings and terms of cybersecurity, includes various concepts related to the entire field of cybersecurity. For example, network and information infrastructure and their security, the definition of cyberattack, and program security.

In the field of information, security refers to ensuring reliability and protection against various threats.

Cyber-attack is the premeditated exploitation of computer systems, technological enterprises and networks [4].

In order to harm and exploit personal data, hackers use various virus codes and software due to which computer data is changed, which brings bad consequences and great damage. Few people pay proper attention to this, but data should be protected to the maximum, because it is always good to be prepared and protected from information theft.

These actions performed by so-called cybercriminals allow them to get absolutely any information, up to medical and financial data. And stealing this type of information is a crime, only in this area it is correct to call it cybercrime, because stealing such important data hackers conduct various transactions and any illegal actions. Hackers use a lot of different ways to steal information, but statistically most often cybercriminals steal personal data for blackmail and ransom, so cybercrime is a serious threat to companies and individuals. Data can be stolen from anywhere: from gadgets, messengers, emails, various programs, etc. You should not provide your personal data to anyone suspicious and unfamiliar; you should not click on the links sent to you because they contain malicious nature, otherwise, in a matter of seconds your personal information will be stolen and used for personal purposes of cybercriminals and you will have huge problems. After all, the easiest way for fraudsters is to find out your personal card details. The biggest risk of you being cyberattacked comes from how much information you store digitally and how often you use the internet.

Russia's banks are not yet well equipped to regulate and deal with cyber risks. According to 2019 data, 75 Central Banks out of all audited banks were found to have various kinds of breaches. [5] Upon reflection, we can conclude that this difficult situation in banks and businesses arises because executives are shifting their cybersecurity responsibilities to managers. And as one can already guess, managers do not have sufficient competence and power to deal with these complexities.

But, on the other hand, to ensure reliability, you not only need to be empowered but also have a strong association across the banking industry. The Central Bank has taken measures to strengthen cyber security and has ensured greater

security of funds and privacy of customers' personal data. Therefore, we can conclude that the government is paying attention to this problem and trying to get rid of it. First of all, banks now also provide security in deposit procedures, not only for fund transfers.

Russian banks are now strengthening their bank protection requirements. According to analysts, from 2019 to 2030, the damage from cyberattacks is expected to increase. A study by Group IB showed that 74% of Russian banks are not prepared for hacker attacks. Defenses are not high enough. In one year (from 2017 to 2018), cyberattacks in the financial sector caused damage of almost 3 billion rubles [6].

These figures indicate a negligible degree of cybersecurity, which in turn has an impact on the development and subsequent creation of foundations in the Russian Federation. The norms of simple and intensive values of information defense are specified in GOST 2017 [7]. One of the most important differences concerns such questions as what measures should be used for information defense - technical or organizational? There are several cybersecurity rules for all types of banks [8]:

Huge organizations that use an advanced level of data protection are required to immediately delete the accounts of terminated employees and/or people who have been absent from work for more than ninety days.

With a normal level of protection is enough single-factor authentication of the user when connecting to the networks of the organization, with more advanced security is necessary multi-factor authentication.

Rooms with servers must be maximally secured, as they give access to the networks of the bank. It is necessary to put video surveillance and alarm systems in them;

The rest of the most important requirements are introduction of increased electric signature of the consumer, fulfillment of every rule when working with cryptocurrency resources, informing the Central Bank about any incident of information security.

Two years earlier, in 2016, a security data breach at a company in America caused $4 billion in damage. Protecting the information environment, preventing hacker attacks and other measures in the UK costs the industry $472 million. A survey of frontline engineers was conducted on the primary challenges in protecting data. More than half of the respondents agreed that current policies in this area have a negative tendency to affect the progress of the company. Spending on security preservation, data leakage tops the list of UK challenges for management. As a consequence of these events, the prestige of companies is undermined, which is also related to the problem. After the Hitachi Services ATM attack in 2016, millions of users were left without their cards, causing a $171 million loss to Union

Bank of India. For this reason, Union Finance Minister Aruna Jightly recorded a speech and announced the creation of an organization to take action against finance-related cybercrime. PwC's testimony shows that JPMorgan Chase, Global Payments, Inc and others were attacked for information data for that year in 2014.

International experience that we can take hold of points us to, and gives us the most important guidelines and a list of countermeasures to illegal online activities. Also note that the first versions of cyber defense are 99.9% interpretations of traditional organizational and technical measures that are largely unsystematized, which in turn is one of the main reasons why they are not widely used.

Literature

1. Zvereva T. V. Opportunities of tax administration to minimize tax risks in the digital economy // Innovative development of the economy. 2017. № 5 (41). C. 86-90.

2. Putin: the formation of the digital economy is a matter of national security of the Russian Federation. URL: https://tass.ru/ekonomika/4389411 (date of access: 13.06.2019).

3. Alexey Sergeevich Markov, Valentin Leonidovich Tsirlov. Guidelines on cybersecurity in the context of 27032. 2014. C. 29.

4. Veracode. URL: https://www.veracode.com/ (accessed 13.06.2019).

5. Designing cybersecurity for the financial sector. Livemint. URL: https://www.livemint.com/.

6. Secure Bank. URL: https://www.group-ib.ru/secure-bank.html.

7. GOST R 53114-2008 Information Protection. Ensuring information security in the organization.

8. Cybersecurity Center // World Economic Forum. URL: https://www.weforum.org/centre-for-cybersecurit

DOI 10.34660/INF.2023.71.17.279

旅游集群发挥作用的潜力
POTENTIAL FOR THE TOURISM CLUSTERS FUNCTIONING

Maliaronak Viktoryia Nikolaevna
Master in Economics and Management Science, Assistant
Belarusian State Economic University

抽象的。 文章探讨了集群融入旅游业的问题。 白俄罗斯共和国旅游业的发展受到特别关注。 已经制定了一系列相关指标来确定该国境内集群形成的发展潜力。 计算了 2012 年至 2021 年期间白俄罗斯共和国各地区旅游集群的运作潜力。

关键词：旅游集群、旅游集群潜力、旅游产业。

Abstract. The article discusses the problem of integrating clusters into the tourism industry. Particular attention is paid to the development of the tourism industry in the Republic of Belarus. A list of relative indicators has been developed to determine the development potential of cluster formations in the country's territories. The potential for the functioning of tourism clusters in the regions of the Republic of Belarus for the period 2012-2021 was calculated.

Keywords: tourism cluster, tourism cluster potential, tourism industry.

Tourism is one of the leading and most dynamically developing sectors of the world economy. According to the World Tourism Organization, the world recorded more than 900 million international tourist trips in 2022, double the number in 2021 but 37 percent lower than before the pandemic. According to UNWTO experts, international tourism will continue to recover in 2023: the total number of trips will reach 80 to 95% of pre-pandemic levels. The process of returning to the pre-Covid level of tourism will be asynchronous in dynamics in different regions of the world. According to World Tourism Organization forecasts, in 2023 the number of international arrivals may return to 2019 levels only in Europe and the Middle East [1]. The tourism sector is impacted by ongoing uncertainty caused by geopolitical conflicts as well as the COVID-19 situation.

Identification of tourism clusters will allow optimizing the territorial organization of the tourism industry, forming a competitive regional tourism product, involving more labor resources in economic activities, improving the quality of personnel training, strengthening the practical orientation of research work, inten-

sifying advertising and information activities and consulting in the field of tourism, which in As a result, it will contribute to the effective sustainable regional development of the country's territories.

Speaking about Belarusian tourism, about factors and trends in the development of demand in the domestic market and about the future of this industry as a whole, first of all it is necessary to note the National Strategy for Sustainable Social and Economic Development of the Republic of Belarus for the period until 2030 [2], which determines the development the tourism industry as one of the most important areas of Belarus' transition to a post-industrial society and innovative economic development. The main goal of the development of the tourism industry is the creation of a highly efficient and competitive tourism complex, the entry of the Republic of Belarus into the top 50 countries in terms of tourism development. In Belarus, over the past two decades, State tourism development programs have been implemented, aimed at developing infrastructure and promoting the national tourism product.

At the same time, an analysis of the main indicators of tourism development in the Republic of Belarus for 2012-2021 was carried out. according to the National Statistics Committee [3-6]. During this period, the volume of inbound and outbound tourism increased. However, the pandemic has had a negative impact on the tourism industry. In 2019, the number of tourist trips by foreign citizens to the Republic of Belarus amounted to 11,832.1 thousand trips, when in 2020 the figure decreased by 4.5 times. In 2021, the number of tourist trips by foreign citizens amounted to 3361.0 thousand trips. The same trend was maintained by the number of tourist trips abroad by citizens of the Republic of Belarus. In 2019, the figure reached 9221.2 thousand trips, when in 2020 it decreased by 3.2 times. In 2021, the number of tourist trips abroad by citizens of the Republic of Belarus amounted to 2615.6 thousand trips. At current growth rates, these indicators will be able to return to the pre-Covid period no earlier than in a decade.

Belarus is characterized by the predominance of outbound tourism over inbound tourism, which continues in the post-Covid period. Thus, in 2021, exports of services under the item "Travel" amounted to $356.4 million, when imports, in turn, were equal to $525.5 million.

In recent years, the number of tourism organizations has increased significantly, most of which are engaged in tour operator and travel agency activities. In 2021, the number of such organizations amounted to 1,315 units. Dynamics of the number of tourists and excursionists served by organizations carrying out tourism activities for 2012-2021 presented in Figure 1.

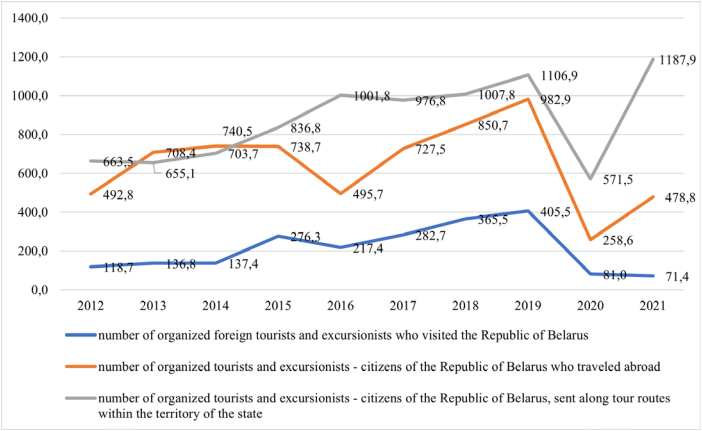


Figure 1. *Dynamics of the number of tourists and excursionists served by organizations engaged in tourism activities for 2012-2021, thousand people*

It should be noted that the general recommendations of the World Tourism Organization on the ratio of forms of inbound, outbound and domestic tourism are as follows: 1: 1: 4, respectively. When in Belarus in 2021 the situation is 1: 6: 16.

Belarus is characterized by an uneven distribution of the number of foreign tourists and excursionists across regions and the city of Minsk (Figure 2).

Among the absolute leaders for the analyzed period 2021-2021. located in Minsk and Brest region. In 2021, 42,200 thousand foreign tourists and excursionists visited Minsk, 21,100 thousand people visited the Brest region. In 2015, visa-free entry into the territory of the "Belovezhskaya Pushcha" National Park was introduced, then the number of foreign tourists and sightseers in the Brest region amounted to a record 172,606 thousand people.

Since 2016, there has been an increase in foreign tourists in the Grodno region, which is associated with the introduction of a visa-free regime on the territory of the Augustow Canal tourist and recreational park.

Since 2018, the Decree of the President of the Republic of Belarus came into force, according to which citizens of 74 countries can enter Belarus visa-free, which also had a positive impact on the number of foreign tourists.

With government support, new tourism industry facilities were created and modernized in the country. In 2021, the number of collective accommodation places amounted to 1,066 units. Activities in the field of agroecotourism are carried out by 3,150 entities. Moreover, it should be noted that only indicators of agroecotourism development are characterized by positive dynamics for 2012-2021: there is an increase in the number of agroecotourism entities, the number of

tourists served by agroecotourism entities, and the amount received in payment for services provided by agroecotourism entities by approximately 1.5 times annually.

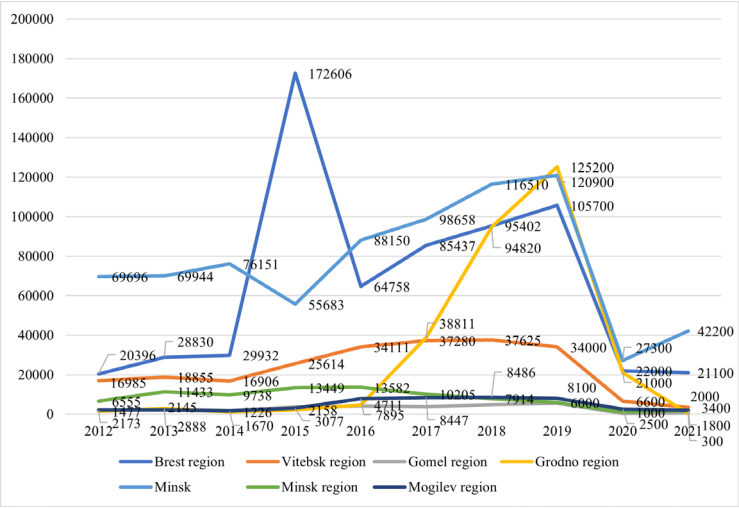


Figure 2. *Dynamics of the number of tourists and excursionists served by organizations engaged in tourism activities for 2012-2021, thousand people*

The problem of insufficient development of domestic and inbound tourism remains relevant for Belarus, which entails imperfections in the mechanism for attracting investments, the system of state management of tourism, and the collection of information about economic entities in this industry. The economic potential of the tourism industry remains unrealized to its fullest extent.

Foreign experience shows the success of applying the cluster model in the tourism sector. Cluster formations are primarily characteristic of developed countries, but are also present in developing countries and countries with economies in transition.

It should be noted that tourism clusters in the Republic of Belarus are characterized by spontaneous formation, that is, tourism clusters in the classical sense already exist, but they are not formalized, which makes the effective functioning of these formations difficult. In this regard, at the moment we can only talk about assessing the level of self-organization of the cluster, about individual cluster initiatives and about economic potential.

The potential of a tourism cluster is understood as the ability of subjects of the tourism industry to engage in economic activity, reflecting the maximum possible overall result of functioning. To obtain an objective assessment of the potential

for the functioning of a tourism cluster, it is necessary to take into account the economic, environmental, and social components of efficiency, which will further contribute to obtaining a real idea of the changes that have occurred.

In order to determine the development potential of cluster formations of territories, a list of relative indicators was developed (Table 1).

Table 1

List of relative indicators for calculating the development potential of cluster formations

Coefficient	Calculation formula
p1	Number of organizations carrying out tourism activities, units. / Territory area, thousand km2
p2	Number of organizations carrying out tourism activities, units. / Population, thousand people
p3	Number of tourists and excursionists who visited the Republic of Belarus and served by organizations engaged in tourism activities, people. / Territory area, thousand km2
p4	Number of tourists and excursionists who visited the Republic of Belarus and served by organizations engaged in tourism activities, people. / Population, thousand people
p5	Number of organized tourists sent on tours within the Republic of Belarus, people. / Territory area, thousand km2
p6	Number of organized tourists sent on tours within the Republic of Belarus, people. / Population, thousand people
p7	Capacity of hotels and similar accommodation facilities (at the end of the year), beds / Territory area, thousand km2
p8	Capacity of hotels and similar accommodation facilities (at the end of the year), places / Population, thousand people.
p9	Capacity of hotels and similar accommodation facilities (at the end of the year), places / Number of tourists and excursionists who visited the Republic of Belarus and served by organizations carrying out tourism activities, people.
p10	Capacity of hotels and similar accommodation facilities (at the end of the year), places / Number of organized tourists sent on tours within the Republic of Belarus, people.
p11	Number of persons accommodated, thousand people / Capacity of hotels and similar accommodation facilities (at the end of the year), places
p12	Capacity of sanatorium-resort, health-improving organizations and other specialized accommodation facilities, thousand units / Territory area, thousand km2
p13	Throughput capacity of sanatorium-resort, health-improving organizations and other specialized accommodation facilities, thousand units / Population, thousand people.

p14	Persons accommodated, thousand people / Capacity of sanatorium-resort, health-improving organizations and other specialized accommodation facilities, thousand units
p15	Number of employees of organizations engaged in tourism activities, people. / Population, thousand people
p16	Number of employees of organizations engaged in tourism activities, people. / Number of organizations carrying out tourism activities, units.
p17	Graduated specialists, people. / Number of organizations carrying out tourism activities, units.
p18	Number of museums, units / Territory area, thousand km2
P19	Immovable heritage objects included in the State List of Historical and Cultural Heritage, units. / Territory area, thousand km2
p20	Emissions of pollutants into the air, thousand tons per person

Note - Source: own development.

To include indicators in assessing the potential for the functioning of a tourism cluster, a correlation analysis was carried out, thanks to which a number of indicators were excluded in order to obtain more adequate values.

Relative indicators for calculating the potential for the creation and operation of a tourism cluster were brought to a comparable form using formula 1.1.

$$P_n = \sum_{i=1}^{n} \frac{p_i - p_{min}}{p_{max} - p_{min}}, \quad (1.1)$$

where pi — relative indicators for calculating the potential for creation and functioning of the tourism cluster.

Next, based on data from the National Statistical Committee of the Republic of Belarus, by summing up relative indicators, the potential for the creation and functioning of tourism clusters in dynamics by region was determined.

Table 2 presents the results obtained, reflecting the potential for the functioning of tourism clusters by region for the period 2012–2021.

Table 2

Rating by potential of regions of the Republic of Belarus

Region	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Brestskaya	2,2031	1,7219	1,5942	1,2056	1,4558	1,3640	1,2625	1,2196	1,1287	1,0789
Vitebskaya	1,3657	1,4869	1,3967	1,7137	1,5703	1,5628	1,5977	2,2432	1,3054	1,1504
Gomelskaya	1,5154	1,7921	1,5254	1,6472	1,7617	1,8121	1,7811	1,7433	1,9811	1,3268
Grodnenskaya	1,2338	1,2636	1,2378	1,2667	1,2833	2,1249	1,6365	1,4687	2,1261	1,1490
Minskaya	1,1826	1,2333	1,2336	1,3280	1,3482	1,3252	1,3591	1,2654	1,5265	1,2503
Mogilevskaya	1,1419	1,1700	1,1495	1,2113	1,3311	1,3585	1,3489	1,3250	1,6745	1,2064

Note - Source: author's own development.

The lower the value of the indicator, the greater the potential for the creation of tourism clusters. Accordingly, according to the calculations obtained, the most promising are the Grodnenskaya and Brestskaya oblast, followed by Vitebskaya, Mogilevskaya and Minskaya. And the least attractive is the Gomelskaya oblast.

Thus, as a result of the cumulative impact of clustering factors, an economic effect is created from the activities of the tourism cluster. From the perspective of the developed methodology for assessing the potential of a tourism cluster, it is based on the distinction between key performance indicators of the system: effectiveness and efficiency. At the stage of creating a tourism cluster, it is advisable to limit ourselves to the main indicators of the development of the tourism industry. Standard values for these indicators can be developed in relation to specific tourism clusters, taking into account their configuration and initial conditions of creation.

References

1. World tourism barometer [Electronic resource]. – Access mode: https://webunwto.s3.eu-west-1.amazonaws.com/s3fs-public/2021-10/UNWTO_Barom21_05_September_excerpt.pdf. – Access date: 09/26/2023.

2. National strategy for sustainable socio-economic development of the Republic of Belarus for the period until 2030 [Electronic resource]. – Access mode: http://www.minzchie.by/images/stories/doc/cur.pdf. – Access date: 09/26/2023.

3. Tourism and tourist resources in the Republic of Belarus, 2022 [Electronic resource]. — Access mode: https://www.belstat.gov.by/ofitsialnaya-statistika/realny-sector-ekonomiki/turizm/statisticheskie-izdaniya/index_54360/. — Access date: 05/10/2023.

4. Tourism and tourist resources in the Republic of Belarus, 2021 [Electronic resource]. — Access mode: https://www.belstat.gov.by/ofitsialnaya-statistika/realny-sector-ekonomiki/turizm/statisticheskie-izdaniya/index_39563/. — Access date: 05/10/2023.

5. Tourism and tourist resources in the Republic of Belarus, 2020 [Electronic resource]. — Access mode: https://www.belstat.gov.by/ofitsialnaya-statistika/solialnaya-sfera/turizm/publikatsii_9/index_17416/. — Access date: 05/10/2023.

6. Tourism and tourist resources in the Republic of Belarus, 2019 [Electronic resource]. — Access mode: https://www.belstat.gov.by/ofitsialnaya-statistika/publications/izdania/public_compilation/index_13890/. — Access date: 05/10/2020.

DOI 10.34660/INF.2023.94.21.280
CDU: 341.3

代理人战争和国际法中似是而非的否认：以俄罗斯干预乌克兰为例
PROXY WAR AND PLAUSIBLE DENIAL IN INTERNATIONAL LAW: THE CASE OF THE RUSSIAN INTERVENTION IN UKRAINE

Tshibola Aimée Murphie Lubeshi
Ph.D. in Law, Associate Professor, Research Fellow
Human Sciences Research Center
Lecturer
Manono University, Democratic Republic of the Congo,
AGORA International training and pedagogic center of USA

Aboubacar Sidiki Fofana
Auditor in Master degree
University General Lasana Conte, Conakry, Republic of Guinea

Yumba Mutono Tristan
Graduate
William Booth University
Independent Researcher in International Law and International Relations

Namegabe Masirika Elie
Graduate
Official University of Bukavu
Independent Researcher in International Law and International Relations Democratic Republic of Congo

抽象的。 本文探讨了国际法中的代理人战争和合理推诿问题，重点关注俄罗斯对乌克兰的干预。 代理人战争是国家通过第三方参与者参与冲突的一种策略，而合理否认是否认参与此类冲突的能力。 文章探讨了国际法中代理人战争的合法性，包括主权、不干涉和使用武力原则。 它还分析了俄罗斯干预乌克兰过程中合理否认的作用，包括使用非正规部队和否认直接参与。 文章最后强调了处理代理人战争和国际法中合理推诿的挑战，以及在此类冲突中加强问责制和透明度的必要性。

关键词：国际法、战争、俄罗斯-乌克兰危机、代理人战争、合理推诿、国际责任。

Abstract. *This article explores the issue of proxy warfare and plausible deniability in international law, focusing on the Russian intervention in Ukraine. Proxy warfare is a strategy used by states to engage in conflict through third-party actors, while plausible deniability is the ability to deny involvement in such conflict. The article examines the legality of proxy warfare in international law, including the principles of sovereignty, non-intervention and the use of force. It also analyzes the role of plausible deniability in the Russian intervention in Ukraine, including the use of irregular forces and the denial of direct involvement. The article concludes by highlighting the challenges of dealing with proxy warfare and plausible deniability in international law and the need for greater accountability and transparency in such conflicts.*

Keywords: *international law, war, Russian-Ukrainian crisis, proxy war, plausible deniability, international responsibility.*

I. INTRODUCTION

Proxy warfare is a strategy used by states to engage in conflict through third-party actors, while plausible deniability is the ability to deny involvement in such conflict. These tactics have been used in many international conflicts, including the Russian intervention in Ukraine. In this article, we examine the legal aspects of proxy warfare and plausible deniability in international law, focusing on the case of the Russian intervention in Ukraine.

Legality of proxy war:

Proxy warfare raises complex legal issues in international law. State sovereignty is a fundamental principle of international law, meaning that states have the exclusive right to govern their own territory and decide their own foreign policy. However, proxy warfare often involves the use of irregular forces or terrorist groups that operate outside a state's borders, which can violate the sovereignty of other states. Moreover, the use of irregular forces can lead to violations of human rights and international humanitarian law.

The legality of proxy warfare depends on the specific circumstances of each case. For example, the use of irregular forces to fight a terrorist group can be considered legitimate, if carried out with the authorization and cooperation of the government of the country concerned. However, the use of irregular forces to overthrow an elected government or to annex territory can be considered a violation of the sovereignty and territorial integrity of a state.

Role of plausible deniability:

Plausible deniability is another tactic used in proxy wars. It is the ability to deny any direct involvement in a conflict, even if the state is involved behind the scenes.

To conduct this study, we used a literature search approach to examine available sources on proxy warfare, plausible deniability, and Russian intervention in

Ukraine. We used primary sources, such as speeches by Russian leaders, diplomatic documents and media reports, as well as secondary sources, such as books and academic journal articles. We also reviewed relevant legal documents, such as UN Security Council resolutions and international treaties, to understand the legal obligations of the states involved in the conflict.

We analyzed the sources to identify the main arguments and trends in the proxy war, plausible deniability and the Russian intervention in Ukraine. We also assessed the evidence for its relevance and reliability, in order to formulate coherent and convincing arguments.

Finally, we considered the limitations of our research approach, such as the limited availability of some sources and potential biases in the sources we used. Despite these limitations, we believe that our research approach provides a solid understanding of proxy warfare and plausible deniability in international law, focusing on the Russian intervention in Ukraine.

II. PROXY WAR: DEFINITION AND HISTORICAL EXAMPLES

Here, we will try to give a definition of the notion of ‘’WAR BY PROXY’’. But well before doing so, it is necessary to know what war is. Thus, by definition in (International Relations), war is an “*armed struggle between States, desired by at least one of them, and undertaken with a view to a national interest*”. [1] War can be civil, state, internal, international or interstate, revolutionary, psychological. Recently, we are witnessing a new form of warfare that is unrecognized by international law, given its complexity and limitations arising from state sovereignty. So the “proxy war” is distinguished from other new concepts by the fact that it is a conflict where two actors confront each other indirectly by financing or arming intermediaries, who themselves confront each other conventionally. Thus, proxy wars allowed states to be more adventurous, to project their influence around the world and to make gains at the expense of their [rivals .]However, Groh points out that proxy wars consist of a delegation of control over the conflict and the intervention, thus complicating the achievement of the objectives targeted by the sponsoring state [3].

From the Korean War in the years 1950-1953 [4]through the Vietnam War of 1957-1975 [5], the Bay of Pigs landings of 1961 [6], the Cuban Missile Crisis of 1962 [7], the Angolan civil war of 1972-2002 [8], the Afghan war of 1979-1989 [9], the Iranian hostage crisis of 1979-1981 [10]; there are factual differences in these conflicts although they have in common the involvement of a foreign power, which falls within the scope of a proxy war.

III. RUSSIAN INTERVENTION IN UKRAINE: A PROXY WAR?

The sovereignty enjoyed by States excludes any intervention on their soil without their authorization, which would be likely to violate the provisions or the purpose of the United Nations as provided for in the Charter [11]. However, since

February 2022, the world is facing one of the major geopolitical crises since the Cold War; the Russian-Ukrainian crisis, far from being a simple quest to preserve the sovereignty of the two States, turns out to be a game of ping-pong in which the great powers are engaged, which are becoming more and more interventionist and even real actors interference in the internal affairs of other States, albeit sovereign ones.

It should be noted that the Russian intervention in Ukraine is marked by an increasingly active participation of the Wagner group, a Russian paramilitary company which is part of "Active Measures 2.0" 12 [and]to which Moscow can entrust the implementation of its foreign policy throughout the world, and of which he can deny any link by invoking "*plausible deniability*" [13]in order to contest his involvement. As a result, the Wagner Group's connection to the Russian state has been proven and its existence has been openly acknowledged by Vladimir Putin [14]. From a legal point of view, the fact that this situation has not been described as a "proxy war" is deplorable given the participation of the Wagner group in this conflict alongside Russian troops. That said, it should be mentioned that the interventions of States or non-State entities in a conflict can change the nature of the conflict. This is the case, for example, of an internal armed conflict that becomes international.

So, doesn't the Russian intervention in Ukraine constitute a breach of international law? The answer to this question is practically positive; As a matter of principle, the United Nations primarily advocates non-violent means in the prevention and resolution of conflicts, but very unfortunately diplomatic means have not been able to prevent Russia's intervention in Ukraine.

IV. PLAUSIBLE DENIAL IN INTERNATIONAL LAW: DEFINITION AND HISTORICAL EXAMPLES

Defined by Druetz as a "*technique which designates the fact that a State which delegates the exercise of violence to private actors can easily deny its responsibility in certain acts which it claims to be a matter only for the private sector*" 15 [,] plausible deniability (or "*plausibly deniable*") therefore appears as a formula generally designating the ability of certain people to affirm that they were not aware of or are not responsible for reprehensible acts committed by third parties, due to a lack evidence likely to confirm their involvement or their knowledge of the facts.

International law finds itself involved in this, given that States use plausible deniability to clear themselves of any possible involvement of their international responsibility; however, the draft articles on the responsibility of States for internationally wrongful acts provide information on the possibilities of bringing such responsibility into play in articles 1, [16]5, [17]and 8, [18].

V. RUSSIAN INTERVENTION IN UKRAINE: AN EXAMPLE OF PLAUSIBLE DENIAL IN INTERNATIONAL LAW?

During the conflicts opposing it to Ukraine from 2014 (annexation of Crimea in February-March and the Donbass war from April 2014), Russia's strategy is

based on the plausible denial of its military intervention. Russian military units on the ground wore uniforms without insignia and were presented by Russia as "local resisters" [19].

Russia employs "grey area strategies" (plausible deniability) via "semi-informal/hybrid state" entities20 to serve its foreign [policy]ambitions without risking open confrontation. The recourse to the Wagner group fits precisely into these strategies.

Russian actions on Ukrainian soil since February 2022, as well as the resulting consequences, have aroused considerable interest attached to the legal aspects of its aggressions. If the Charter of the United Nations provides in its article 2 §4 [21]the principle of the prohibition of the use of force and implicitly that of respect for the territorial integrity of States, several acts, declarations and agreements have been concluded under the leadership of the United Nations recall the need for the peaceful settlement of disputes, non-interference or the duty of cooperation between States. Among these acts is resolution 3314 [22]adopted on December 14, 1974 by the UN General Assembly, which defines the concept of aggression while including several acts of which Russia has been guilty in Ukraine since its invasion. (military occupation, deportation, disproportionate bombardment, use of armed gangs). In the light of this document and the evolution of the situation on the ground, we must say that Russia refuses to admit the commission of serious violations of international humanitarian law by its troops and their auxiliaries of the group Wagner in Ukraine, something that would expose it to condemnation by the UN under many legal instruments to which it is a party.

This is quite abnormal from a legal point of view and is justified by the fact that international law has not dealt with this notion of war by proxy. However, it should be mentioned that the interventions of States or entities that are third parties to a conflict can change the nature of the conflict. This is the case of an internal armed conflict which becomes international. This does not mean that the Russian-Ukrainian war is not international.

VI. THE LEGAL AND POLITICAL IMPLICATIONS OF PROXY WAR AND PLAUSIBLE DENIAL IN THE RUSSIAN INTERVENTION IN UKRAINE

As for any organization, the international system responds to the principle according to which: "*With an action corresponds a reaction*". The right to intervene, which some prefer to call the duty to intervene, is undergoing significant development in international law [23]. There is still a real tension between this new practice and the fundamental principle of state sovereignty. The principles of State sovereignty and equality between States are invoked as means of protection against an abusive exercise of the right of intervention [24]. In the wake of state interventions of various kinds, those concerned are looking for the legal foundations

of such interventions as well as effective frameworks to prevent their diversion from the humanitarian objective [25].

However, in international law, it is rather the principle of non-intervention that has been recognized for a very long time. It includes the fundamental obligation of States not to intervene in the internal and external affairs of another State and also applies to any threat of such intervention [.]Thus, through the Russian intervention in Ukraine, we find that the right to war has been used under a dome with a high risk of slippage, without this being clearly defined by the existing law in the matter. Moreover, the power of attorney as an act bringing together the principal and the agent in a relationship of subordination, not only raises the problem of complicity and that of criminal associations in domestic law in the event of serious violations of the established rules, being given that the two interveners constitute existing subjects of the law, and can therefore engage their responsibility either individually or collectively.

Recourse to the services of a non-state entity (paramilitary company) to the detriment of the regular army constitutes a major risk in the event of a lack of control. Thus, the fear becomes the clearance of political leaders who would have been involved in this conflict through an international legal fiction, and of falling on the difficulty of establishing the principle of cause and effect between non-existent subject of international law, its misdeeds as well as the command of the regular army on the one hand, and between state and private actors on the other.

The political aspect remains subjective. It must also be recognized that the geopolitical context has changed, and that the poles of power are gradually changing position. Moreover, politics as a mode of city-state management is transformed into an activity to destabilize other states through the use of entities whose legal existence remains unclear. The international system will be upset, because each State will be able to constitute its military groups or mercenaries in any non-international or international conflict.

VII. THE CHALLENGES OF PROXY WAR AND PLAUSIBLE DENIAL FOR THE INTERNATIONAL SYSTEM

As in most proxy wars, there are issues and challenges that arise, no doubt due to the neglect of international law in relation to the said notion. These challenges are best explained by the consequences that flow from them. In times gone by, significant problems have arisen after certain conflicts: Afghanistan turned against the United States after the Cold War through acts of sabotage, suicide bombers, terrorist acts that led to other crises through the intervention of the American army launched on October 7, 2001 on the order of Georges W. Bush, a few weeks after the attacks of September 11. This conflict was the longest in the history of the United States, which moreover lost more than 100,000 soldiers, with great financial losses. In September 2019, the Pentagon estimated the cost of US operations in

Afghanistan to be $776 billion. Taking all costs into account, researchers at Brown University have estimated that the "war on terror" in Iraq, Syria and Afghanistan has cost $6.4 trillion since 2001 [27]. In addition, it is necessary to note the social problems, which are characterized by the loss of human lives, the massive destruction of public and private property, the degradation of the environment, the prolonged insecurities, the development of terrorist groups, the lack of trust of populations in international institutions and mistrust between the various players on the international scene, soaring food prices leading to serious food crises, and to close this section, the emergence of dictatorial regimes in certain States.

VIII. POSSIBLE RESPONSES OF THE INTERNATIONAL COMMUNITY TO PROXY WAR AND PLAUSIBLE DENIAL IN THE RUSSIAN INTERVENTION IN UKRAINE

Today this phenomenon is a serious handicap which slows down the international community in its drive towards the common ideal, which is international peace and security. So in order to be able to overcome these consequences and give strength to pacification, international law must be imbued with this new problem that is "war by proxy".

First, it should be remembered that States are the primary subjects of international law, and the first actors in international relations; by their will, they give birth to other entities on the international scene. This strength lies in sovereignty, which makes the State free of its choices and equal to other States on the international level. That said, states are willing to do what they see fit to be internationally bound. They have the ability to meet the obligations they have assumed through the signature or ratification of international texts. In addition, they have the possibility of defining the main lines of conduct to safeguard the interest of the nation. Alongside these different characteristics, the flexibility of international law and the lack of coercive sanctions give States the possibility of resorting to illicit methods to settle their disputes with other States, which justifies the use of entities without status to possibly avoid international obligations.

Above all, when it comes to a state with the right of veto, it categorically refuses to pass resolutions or decisions going against its interests and perpetuates the conflicts or problems experienced by the international community.

Finally, to overcome these challenges, the general interest must be put above individual interests. African states must in turn strengthen solidarity in order to be able to challenge the powers in their maneuvers; Western states must take the problems on an equal footing, that is to say put an end to their policy of double standards; emerging countries such as Turkey, Brazil, India, South Africa and especially China must also play active diplomacy to find suitable solutions between the protagonists. It would also be better to regulate proxy warfare, to raise doubts about the nuances and force States to assume the resulting responsibilities and

always advocate non-violent means in the prevention and resolution of conflicts, while renouncing recourse to weapons.

IX. CONCLUSION

Da mihi factum, dabo tibi jus, a principle of law meaning that the facts observed or manifested allow the lawyer to be able to name the offending act according to existing law. And that the facts precede the law, hence the fact in question here, must find a corresponding response and be codified to be truly incriminated.

War by proxy being a new fact on the international scene and particularly in the law of war, we can hardly remain in the status quo, and that the reaction of the States be contrary to the reality on the ground; their denial should not jeopardize world peace and security. The proxy war must be taken into account by international law to ensure that each State respects the law. And plausible deniability, on the other hand, is a diplomatic paradigm that must already be refuted by the behavior of the state accused of being in a position of belligerence with another, who declares it or not. Proximity and coordination on the ground of the conflict are elements to be taken into account to refute both the irresponsibility of the States involved and the plausible deniability that they would like to employ.

References

1. *Lexique des thèmes juridiques, édition 2017-2018 (Dalloz 2017), p.958.*
2. *L. Groh, Tyrone. Proxy War : The Least Bad Option. Stanford, California: Stanford University Press, 2019. – p. 2.*
3. *Ibid. – p. 3*
4. *Il s'agit d'une guerre entre la Corée du Sud soutenue par les Nations Unies et la Corée du Nord soutenue par l'URSS et la République Populaire de Chine. Les conséquences de cette guerre ont été si désastreuses au point que les retombées se font sentir jusqu'à ce jour. En ligne : https://fr.m.wikipedia.org/wiki/Guerre_de_Cor%C3%A9e Consulté le 24/06/2023*
5. *Une guerre dont l'année de début fait débat ; de plus les moyens tant humains, militaires, stratégiques que stratégiques ont été si considérable que lors de la seconde guerre mondiale. En ligne : https://fr.m.wikipedia.org/wiki/Guerre_du_Vi%C3%AAt_Nam Consulté le 24/06/2023*
6. *Cette opération militaire avait été menée par les antis régime castriste soutenus par les États-Unis, planifiée sous l'administration de Dwight D. Eisenhower, mais lancée durant la Présidence de John F. Kennedy, avec pour but de renverser le gouvernement cubain établi par Fidel Castro ; mais cette opération fut un véritable fiasco total. En ligne : https://fr.m.wikipedia.org/wiki/D%C3%A9barquement_de_la_baie_des_Cochons Consulté le 24/06/2023*

7. Loin d'être les prémisses d'un conflit armé, cette crise consiste en une confrontation diplomatique et militaire entre les Etats-Unis et l'URSS du fait de la présence des missiles nucléaires soviétiques pointés en direction du territoire américain depuis l'ile de Cuba. En ligne : https://fr.m.wikipedia.org/wiki/Crise_des_missiles_de_Cuba Consulté le 24/06/2023

8. Démarrée peu après l'indépendance angolaise, cette guerre avait opposé le Mouvement Populaire de la Libération de l'Angola (MPLA) à l'Union nationale pour l'indépendance totale de l'Angola (UNITA). Très vite les confrontations idéologiques s'en mêlèrent, ce qui en a fait un conflit de plus grande envergure qui opposa un bloc dirigé par les Etats-Unis et le bloc communiste mené par l'URSS, représenté sur le terrain par Cuba. En ligne : https://fr.m.wikipedia.org/wiki/Guerre_civile_angolaise Consulté le 24/06/2023

9. Cette guerre avait connue l'intervention de l'URSS en soutien à une faction afghane communiste opposée aux Moudjahidines. Cependant, du fait des tensions idéologiques entre les Etats Unis et l'URSS, les Moudjahidines avaient bénéficié du soutien américain contre l'Armée rouge. Cette guerre est considérée comme l'une des dernières de la guerre froide. En ligne : https://fr.m.wikipedia.org/wiki/Guerre_d%27Afghanistan_(1979-1989) Consulté le 24/06/2023

10.Il s'agit d'une tension qui avait profondément marqué les relations entre les Etats-Unis et l'Iran, du fait de la prise en otages du personnel diplomatiques et consulaires des Etats-Unis (cinquante-deux diplomates et civils américains) par des étudiants iraniens durant 444 jours. Celle-ci avait menée à une action en justice initiée par les Etats-Unis contre l'Iran par devant la Cour internationale de justice (CIJ) en l'accusant de n'avoir rien fait pour mettre fin à l'assaut de son ambassade à Téhéran par les étudiants iraniens. La Cour avait qualifiée l'inaction du gouvernement iranien comme un acquiescement de leur part des actes posés par leurs compatriotes. En ligne: https://fr.m.wikipedia.org/wiki/Crise_des_otages_am%C3%A9ricains_en_Iran Consulté le 24/06/2023

11.Charte des Nations Unies, C.N.U.O.I., vol. 15.

12.ANDREI SOLDATOV et IRINA BOROGAN, Les héritiers du KGB : enquête sur les nouveaux boyards, Paris, François Bourin, 2011, p. 56.

13. Thomson souligne également que ce principe datant du XVIIe siècle implique que : « [i]f a private undertaking that a ruler authorized met with success, s/he could claim a share in the profits. If the enterprise caused conflict with another state, the ruler could claim it was a private operation for which s/he could not be held responsible ». JANICE E. THOMSON, Mercenaries, Pirates, and Sovereigns : State-Building and Extraterritorial Violence in Early Modern Europe, Princeton, Princeton University Press, 1994, p. 21.

14. [Poutine à propos du Groupe Wagner : « Ils peuvent promouvoir leurs intérêts n'importe où dans le monde »], Meduza, 20 décembre 2018, disponible sur https://meduza.io/news/2018/12/20/oni-mogut-prodavlivat-svoi-biznes-interesy-v-lyuboy-tochke-planety-putin-o-chvk-vagner Consulté le 24/06/2023

15. TH. DRUETZ. La contractualisation de compagnies militaire privées dans la guerre : Retour à l'utilisation des mercenaires ou nouvelle configuration de l'exercice de la violence légitime? Mémoire de maîtrise en études internationales. Université Laval. 2009. -p. 16 ;

16.«Tout fait internationalement illicite d'un État engage sa responsabilité internationale. » Art. 1 du projet d'articles sur la responsabilité de l'état pour fait internationalement illicite, Annuaire de la Commission du droit international, vol. II(2), 2001.

17. « Le comportement d'une personne ou entité qui n'est pas un organe de l'État au titre de l'article 4, mais qui est habilitée par le droit de cet État à exercer des prérogatives de puissance publique, pour autant que, en l'espèce, cette personne ou entité agisse en cette qualité, est considéré comme un fait de l'État d'après le droit international ». Art. 5 du projet d'articles sur la responsabilité de l'état pour fait internationalement illicite, Annuaire de la Commission du droit international, vol. II(2), 2001.

18.« Le comportement d'une personne ou d'un groupe de personnes est considéré comme un fait de l'État d'après le droit international si cette personne ou ce groupe de personnes, en adoptant ce comportement, agit en fait sur les instructions ou les directives ou sous le contrôle de cet État. » Art. 8 du projet d'articles sur la responsabilité de l'état pour fait internationalement illicite, Annuaire de la Commission du droit international, vol. II(2), 2001.

19.F. Merz. La guerre en Ukraine et la stratégie militaire occidentale, analyse du Center for Security Studies (Zürich), avril 2019. En ligne : https://ethz.ch/content/dam/ethz/special-interest/gess/cis/center-for-securities-studies/pdfs/CSSAnalyse242-FR.pdf Consulté le 25/06/2023

20.M. Kimberly. « Russia's Use of Semi-state Security Forces: the Case of the Wagner Group ». Post-Soviet Affairs, 26 mars 2019, p. 181.

21.«Les Membres de l'Organisation s'abstiennent, dans leurs relations internationales, de recourir à la menace ou à l'emploi de la force, soit contre l'intégrité territoriale ou l'indépendance politique de tout Etat, soit de toute autre manière incompatible avec les buts des Nations Unies. » En ligne : https://www.un.org/fr/about-us/un-charter/full-text Consulté le 25/06/2023

22.https://undocs.org/en/A/RES/3314(XXIX) Consulté le 25/06/2023

23.JUANITA WESTMORELAND TRAORE, Droit humanitaire et droit d'intervention, 34 R.D.U.S., 2003-2004, p. 159.

24. Ibid.

25. Id.

26. Déclaration relative aux principes du droit international touchant les relations amicales et la coopération entre les États conformément à la Charte des Nations Unies, Rés. A.G. 2625 (XXV), Doc. off. A.G. N.U., 25e session, supp. n° 28

à la p. 131, Doc. N.U. A/5217 (1970); Acte final de la Conférence sur la sécurité et la coopération en Europe, Helsinki, 1er août 1975. Adresse URL [en ligne] : http://www.osce.org/docs/french/1990-1999/summits/helfa75f.htm. Consulté le 25/06/2023

27. Tv5MONDE-INFORMATIONS, Afghanistan: les chiffres-clés de la défaite américaine, publié le 16 août 2021 à 15H38 (TU), mise à jour le 24 déc. 2021 à 14h47 (TU).

DOI 10.34660/INF.2023.38.45.281

公关专家培训的创新：区域方面
INNOVATIONS IN THE TRAINING OF PR SPECIALISTS: REGIONAL ASPECT

Skripnikova Nadezhda Nikolaevna
Doctor of Philological Sciences, Associate Professor,
Head of Department
Voronezh State Technical University

Lutaya Ksenia Alexsandrovna
Candidate of Pedagogical Sciences, Associate Professor
Voronezh State Technical University

抽象的。 本文讨论了广告和公共关系领域培训专家的创新方法。 在这一领域学习的学生的现代能力矩阵有助于深化广告和公共关系学士的专业培训，并扩大其专业活动范围，同时考虑到区域劳动力市场。

关键词：创新、教育空间、教育轨迹、专业能力、公共关系、传播。

Abstract. *The article discusses innovative approaches to training specialists in the field of advertising and public relations. The modern matrix of competencies of a student studying in this area contributes to both deepening the professional training of bachelors in advertising and public relations, and expanding the scope of their professional activities, taking into account the regional labor market.*

Keywords: *innovation, educational space, educational trajectory, professional competencies, public relations, communications.*

Introduction

In modern conditions, the main paradigm of education is: “learning - how to learn,” “self-development” and “lifelong learning.” The rapid and intensive development of modern society largely determines the need to intensify higher education. This, in turn, requires constant operational design of the educational process, the use of innovative approaches to students mastering a wider range of professional competencies, because the successful training of qualified specialists must, of course, be based on clear ideas about the professionally necessary characteristics of the future subject of activity. This also applies to the training of public relations and advertising specialists. The demand for PR specialists is growing along with business understanding of the fact that without quality promotion it

is impossible to develop dynamically, be relevant and in demand [1]. According to practitioners in the field of PR, the direction of "Advertising and Public Relations" has great development prospects, and the demand for PR management services will grow "depending on the dynamic indicators of the economic sphere." [2, pp.24-26].

Formulation of the problem

Today, the market for educational services in the field of PR and advertising includes a system of secondary vocational and higher education (bachelor's and master's degrees) with a wide range of competencies and skills, and additional education programs. However, in our opinion, the most important thing is not yet available - the successful professional growth of a graduate at the university or college itself, the acquisition of those competencies that are necessary for the employer and the economy as a whole, and applicants who have chosen "Public Relations" as their specialty have a vague idea of what they will do in the future, and often do not know that this profession requires much more serious skills than can be presented in popular culture in the image of professional PR specialists.

Research methods: empirical research methods: observation, comparison, experiment, sociological survey.

Material analysis

The authors of the article conducted a sociological study among students of regional universities (Voronezh, Russia). Here are the results of an express study1. To the question: "Which university did you choose and why?" – the applicants' answers were as follows, namely: 95% – any university for a budget place; any university where the Unified State Exam results are suitable; the university that parents choose; the university where friends will go; university located near home. Only 5% of all respondents consciously made their choice of educational institution and future profession. At the same time, a survey was conducted among 4th year students, and the following results were obtained2. In response to the question: "Did you enter the right university, will you work in your specialty?" – 85% of respondents answered "no", 10% answered firmly "yes", the rest were undecided. The analysis showed: neither the applicant nor the student imagines their professional future. But a graduate student must be part of an open environment, the participants of which are teachers, partners, and employers. That is why, in

[1] The study was conducted on the basis of the branch of the department of "Public Relations" of the VSTU ANO "Agency for Regional Socio-Economic Projects" in the period from December 2 to December 20, 2022 using the method of mass interviews. 103 respondents aged 17-18 years were interviewed from a non-representative sample of first-year university students in Voronezh.

[2] The study was conducted on the basis of the branch of the Department of Public Relations of VSTU ANO Agency for Regional Social and Economic Projects in the period from December 20, 2022 to January 20, 2023 using the method of mass interviews. 150 respondents aged 20-22 years were interviewed among final year undergraduate students at a Voronezh university.

our opinion, HR specialists should actively work with the student; Together they will determine an educational trajectory, within which the student will develop and implement a series of personal projects in a group with mentors and will independently design their professional future.

Research results

Almost all graduates of higher educational institutions face the problem of entering a professional activity, one way or another. With public relations specialists, the situation is even more complicated, since the direction of "Advertising and Public Relations" as a profession took shape in Russia at the state level not so long ago. Difficulties in finding employment in this field stem both from the still unformed PR market itself, and from the lack of clear practical foundations from which to build. Do not forget that public relations are more applied technologies, which is why PR is largely influenced by surrounding changes, ranging from global market changes to the emergence of new local products.

At the Department of Public Relations of the Voronezh State Technical University (hereinafter referred to as VSTU), the trajectory of "professionalization" of the education received is being implemented, namely: the educational program is designed for intensive educational and practical work of students. In training courses, simultaneously and in parallel, a movement is carried out from schematic theoretical structures (models) to their practical application. Creative laboratories serve as a platform for practicing practical skills, where, in addition to educational content (seminars, master classes, trainings, case studies, etc.), discussion meetings are held with leading specialists in the communication field. Today we can confidently say that student creative teams, formed according to areas, are an effective tool for expanding the educational space, as well as a modern platform for the implementation of student projects. At the Department of Public Relations, these are the creative laboratories Profi communica [Profi communica 2020] and "Direct PR. Workshop of Professionals" [Direct Action PR, 2015], which operate jointly with the Research Innovation Center for Public Relations of VSTU, the communication group "PRegion", advertising, marketing and PR agencies, public organizations, regional operators of the PR market. advertising, mass media, being an effective tool for expanding the communicative space of the industry in the region, as well as a modern platform for the implementation of innovative ideas of students. [3].

Conclusions

The development of a new educational trajectory at Voronezh State Technical University is based on modern educational technologies that are in demand in the regional labor market, which contributes not only to deepening the professional training of public relations specialists, but also to expanding the scope of their professional activities, taking into account regional specifics and strengthening competitiveness in this area. sphere.

The educational process at the Department of Public Relations at VSTU is a special communication space that shapes the professional outlook and understanding of the future profession by students and combines all stages of the professional development of a PR manager: from strong basic professional competencies to the creation of creative student teams in areas. This organization of the educational process allows you to better see real practical problems, and also training is as close as possible to the needs of employers. It is obvious that the educational strategy chosen by the department is fully consistent with modern trends. Today, most employers consider public relations as an integral part and potential coordinator of an integrated mass communications system (marketing, PR and advertising), which is why public relations specialists who can implement an integrated approach to communications are in demand on the market.

The need for public relations specialists in the region is growing every year. In both commercial and public structures, departments are formed whose activities are in one way or another connected with PR: public relations departments, marketing departments, advertising departments, information and analytical centers, external relations departments, etc. Many state enterprises are introducing a specialist position Public Relations Thus, communicative activities in public relations in a professional environment are becoming increasingly structured, and graduates of the Public Relations Department of VSTU play an important role in this process.

References

1. Vavilova Zh.E. Innovations in training public relations specialists. Kazan School of Public Relations / Ed. D.K. Sabirova. Kazan: Publishing house Kaz. state tech. un-ty. 2013. pp. 16-21.

2. Komissarenko S.S. Public relations: on the issue of historical experience in Russia//Advertising and PR in Russia: current state and development prospects: XIV All-Russian Scientific and Practical Conference, February 16, 2017. St. Petersburg: SPbSUP, 2017. pp. 24-26.

3. Selivanova E.S., Skripnikova N.N.//Modern trends in the training of PR specialists: regional aspect/ Selivanova E.S., Skripnikova N.N.//Russian school of public relations: almanac. Vol. 16. Moscow, 2020. - P.135-149.

4. Shumilova E.A. Social and communicative competence as an attribute of a modern teacher's brand//Branding as a communicative technology of the 21st century: Proceedings of the VI scientific and practical conference. – St. Petersburg: Publishing house of St. Petersburg State University of Economics, 2020. – P.196-198.

5. Profi communica/ https://vk.com/club193350075 [Electronic resource]. Date of appeal – 09/16/2023.

6. "Direct PR. Workshop of professionals"/https://vk.com/club31511967 [Electronic resource]. Date of appeal – 09/16/2023.

DOI 10.34660/INF.2023.70.27.282

音节语言的语音系统分析，用于教育目的 面向东南亚学生的俄语发音
ANALYSIS OF THE SOUND SYSTEMS OF SYLLABIC LANGUAGES FOR EDUCATIONAL PURPOSES RUSSIAN PRONUNCIATION FOR STUDENTS FROM SOUTHEAST ASIA

Lubimova Nina Aleksandrovna
Doctor of Philological Sciences, Full Professor
St. Petersburg State University, St. Petersburg, Russia

Pervushina Irina Sergeevna
Senior Lecturer
St. Petersburg State University, St. Petersburg, Russia

抽象的。 本研究的目的是比较越南语、老挝语、高棉语和俄语的音节结构，以达到向音节语言母语者教授俄语发音的方法论目的。 研究的对象是音节的语音性质。 研究的主题是越南语、老挝语和高棉语的音节结构与俄语音节结构的比较。 研究方法：比较分析、模拟朗读俄语重要单词时受访者干扰言语的听觉语音分析。 研究结果确定了越南语、老挝语和高棉语音节的一般和特定特征，以及越南语、老挝语和高棉语在复制俄语单词（模仿和阅读）时的语音中的一般和特定错误。 ）。 结论：东南亚学生的语音中，由于依赖母语语音系统，也会出现类似的干扰语音错误，这使得为俄语语音语音教学制定通用方法建议成为可能。 某种语言的母语者的错误特征已经被识别出来，这证实了开发面向全国的教学模式的必要性，并考虑到混合群体的个性化。

关键词：音节，音节划分，干扰错误，语音实验。

Abstract. *The purpose of the study is to compare the structure of syllables of Vietnamese, Laotian and Khmer and Russian languages for methodological purposes of teaching Russian pronunciation to native speakers of syllabic languages.* ***The object of the study*** *is the phonetic nature of the syllable.* ***The subject of study*** *is the structure of syllables in Vietnamese, Laotian and Khmer languages in comparison with the structure of the Russian syllable.* ***Research methods:*** *comparative analysis, auditory phonetic analysis of respondents' interference speech when simulating and reading aloud significant words in Russian. As a result of the study, general and specific features were identified in the syllables of the Vietnamese, Laotian and Khmer languages, as well as general and specific errors in the speech of the Vietnamese, Laotians and Khmers when reproducing Russian words (imitation and reading).* ***Conclusions:*** *in the speech*

of students from Southeast Asia, similar interference phonetic errors arise due to reliance on the sound system of their native language, which makes it possible to develop general methodological recommendations for teaching the sound side of Russian speech. Errors characteristic of native speakers of a certain language have been identified, which confirms the need to develop a nationally-oriented teaching model, as well as take into account individualization in mixed groups.

Keywords: *syllable, syllable division, interference errors, phonetic experiment.*

When studying the Russian language, representatives of Southeast Asia (namely the Vietnamese, Laotians, Khmers) face serious difficulties in mastering Russian pronunciation, which is caused by significant differences in the sound systems of the Russian language and the native language of the students. It should be noted that the sound systems of Vietnamese, Laotian and Khmer languages are still not well understood. The sound structure of the Vietnamese language was subjected to instrumental research by phoneticians, which was reflected in the books of T.T. Mkhitaryan [1], as well as I.S. Bystrova and M.V. Gordina [2]. However, the authors point out that these works do not claim to be a complete presentation of the phonetic phenomena of the Vietnamese language. In the domestic literature there is no detailed description of the sound structure of the Lao language based on experimental research. The book by L.N. is devoted to a description of the Lao language. Moreva, A.A. Moskaleva, Y.Ya Plum [3], J. Andersen [4], N.J Enfield [5]. Data on the sound structure of the Khmer language are contained in the works of Yu.A. Gorgonieva [6], D.I. Elovkova [7], Yu.Yu. Krylova [8], F. Martini [9], E. Henderson [10], etc. The sound systems of these languages have both similarities and differences, as well as a number of specific features that differ significantly from the sound system of the Russian language. Vietnamese and Laotian languages are classified as so-called syllabic and tonal languages, which is explained by their phonological specificity: “In syllabic languages there is no complete analogue of the phoneme of a non-syllabic language. Instead, units of two phonological levels are presented here: syllables, on the one hand, and their components, initials and finals, on the other” [11]. Khmer differs from Southeast Asian languages (particularly Laotian and Vietnamese) in that it is not a tone language. The Khmer language is classified as a quasi-syllabic language because it contains morphemes with exponents shorter than the syllable. However, as noted by D.I. Elovkov, “in its phonological structure it is fundamentally different from non-syllabic languages <...> it has all the main features of a syllabic language.” In these languages of Southeast Asia, compared to the Russian language, the number of consonants is less than the number of vowels; there is no opposition of noisy consonants, voiceless and voiced, hard and soft, single-focal and bifocal fricative; there is no opposition between fricative and tremulous sonants. A syllable is a

morpheme and is a word, while it has a strict rigid structure. Intonation in syllabic languages does not play the same role as in the Russian language, where it not only formalizes the utterance, but in some cases is the only means that determines its type, and also participates in the formation of emotions. In syllabic languages, each syllable is marked by a tone. Russian is a phonemic language. In the Russian language, almost all consonants can occupy any position in a syllable, except for noisy voiced consonants at the absolute end of a word; words can be either monosyllabic or polysyllabic with different places of stress. Consonantal clusters are possible in all positions (word beginning, middle and end). In addition, a word can have several consonantal clusters (to **pre**side). The maximum number of consonants in a cluster is seven (coun**ter-m**eeting).

A comparison of the syllable structures of Vietnamese, Lao and Khmer languages has revealed both common and specific features. The number of syllables in the **Vietnamese** language is strictly fixed; there are about 2500 of them. The smallest syllables consist of one obligatory element - a syllabic vowel (tonal). The maximum number of sounds in a Vietnamese syllable is four. All sounds in a syllable are arranged in relation to the syllabic vowel in a strictly defined order. The syllable structure of the Vietnamese language is represented by four types of syllables, of which 16 subtypes are distinguished. Depending on the final element, Vietnamese syllables can be open (ending with a syllabic vowel), semi-open (ending with a strong-final semivowel), closed (ending with a voiceless implosive consonant), semi-closed (ending with a sonant). The Lao language has two types of syllables: CV and CVC, where C is any Lao consonant and V is any vowel. Depending on the final element, the syllables of the **Laotian** language are divided into types: open (ending in a vowel), semi-open (with final: labial fricative sonant [w], middle lingual fricative sonant [j]), semi-closed (with final sonants: labial [m], anterior lingual [n], posterior lingual [ŋ]) and closed (with final stops [p], [t], [k], [ʔ]). N.Yu. Lisina [12] identifies another type of syllable - open - starting with a vowel. In open syllables, as noted by L.N. Morev and Yu.Ya. Plum, only long vowels occur. In semi-open syllables, the labial final syllabic sonant [w] can only be used after the front vowels [i̯], [iə], [e], [ɛ], and the only possible final syllabic consonant after the back vowels [u], [uə], [ɯ], [ɔ] [ɯɔ] is [j]. In semi-closed syllables there is no restriction on the use of final syllabic consonants depending on the quality of the preceding vowel. The Khmer language is predominantly monosyllabic or disyllabic. A syllable is constructed according to the following scheme: initial consonant (any of those available in the sound system of the language) or initial consonantal group, syllabic vowel, final consonant. The structure of the Khmer syllable can be represented as the formula (C)V(C). The final consonant is obligatory if the syllabic vowel is short and optional if the syllabic vowel is long. If a syllable begins with a vowel, then it is preceded by a light glottal stop.

All consonants present in the language can act as initials in the Lao language, while in Vietnamese and Khmer there are distributional restrictions. Distributive restrictions on the use of consonants as finals exist in all three languages. The realization of consonants depends on their position in the syllable: in the initial syllable position, stop consonants are pronounced as explosive in Vietnamese, Lao and Khmer, but final syllables in Vietnamese and Lao are realized as implosive. Words in Vietnamese, Lao and Khmer are predominantly one- or two-syllable. A larger number of syllables (no more than 4) is possible only in borrowed words. A comparative analysis of the syllable structures of Vietnamese, Laotian, Khmer and Russian languages is presented in Table 1.

Table 1

General and specific features of syllable structure in Vietnamese, Laotian, Khmer and Russian languages

Language	Initial syllable consonants	Final-syllabic consonants	Consonant clusters	Maximum number of sounds in a syllable	Stress
Vietnamese	[p], [b], [m], [f], [v], [t], [tᶜ], [d], [n], [s], [z], [l], [r], [ʈ], [ʂ], [ʐ], [x], [ɦ], [ɲ], [ŋ], [j], [h], [r]	[p], [t], [ʈ], [k], [m,] [n], [ɲ], [ŋ] pronounced as implosive	None	4	-
Laotian	all consonants in inventory [p], [pᶜ], [b], [t], [tᶜ], [tw], [d], [ɦ], [ɦw], [k], [kᶜ], [kw], [kᶜw], [ʔ], [ʔw], [m], [n], [ɲ], [ŋ], [ŋw], [f], [s], [sw], [h], [w], [l], [lw], [j]	[p], [t], [k], [ʔ],[m], [n], [ŋ], [w], [j] pronounced as implosive	None	3	-
Khmer	[k], [c], [t], [d], [p], [b], [ɲ], [ŋ], [n], [m], [j], [r], [l], [v], [s], [h], [ʔ]	[p], [t], [c], [k], [ʔ], [m], [n], [ɲ], [ŋ], [l], [s] (h), [w]	Initial-syllable group of two consonants: kh, ch, th, ph, kr, cr, tr, pr; s+ any consonant except h, j, ɦ	4	Powerful, assigned to the last syllable. In unstressed syllables, vowels are pronounced clearly if the syllable has semantic weight, in other cases they are reduced

Russian	Almost all consonants of the Russian language can occupy any position in a syllable. The position of the absolute end of a word cannot be occupied by noisy voiced consonants.	CCV- hundred VCC- X CVCCC- text CCVC- term CCCVC- lines CCCCVCC- splash		Characterized by a combination of three characteristics - duration, tension and timbre

To determine the level of development of auditory pronunciation skills among Vietnamese, Laotian, and Khmer students and to identify a body of segmental violations in their Russian speech, a linguistic experiment was conducted, consisting of two experiments - imitation and reading aloud Russian words.

Respondents. In the experiment conducted in November 2021, the participants in the experiment were 10 Vietnamese, 10 Lao and 10 Khmer. Before the start of the experiment, during a survey and in a private conversation, it was established: 1) the age of the subjects was from 17 to 20 years (29 boys and one girl); 2) before arriving in Russia, students did not study Russian; 3) at the start of the experiment, students could carry out basic verbal communication orally on everyday topics: biography, family, friend, work day, free time; 4) they identified the phonetic aspect of learning the Russian language as the most difficult; 5) students have different levels of phonetic design of Russian speech (they rated their own pronunciation as “bad”, “very bad”, “not very good”). Students completed 50-60 hours of Russian language training.

Material. The source of the material was the manual “Linguistic foundations of teaching the articulation of Russian sounds. Staging and correction” [13]. 246 significant words belonging to different parts of speech (mainly nouns) were used as speech material. Not all words were included in the students’ active vocabulary. The phonemic composition of words took into account all consonants and vowels in different positional-combinatorial conditions.

The purpose of the first experiment (imitation) is to identify the level of development of the respondents’ auditory-pronunciation skills and to obtain a corpus of errors when simulating familiar and unfamiliar words, based on sound.

The words to be imitated were recorded on a Ritmix RR-120 recorder in random order. The experimental material was read by a Russian speaker - a woman who speaks Russian literary pronunciation. The interval between words was 4-5 seconds depending on the length of the word. The subjects were given the following instructions: Listen and repeat the words during the pause. The subjects’ speech was recorded on a voice recorder and then subjected to auditory analysis by the experimenter, followed by transcription and linguistic interpretation of the data obtained.

The purpose of the second experiment is to determine to what extent the mechanism of sound-letter correspondences is formed among respondents when repro-

ducing graphically displayed words and phrases when reading aloud. Reproduction of printed text aloud (reading) was used because in the minds of a literate person the sound image of a word is correlated with its graphic display and, if mastering a foreign language was carried out in the interconnected teaching of oral and written speech, then the sound and graphic appearance of the word are acquired simultaneously. But the correlation between the sound and written appearance of a word in the minds of a student may be different than that of native speakers [14].

According to the instructions, the subjects read words and phrases out loud. Their answers were recorded on a voice recorder. The material was presented in the form of a printed list. The answers were recorded using a voice recorder. Participants in the experiment were given the opportunity to preview the list. In addition, they had to underline words whose meaning they did not know.

As a result, phonetic errors were identified in the speech of the Vietnamese, Laotians and Khmers, and general and specific erroneous implementations in their speech in Russian were identified.

1. Common mistakes

1.1 Representatives of all three languages commit violations of the following differential features of consonants.

Method of formation: in place of the front-lingual voiceless hard and soft affricates, a middle-lingual affricated voiceless stop sound with an oversound [s] is pronounced, which to the Russian ear is perceived as a soft stop consonant (*[t's']ay* instead of *[h']ai*, *[t's']irk* instead of *[ts]irk*); in place of the trembling vibrant [r], a fricative [ž] is realized, but the lateral fricative sonant [l] of the native language is more often pronounced.

Active organ: in place of sibilant fricatives [š], [ž], [š:'] the apical sibilant [s] of the native language is realized (*[s]ar* instead of *[sh]ar*, **[s]al** instead of *[zh]al*); in place of the posterior lingual stops [k], [k'], [g], [g'] the pharyngeal fricative [h] of the native language is realized (*[h]ni[h]a* instead of *[k]ni[g]a*).

Voicelessness-voice: in place of [g], [g'], pronouncing the voiceless sound [k] of the native language.

Hardness-softness: representatives of all three languages pronounce non-palatalized consonants of their native language or borrowed from previously studied languages in place of soft consonants.

1.2 Speakers of all three languages violate the following integral features: in place of the dorsal consonants of the Russian language, the corresponding apical consonants of the native language are pronounced; in place of the kakuminal [ɬ], it is possible to pronounce the apical [l] of the native language.

2. Specific errors

Representatives of each of these languages may make mistakes when speaking in Russian that are characteristic only of native speakers of their language. Viet-

namese can pronounce Russian [j] with the sound of a whistling frontal consonant [z] at the beginning of a word, for example, [zja] - I. In the speech of Laotians and Khmers, it is possible to pronounce Russian consonants [p], [t], [k] as aspirated by analogy with the native language.

The manifestation of phonetic-graphic interference in the speech of the Vietnamese when reproducing written text aloud was noted, since the Latin alphabet is used in Vietnamese writing.

The following mistakes are made in the area of vocalism:

1) in place of Russian vowel phonemes after hard consonants in stressed syllables, pronounce similar vowels of the native language;

2) in place of vowels, after soft consonants, pronouncing non-diphthongoid vowels;

3) non-distinction of syllables like ta-tya (sema-seed), *ta-tya (sema-family), tya-tya (seed-family)*;

4) non-distinction between stressed and unstressed vowels.

Students will transfer positionally conditioned phonetic skills of syllable formation into speech in Russian. The greatest difficulty was caused by words with a combination of consonants.

For example, in the speech of the Vietnamese and Laotians it is possible:

1) the appearance of epentic vowels in combinations of consonants (*Tols[a] toy* instead of *Tolstoy*);

2) simplification of consonantal clusters - diaeresis (*T[...]et[...]yako[...]skaya* instead of *Tretyakovskaya*);

3) complete implosion when pronouncing noisy consonants [p], [t], [k] at the end of a syllable, which to the Russian ear is perceived as zero sound (to[...] instead of that, ma[...] instead of mak);

4) replacing Russian consonants in the final position of a closed syllable with consonants of the native language, which is due to restrictions on the distribution of consonants depending on phonetic conditions (consonants allowed in the final position). For example, *ku[n]tura* instead of *ku[l']tura*, *su[ŋ]ka* instead of su[m]ka.

In the structure of a Khmer syllable, consonantal clusters are possible, but no more than two components and only in the position of the beginning of the syllable, therefore, in Khmer speech, epinthesis and dieresis are possible in consonantal clusters consisting of more than two elements.

Thus, all of the above allows us to come to the conclusion: the model of teaching Russian pronunciation, focused on speakers of phonemic languages, is not effective enough for speakers of syllabic languages. Therefore, it is necessary to develop a nationally-oriented teaching model, taking into account the common features in the structure of syllabic languages, as well as taking into account the specific features of the sound system of the native language of students in mixed groups.

References

1. Mkhitaryan T.T. Phonetics of the Vietnamese language / T.T. Mkhitaryan. – M.: Publishing House of Eastern Literature, 1959. – 138 p.

2. Gordina M.V. Phonetic structure of the Vietnamese language./ M.V. Gordina, I.S. Bystrov.-- M.: Science: Main editorial office of Eastern literature, 1984. – 243 p.

3. Morev L.N. Lao language / L.N. Morev, A.A. Moskalev, Yu.Ya. Plum – M.: Nauka, 1972 – 255 p.

4. Andersen J. Syllabic or Non-syllabic Phonology – JL. 1969, vol. 5, no. 1.

5. Enfield N.J. A Grammar of Lao / N.J Enfield. – Berlin and New York: Mouton de Gruyter. 2007 – 593 p.

6. Gorgoniev Yu.A. Khmer language / Yu.A.Gorgoniev. – M.: Publishing House of Eastern Literature, 1961 – 130 p.

7. Elovkov, D. I. Structure of the Khmer language. Phonetics, phonology, grammar, vocabulary, semantics / D.I. Elovkov - St. Petersburg: Faculty of Philology of St. Petersburg State University, 2006 – 470 p.

8. Krylov, Yu.Yu. Problems of syllabic and Mon-Khmer phonology: specialty 10.02.22 Languages of the peoples of foreign countries of Europe, Asia, Africa, the aborigines of America and Australia (countries of Asia and Africa): abstract of the dissertation for the degree of Doctor of Philology / Yu.Yu. Krylov; St. Petersburg State University – St. Petersburg, 2010 – 53 p.

9. Martini F. La lanquae cambodqienne, France-Asie, N114-115, 1995.

10 Henderson E. The main features of Cambodian pronunciation, BSOAS, vol. XIV, 1952.

11. Kasevich, V.B. Works on linguistics / V.B. Kasevich; edited by Yu.A. Kleiner. – St. Petersburg: Faculty of Philology of St. Petersburg State University, 2011. – 880 p.

12. Lisina N.Yu. Methods for correcting and improving auditory pronunciation skills among native speakers of syllabic languages: dissertation for the degree of candidate of pedagogical sciences / N.Yu Lisina; St. Petersburg, 1994 – 202 p.

13. Lyubimova, N. A. Linguistic foundations of teaching the articulation of Russian sounds. Staging and correction / N. A. Lyubimova – Moscow: Russian language. Courses, 2019 – 240 p.

14. Lyubimova, N. A. Phonetic aspect of communication in a non-native language (in conditions of Finnish-Russian bilingualism) / N. A. Lyubimova – Leningrad: LTU, 1988 – 193 p.

DOI 10.34660/INF.2023.12.21.283

俄罗斯与中国在学校数学教育领域的合作
COOPERATION BETWEEN RUSSIA AND CHINA IN THE FIELD OF SCHOOL MATHEMATICS EDUCATION

Kvashko Lyudmila Pavlovna
PhD in Pedagogy, Associate Professor
Primorsky Institute of Railway Transport, a branch of the Far Eastern State Transport University in Ussuriysk,
Institute of Land Management and Agrotechnologies of the Primorsky State Agrarian and Technical University

注解。 本文介绍了俄罗斯和中国数学教育内容的比较分析结果。 据证实，为中学毕业生提供的同化教学单元和有志进入高等教育机构的教学单元有四分之三完全一致。 同时，它们的第四部分并不重合，但并没有从根本上影响教材呈现的逻辑，也没有对教学方法做出调整。 研究结果表明俄罗斯与中国在学校领域合作前景广阔

关键词：学校数学教育、教学单元、比较分析、数学内容。

Annotation. *The article presents the results of a comparative analysis of the content of mathematical education carried out in Russia and China. It is established that three quarters of the didactic units offered for assimilation by graduates of secondary schools and aspiring to enter higher educational institutions coincide completely. At the same time, the fourth part of them does not coincide, but they do not fundamentally affect the logic of the presentation of educational material and do not make adjustments to the teaching methodology. The results of the study suggest that Russia and China have great prospects in the field of cooperation in the field of school*

Keywords: *school mathematical education, didactic units, comparative analysis, mathematical content.*

Introduction

The expansion of cooperation between the countries of the Shanghai Cooperation Organization (SCO) [1] in the field of education is an urgent need of the time. The SCO member states build the present and see their future in joint, mutually beneficial cooperation in the field of security, economy, politics, culture with other states [2, 3]. The People's Republic of China (hereinafter referred to as the

PRC, China) and the Russian Federation (hereinafter referred to as the Russian Federation, Russia) are neighboring states whose political, economic and cultural interests correlate with the interests of the peoples inhabiting them. The field of education is a priority for both countries, and mathematics, as a source of universal knowledge, is especially valued in these countries. For many years, Chinese schoolchildren have demonstrated outstanding achievements in the field of mathematical education [4, 5], which makes these achievements attractive for research. The Russian pedagogical school also has undeniable advantages in teaching mathematics to teenagers and young people, therefore, the subject of our study was the content of mathematical education, which is assimilated by graduates of secondary schools in order to enter higher educational institutions, both in Russia and in China.

Due to the fact that mathematics is the basis of engineering and technical education, and future engineers will be highly qualified specialists to the extent that they know the methods of mathematics, a coordinated and verified content of such mathematical education is required, which could (if mastered by students) become the basis for mastering the future profession. In this regard, it would be very useful for both Russian and Chinese teachers to exchange views on the content of mathematical education that school graduates should have when entering higher educational institutions of engineering and technical orientation.

Materials and methods of the research

The article presents the results of a study aimed at establishing similarities and differences between the requirements for the content of mathematical training of applicants entering universities in China and Russia. The main method of research is content analysis and comparative method. For comparison, school textbooks of the Russian Federation [6,7] and a textbook of the People's Republic of China were selected to prepare applicants for university admission [8], according to which a comparative analysis of the thematic content of the discipline "mathematics" was carried out.

Results of the research

Elements of set theory are included in the mandatory list of knowledge of graduates of Russian and Chinese secondary schools. They are used to denote numerical intervals when solving inequalities, to indicate intervals of sign-constancy and intervals of monotony in the study of functions, as well as when solving inequalities with one variable by the interval method. The symbolism used in the Chinese textbook and the one used in Russian textbooks are identical. The difference is that the method of presentation of educational material in a Chinese textbook is accompanied by a brief solution of examples without geometric interpretation, which most likely complicates students' understanding of the results of solving inequalities and requires additional explanations from the teacher in the audience.

In the Chinese textbook, mathematical logic is presented in sufficient volume and covers the basic operations using quantifiers (∀,∃,∄,∧,∨) and a wide demonstration of examples. Mathematical logic, as a separate topic for studying by schoolchildren of general education classes in Russia, is excluded from the mathematics curriculum of the secondary school course. It is studied in computer science classes and electives (special courses).

The study of functions in the school course of mathematics in Russia and China is one of the main ones and is widely presented in the above textbooks. The textbooks compared didactically and methodically raise the question of finding the domain of definition of functions, types of analytical expressions of linear, power, exponential, logarithmic and trigonometric functions in the same way. The types of functions, the areas of their definition are indicated, their properties are graphically and analytically justified. It is worth noting the similarity of drawings in Russian and Chinese textbooks [10, p. 99]. However, the figures demonstrating the signs of trigonometric functions differ [10, pp. 100-101] and contain different methodological potential, giving different learning effects.

The study of trigonometry is limited to the study of trigonometric formulas and reduction formulas, as well as familiarity with the methods of performing identical transformations of trigonometric expressions. This educational material is presented in the textbook [8] in the same methodological tradition as in Russia. However, the training material on the study of arc-functions in the same textbook is presented as optional. The authors of Russian textbooks have different attitudes to the study of arc-functions: in some textbooks, this educational material should be studied in mathematics lessons by all students [6, pp.87-103], and in other textbooks this section is optional for everyone [7, pp.219-223].

A detailed analysis of didactic units and the establishment of the features of the teaching methodology of three topics of mathematical content: set theory; functions, their properties and graphs; trigonometric functions showed that 27 out of 36 selected didactic units completely coincide. This is 75% of the total number and only a quarter of them have their own characteristics and do not fundamentally affect the structure and logic of the presentation of educational material.

Conclusion

The conducted research on a small sample of educational topics showed that the content and methodical traditions of China and Russia in the field of school mathematics education are close and largely coincide, which indicates the prospects for cooperation between teachers and scientists in this area. The author is aware that such a conclusion requires a broader sample and a more extensive analysis. But even with such a narrow view, there is a similarity in the content of school mathematical education of the Russian Federation and the PRC. The perspective of this study may be to conduct a comparative analysis of other topics from the point of view of didactics and teaching methods.

References

1. Aitbayeva R., Kasimova N. Humanitarian cooperation of the SCO countries // Concorde. 2018. No.2. URL: https://cyberleninka.ru/article/n/gumanitarnoe-sotrudnichestvo-stran-shos (accessed: 27.09.2023).

2. Charter of the Shanghai Cooperation Organization (St. Petersburg, June 7, 2002) URL: https://www.mid.ru/ru/foreign_policy/rso/1728900 /(accessed: 27.09.2023).

3. Alimov R. Charter of the Shanghai Cooperation Organization - compass of the organization // Observer. 2017. No. 6 (329). URL: https://cyberleninka.ru/article/n/hartiya-shanhayskoy-organizatsii-sotrudnichestva-kompas-organizatsii (date of application: 27.09.2023).

4. International program for the assessment of educational achievements of students. URL: https://ru.wikipedia.org/wiki/

5. Tu Rongbao. Characteristics of Mathematics Education in China [Electronic resource]. URL: http://math.unipa.it/~grim/Characteristics of Mathematics Education in China (English version) pdf.

6. Mordkovich A.G. Algebra and the beginning of mathematical analysis. Grades 10-11. At 2 h. H. 1. Textbook for students of general education institutions (basic level) / A.G. Mordkovich. – Moscow: Mnemosyne, 2010. 399 p. (and subsequent editions)

7. Algebra and the beginning of analysis : studies. for grades 10-11. general education. institutions / Sh.A. Alimov, Yu.M. Kolyagin, Yu.V. Sidorov, etc. – Moscow: Prosveshenie, 2007. 384 p. (and subsequent editions)

8. Mathematics // Beijing language and culture university press. 2012. 295 p.

9. Kvashko L.P. Training opportunities for Chinese applicants in Russian universities: comparative analysis of mathematical content // The modern teacher – a look into the future : a collection of scientific articles. Part 3 / Ural State Pedagogical University. Yekaterinburg, 2022. 260, pp.204-206.

10.Kvashko L. P. Comparative analysis of the content of mathematical training of applicants from Russia and China when entering a university // Scientific and methodological electronic journal "Concept". 2022. No. 6 (June). Pp. 91-106. URL: http://e-koncept.ru/2022/221046.htm.

DOI 10.34660/INF.2023.40.68.284

艺术体操运动员通过滚球培养“物体感”
DEVELOPMENT OF A “SENSE OF AN OBJECT” IN ATHLETES ENGAGED IN RHYTHMIC GYMNASTICS BASED ON PERFORMING A BALL ROLL

Suprun Alexandra Alexandrovna
Candidate of Pedagogical Sciences, Associate Professor
P. F. Lesgaft National State University of Physical Education, Sport and Health, St. Petersburg, Russia

Mitryaykina Yulia Valerievna
Master's degree Student
P. F. Lesgaft National State University of Physical Education, Sport and Health, St. Petersburg, Russia

Vlasova Natalya Yurievna
Postgraduate
P. F. Lesgaft National State University of Physical Education, Sport and Health, St. Petersburg, Russia

抽象的。 这项工作确定了有助于艺术体操运动员发展“主体意识”的手段和方法。 确定了球滚动的运动学特征与体操运动员“物体感”发展水平之间的关系。 给出了如何培养高质量滚球的“物体感”的方法建议。

关键词：艺术体操、协调能力、“物体感觉”、技术训练、滚球。

Abstract. *The work identifies means and methods that contribute to the development of a "sense of the subject" among athletes involved in rhythmic gymnastics. The relationship between the kinematic characteristics of ball rolls and the level of development of gymnasts' "object sense" was determined. Methodological recommendations are given for developing a "sense of the object" for high-quality ball rolling.*

Keywords: *rhythmic gymnastics, coordination abilities, "feeling for an object," technical training, ball rolling.*

The main part of the technical training of gymnasts is apparatus work. Subject training is one of the decisive factors in the training of gymnasts; special attention must be paid to it. To successfully master the subject, girls must have strength and dexterity, be able to concentrate, and also "feel" the subject [4].

According to the rhythmic gymnastics rules for the new Olympic season (2022-2024), the most expensive apparatus difficulties with the ball are rolls. Rolls are also one of the most difficult movements with the ball, since their correct execution requires the absence of bouncing of the ball and a smooth, uniform movement. To perform high-quality elements with the ball, including rolls, the gymnast needs to "feel" the object and be able to adapt to its movements even when it is out of sight. This ability to control body movements depending on the movements and position of an object, when the object is not under direct visual contact, is the "feeling of the object" [3].

The sense of the apparatus is a specialized perception, thanks to which the gymnast can accurately reproduce efforts, react to a moving apparatus and control it confidently. Developing a sense of the apparatus in gymnasts can help improve technical skill, as well as faster and more effective learning to work with the apparatus. The feeling of the apparatus plays an important role for gymnasts performing both in individual and group programs. With the development of the sense of the apparatus, throwing becomes more accurate, catching becomes more accurate, the number of losses and the number of technical errors in the work of the apparatus by gymnasts decreases [1, 2].

To study the means and methods used to develop a "sense of the subject" in rhythmic gymnastics for the high-quality performance of ball rolls, a survey of specialists was conducted. The survey found that:

- among the fundamental technical elements with the ball, the level of development of the "feeling for the object" is largely influenced by rolls (60%). Next come rebounds (20%) and throws (15%), with the smallest impact having the ball catches (5%);

- developing a "feeling for the subject" will allow you to avoid such mistakes in competitive compositions with the ball, such as errors in minor work (55%) and inaccuracy when making throws (35%);

- to develop a "feeling for an object", exercises to develop plasticity should be used (80%);

- the development of a "sense of an object" is favorably influenced by performing exercises with objects without visual control (80%), with a change of direction (75%), on rotational elements (70%), without the help of hands (60%);

- mixed rolls (40%), rolls on the arms and back (25%) and rolls on the arms and chest (20%) have the greatest impact on the "feeling of the object."

The survey results showed that ball rolls, namely mixed rolls, can be used to develop a "feeling for an object." In order to determine the relationship between ball rolls and the "sense of the object," a correlation analysis was carried out of the relationship between the kinematic characteristics of performing ball rolls and the components of the "sense of the object," such as reaction speed, accuracy of repro-

duction of the amplitude of movements and accuracy of reproduction of efforts. The study involved 12 highly qualified athletes involved in rhythmic gymnastics at P.F. Lesgaft NSU.

Thus, various degrees of relationship between the kinematic characteristics of ball rolls and the components of the "sense of an object" were identified. For analysis, various ball rolls were selected based on a survey of experts, as well as exercises for testing various components of the "sense of an object" described by O.A. Dveirina [4]. Using the method of non-contact video sequence of movements, the Kinovea licensed program was used to study the kinematic characteristics of ball rolls. Such indicators as the starting angle of the rolling, the rolling distance and the duration of the rolling were determined. Next, the speed of rolling was calculated by dividing the distance by the duration of the rolling.

The correlation analysis revealed a relationship between the gymnast's reaction speed and the angle at which the roll on the arms and chest began in the position of the arms to the sides (r = 0.542), between the speed of performing this roll and the accuracy of reproducing the amplitude of movements (r = 0.598), as well as between the duration this rental and the accuracy of force reproduction (r=0.703). A relationship was revealed between the speed of performing a roll on the arms and back in the position of the arms to the sides and the gymnast's reaction speed (r = 0.514). A relationship was also identified between the angle at which the roll began on the back and arms in the arm-up position and reaction speed (r=547), as well as the accuracy of force reproduction (r=566). The speed of a gymnast's reaction to a moving object also has a relationship with the angle at which the roll on the chest and arms begins while bending back (r=-0.505) (Table 1).

Table 1

Correlation between the level of development of the components of the "sense of an object" and the kinematic characteristics of rolling with the ball

Type of ball rental	Characteristic	Reaction speed (s)	Accuracy of range of motion reproduction (°)	Force reproduction accuracy (kg)
along the arms and chest, arms to the sides	Angle (degrees)	**0,542**	0,493	-0,29
	Speed (m/s)	-0,075	**0,598**	-0,451
	Duration (s)	0,147	-0,322	**0,703**
along the arms and back arms to the sides	Angle (degrees)	0,215	0,226	0,051
	Speed(m/s)	**0,514**	0,189	-0,007
	Duration (s)	-0,439	0,007	0,273
along the arms and back, hands up	Angle (degrees)	**0,547**	-0,18	**0,566**
	Speed(m/s)	0,348	0,157	-0,248
	Duration (s)	-0,215	-0,108	0,458

along the chest and arms while bending backwards	Angle (degrees)	**-0,505**	-0,271	0,264
	Speed(m/s)	0,103	0,024	0,353
	Duration (s)	-0,021	0,463	-0,058
from hands to feet while lying on stomach	Angle (degrees)	0,24	-0,344	0,156
	Speed(m/s)	0,262	-0,021	0,143
	Duration (s)	-0,154	0,142	0,082

Thus, to develop a "sense of the object" when performing ball rolls, mixed rolls should be used, as well as rolls performed without visual control and without the help of hands. It is necessary to use different angles for starting rolls, which will have a beneficial effect on the reaction speed. To increase the accuracy of reproducing the amplitude of movements, it is necessary to control and vary the speed of performing ball rolls, and to increase the accuracy of reproducing efforts, it is necessary to vary and control the duration of the rolls.

References

1. Arkhipova, Yu.A. Study of special abilities of gymnasts for manipulative activities with objects / Yu.A. Arkhipova, L.A. Karpenko // Man in the world of sports: New ideas, technologies, prospects: Abs. of report Intl. congr. M., 1998. - V. 1. - P. 251-253.

2. Bandakov, M.P. Improving methods for developing coordination abilities in girls 6-7 years old in rhythmic gymnastics / M.P. Bandakov, M.G. Mikryukova // Bulletin of Vyatka State University. 2015. - No. 9. - pp. 120-124.

3. Dveirina, O.A. Concept and programming of athlete coordination training in accordance with the specifics of the sport: abstract of Cand. Ped. Sci. St. Petersburg, 2019. - 52 p.

4. Titarenko, S.S. Subject technical training in the educational and training process of gymnasts. Improving personnel training in the field of physical culture and sports in the context of modernization of vocational education in Russia. Moscow, 2010. - pp. 143-145.

DOI 10.34660/INF.2023.74.49.285

教师在远程学习过程中的方法支持
METHODOLOGICAL SUPPORT OF THE TEACHER IN THE PROCESS OF DISTANCE LEARNING

Bagautdinova Diana Ilnurovna
Master's student
Kazan (Volga Region) Federal University, Kazan, Russian Federation

Gavrish Tatiana Alexandrovna
Master's student
Kazan (Volga Region) Federal University, Kazan, Russian Federation

Sayfullina Lilia Nailyevna
Master's student Kazan (Volga Region) Federal University, Kazan, Russian Federation

注解。 教育领域发生的动态变化与国家和世界的流行病学和地缘政治局势有关。 学校被迫加速适应当前形势，寻找组织教育过程的有效解决方案。 为确保俄罗斯联邦信息基础设施的技术独立性和安全性，通过了以下文件： 2022 年 3 月 30 日俄罗斯联邦第 166 号总统令"关于确保技术独立性的措施……" ，俄罗斯联邦交通部命令"关于批准国有企业优先使用国产软件过渡的方法建议"，俄罗斯联邦数字发展、通信和大众传播部关于 俄罗斯联邦管理机构于 2022 年 4 月 1 日开始实施数字解决方案的进口替代。

最重要的方面是教师是否准备好在地缘政治快速变化的条件下独立组织其教育和专业活动，以确保教育过程的成功。

关键词：在线学习、远程学习技术、小学年龄、教师、学校。

Annotation. *The dynamic changes taking place in the field of education are connected with the epidemiological and geopolitical situation in the state and in the world. Schools were forced to adapt to the current situation in an accelerated mode and find effective solutions for the organization of the educational process. To ensure the technological independence and security of the information infrastructure of the Russian Federation, the following documents have been adopted: Decree of the President of the Russian Federation No. 166 dated March 30, 2022 "On measures to ensure technological independence...", order of the Ministry of Communications of the Russian Federation "On approval of methodological recommendations for the transition of state-owned companies to the preferential use of domestic software, letter from the Ministry of Digital*

Development, Communications and mass communications of the Russian Federation on import substitution of digital solutions in the governing bodies of the Russian Federation dated April 1, 2022.

The most important aspect is the problem of the teacher's readiness to independently organize his educational and professional activities in the conditions of rapid geopolitical changes to ensure a successful educational process.

Keywords: *online learning, distance learning technologies, primary school age, teachers, school.*

Modern society imposes increasingly stringent requirements on the teacher. In the field of education, there are constant changes in the content, process and organization of training.

The urgency of the task is expressed in the dynamic changes taking place in the field of education, in connection with the epidemiological and geopolitical situation in the state and in the world.

According to the order of the Ministry of Education of the Russian Federation №104 dated 03.172020 "On the organization of educational activities ...", it is necessary to organize training that would allow effective inclusion of all participants in the educational process, as well as ensure effective training in a remote format. An effective solution in this situation was the transition to distance learning.

According to UNESCO, in the spring of 2020, 92% of students around the world were suspended from studying in the traditional full-time format. Distance learning broke into educational institutions using the method of "shock therapy". Schools were forced to adapt to the current situation in an accelerated mode and find effective solutions for the organization of the educational process.

Moreover, due to the current geopolitical situation, there is a need for active import substitution. The Ministry of Education of the Russian Federation recommended limiting the use of foreign messengers and ensuring the testing of domestic information and communication educational platforms.

In this regard, in modern society there is an increase in the rate of development of interactive platforms and their demand, and the audience of users is expanding. Primary school age occupies a significant percentage of this audience. With the geopolitical changes in the state and the world, people were forced to switch to online mode both in the field of work and in educational activities. All Russian schoolchildren and students in the period from spring to summer 2020 conducted classes online on various educational platforms [7]. According to the Order of the Ministry of Science and Higher Education of the Russian Federation dated March 14 , 2020 № 397 "On the organization of educational activities in organizations implementing educational programs of higher education and relevant additional professional programs in the conditions of preventing the spread of a new corona-

virus infection in the territory of the Russian Federation" according to paragraph 1.2 "when implementing educational programs, provide for: the organization of contact work of students and teaching staff exclusively in an electronic information and educational environment."

To ensure technological independence and security of the information infrastructure of the Russian Federation, the following documents have been adopted: Decree of the President of the Russian Federation № 166 dated March 30, 2022 "On measures to ensure technological independence ...", order of the Ministry of Communications of the Russian Federation "On approval of methodological recommendations...", letter of the Ministry of Digital Development, Communications and Mass Communications of the Russian Federation on import substitution of digital solutions in the governing bodies of the Russian Federation from April 1, 2022.

The most important aspect is the problem of the teacher's readiness to independently organize his educational and professional activities in the conditions of rapid geopolitical changes to ensure a successful educational process.

In this situation, the methodological support of primary school teachers in the process of distance learning is an urgent problem of modern society.

It was in such conditions that a unique experience of organizing training appeared. Readiness to switch to distance learning at any time, or to return to the previous format has become the specifics of training in 2020/2023. However, constant changes, the transition to a distance format and back do not always have a positive effect on the teacher himself, who may face a number of problems. Thus, a certain teacher accompaniment is required to maintain a favorable, painless learning process [2].

In pedagogy, support is understood as a special type of interaction, the purpose of which is to create favorable conditions for the development of subjects of interaction. Methodological support is considered as an integral activity, in the process of which conditions are created for the professional growth of a teacher, the development of professional and pedagogical competence. Methodological support is understood as a specially organized process aimed at overcoming professional difficulties of a teacher, helping him to solve problems that arise in real pedagogical activity [3].

This is a step-by-step individualized process of providing methodological assistance to teachers, representing the interaction of the accompanied (teacher) and the accompanying person, aimed at overcoming the teacher's emerging professional difficulties.

Methodological support contributes to the professional competence of teachers and the creation of more effective educational environments for students, as well as helps teachers to adapt to the changing dynamics of modern education [6].

The table shows the main platforms on which the educational process was carried out before the geopolitical events in the world, as well as the new domestic

platform Spherum. These platforms helped the teacher in the implementation of the educational process.

Table 1

Comparative characteristics of ZOOM, Skype, Microsoft Teams, and Serum services for organizing online classes

Characteristic / platform	**Skype**	**ZOOM**	**Microsoft Teams**	**Spherum**
Number of people (free of charge)	50	100	without limits	50
The possibility of organizing group work	-	+	+	+
Possibility of organizing feedback	+	+	+	+
Working hours	up to 4 hours continuously; 10 hours a day; 100 hours a month	up to 40 minutes	without limits	without limits
Is it mandatory to register students on the platform?	yes	no	yes	yes
Screen Demonstration	+	+	+	+
File Transfer	+	+	+	+
Recording a class	+	+	+	+

It can be seen from Table 1 that the Sferum was created taking into account all the requirements of the modern educational system.

For methodological support of a teacher, a necessary component is the definition of a messenger for interaction with parents, children (a group, a conversation in the Telegram, VK, built-in messengers of online platforms, and more).

It is important to note that distance learning requires teachers not only technical skills, but also the ability to motivate and support students in remote learning, taking into account their individual characteristics and educational needs.

In accordance with the requirements of the federal state standard of primary general education, we have developed a program for the implementation of the Round platform. Which focuses on the safe conduct of leisure activities, as well as the education of a person capable of self-development and self-realization. Special attention in the implementation program of this platform is paid to the disclosure of creative abilities, the problem of socialization, the realization of personality in professional activity and the assimilation and application of social experience [4].

So, as part of our experiment at the formative stage, we developed an author's program for the introduction of the interactive Round platform into the educational process.

Thanks to the online format of educational and leisure activities, which was the only option in the current situation with quarantine introductions, the implementation of the social order and educational standard did not stop. Social order is the official orientation of public institutions to achieve a given result in their activities as necessary for the further development of society as a whole. The implementation of the social order is the meaning of the functioning of the organization as such. The purpose of these organizations is to carry out the activities on which it is based, regardless of external critical conditions [1].

The purpose of the program is methodological support of the teacher on the organization of circle work on the Round platform.

When developing the author's implementation program, we set ourselves the following tasks:

- to introduce teachers to the capabilities of the platform;
- the ability of the teacher to interest the child on the Round platform;
- to reveal the creative potential and improve the dignity of children;
- to show children that leisure can be interesting and useful, and most importantly free and safe in an online format.

In the studies of many teachers and psychologists, it is emphasized that the originality of thinking, the ability to cooperate, and the creativity of schoolchildren are most fully manifested and successfully developed in activities, and activities with a research focus [2]. Thus, the disclosure of universal educational activities through the use of the Round platform will ensure the safe and effective development of a full-fledged personality of the child.

The author's program for the implementation of the interactive Round platform is focused on supporting the teacher in organizing work with the child.

The main effect of the implementation of the implementation of the Round platform is the formation of an idea about the professions of the future, understanding the importance of safe affordable leisure and identifying the creative potential of younger schoolchildren.

The following is detailed information about the Round platform, which reveals the goals, objectives, methods of implementation, the authors of the platform, etc.

Implementing informal educational projects, there are tools to influence the interests of the younger generation. There is an opportunity to "highlight" the fields of science and industry for which personnel are needed in the future. And children have the opportunity to be in demand in the labor market in the future. Figure 7 shows the number of children in the Russian Federation, which is potentially this popular audience.

One of the main target audience is "Generation Z" or "homelanders". Personal freedom is important for representatives of Generation Z. They are independent in everything. They think about work earlier-they are looking for ways to become fi-

nancially independent. At the same time, people from generation Z do not want to work in areas that are not intertwined with digital technologies. They are unusual for them and seem unpromising, which is partly what they are. Also, this generation does not choose activities that are related to creativity. Since it believes that such work will soon disappear under the onslaught of universal automation. The values of this generation are: security, family-the basis of everything, diversity in everything, any business, the priority of science, investing in art creativity, taking care of health all your life, the culture of food and taste.

Using the Round platform in the educational process, the child has the following opportunities: to post photos and videos of realized challenges, communicate with peers by interests, participate in contests from partner companies of this platform. And as part of gamification, a child can: receive badges as a reward for the implementation of the project, accumulate experience, earn game currency.

The main principles of the development of the Round platform are:

Expertise. All challenges in the project are created together with recognized experts in the profession and teachers. Also, the specifics of the user audience are children, which means that you need 100% confidence in the proposed tasks that give an impetus to development in a specific area.

Children to children. The younger generation takes an active part in creating the content of the application. They do it for the same as them: they describe challenges in "their" language, create examples of photo or video projects, etc.

Volunteering. All experts take part as volunteers and give themselves, realizing that they are participating in the cultivation of a new generation.

Compliance with market needs. All skills are not chosen by chance. Namely, analyzing the projected needs for human resources and focusing on those competencies that will be the maximum need. While maintaining a balance with the interests of the new generation. The target audience was studied on the basis of the content of the Russian School of Generation Theory.

The Round platform has many different skills-professions of the future: mechanical engineer, blogger, journalist, photographer, beatmaker, do-gooder, chef, illustrator, videographer, city farmer, zoologist, fashion designer, esports player, biohacker, environmentalist, animator, actor, entrepreneur, barista, beauty master, designer mobile applications and others.

The Round platform development team: Galina Akhmerova (strategy), Andrey Matveev (creative), Kamilla Chinakhova (management), Ruslan Fakhrutdinov (IT), Alyona Gorshkova (analytics), Elvina Shayakhmetova (content), Zarina Zaripova (promotion), Larisa Matveeva (content).

Approbation and implementation took place in schools of the Republic of Tatarstan (Kazan, Yelabuga). Scientific supervisors and consultants: Prof., Doctor of Pedagogical Sciences, Venera Gilmkhanovna Zakirova, Candidate of Pedagogical

Sciences, Kayumova Leysan Rafisovna. Primary school teachers Gainullina Lilia Nailevna, Bagautdinova Diana Ilnurovna, Gavrish Tatiana Alexandrovna.

The work on the implementation of the Round platform was carried out in 2 stages.

The purpose of stage 1 was to study the attitude of parents of younger schoolchildren to the concept of leisure and its significance in the life of a child. Conducting a conversation with parents, it turned out that everyone is of the opinion that leisure should primarily include activities of interest to the child. So that classes are based on the initiative and desire of the child. Also important is the aspect of security, and the financial costs that are necessary to visit certain sections and circles. Based on the conversation with the parents, we came to the conclusion that with great interest they approve of the child's leisure activities in the online format.

The goal of the 2nd stage was to test the leisure of a younger student in an online format through the use of the Round platform. To do this, a group of junior schoolchildren was formed, which for a certain period of time with the same frequency spent leisure time on the basis of the Round platform. In preparation for the classes, the diagnosis of this group of younger schoolchildren was carried out, for a detailed study of creative inclinations and the subsequent choice of a profession that sympathizes with younger schoolchildren. For high-quality and effective use of this platform, the work was carried out within the framework of the following steps-instructions, of which there were 7. A group of younger schoolchildren in using the Round platform adhered to this sequence:

Step 1. Register in the app and create a profile

Step 2. Choose the profession you are interested in

Step 3. Familiarize yourself with the proposed task for this profession

Step 4. Study the results of the task they completed in the profiles of friends

Step 5. Figure out how to complete tasks, execute and issue a report in the form of photo or video material

Step 6. Upload the task completion material to your profile

Step 7. Check the received reward badges for the completed task in the profile

Then, after the younger students completed this instruction, we had a conversation with them about what feelings they experienced while working on the Round platform. All the children answered unanimously that they liked the process of completing tasks, and it was interesting. Difficulties and difficulties during the execution of tasks were not experienced. So far, there have been no serious proposals and additions to the tasks on behalf of younger schoolchildren.

Methodological support of a teacher plays an important role in improving the quality of education and professional competence of a teacher. This process includes a number of actions and activities aimed at helping the teacher in his professional development and achieving educational goals.

Methodological support contributes to the continuous improvement of the teacher and the improvement of the quality of education, which, in turn, has a positive effect on the academic performance and development of students.

Literature

1. Aleshkina, O.V. Distance educational technologies - the key to mass education of the XXI century: actual tasks of pedagogy. Materials of the VI International Scientific Conference / O.V.Aleshkina, M.A.Minalieva, N.A.Rachiteleva // Young Scientist. - 2015. - No.8 - p. 63 – 65

2. Distance learning in additional education of children: types and forms : studies.- method. manual / E.V. Yevtukh; scientific ed. by E. N. Korobkov. – Saint Petersburg: SPb APPO, 2018. - 67p.

3. Kazakova, T.Y. Psychological and pedagogical support of distance education of students: Primary education // T.Y. Kazakova. - Moscow, 2017. - №. 1. - pp. 25-28.

4. Kotova, S.A., Organization of distance learning in primary school: Society: sociology, psychology, pedagogy // S.A.Kotova, E.A. Bulaeva. - Krasnodar: HORSE Publishing House, 2015. - № 1. - pp. 37-40.

5. Ryazanova, E.R. The use of educational platforms in the process of teaching younger schoolchildren: scientific research // E.R. Ryazanova. – M.: Pedagogy, 2019. - № 2(28).

6. Saprykina, D. I. Problems of transition to distance learning in the Russian Federation through the eyes of teachers: National Research University "Higher School Economics", Institute of Education / D. I. Saprykina, A. A. Volokhovich. - M.: HSE, 2020. -132 p.

7. Shalaginova, K.S. Psychological and pedagogical aspects of distance education in a pandemic: Psychological and pedagogical research / K.S.Shalaginova, E.V. Dekina. - Tula, 2020. – 102 p.

DOI 10.34660/INF.2023.13.68.286

空间概念化：俄语法律隐喻术语
SPATIAL CONCEPTUALIZATION: RUSSIAN LEGAL METAPHORICAL TERMINOLOGY

Tsukanova Elena Vasilievna
Head of International Resource Center, Research Library,
National Research Tomsk State University, Russian Federation

抽象的。 本研究的重点是俄罗斯法律隐喻术语通过空间概念化的表达。 本文的目的是确定俄罗斯法律话语中通过隐喻术语表示的空间映射模式的主题配置。 该研究基于多种方法的组合：隐喻识别程序（MIPVU）、概念隐喻理论。 该研究的材料取自《当代俄英法律词典》。 进行的分析证实，方向隐喻术语中的许多非空间抽象法则概念是通过空间配置概念化（结构化）的。 该分析说明了通过空间表征概念化的法律话语中事件的多样性。 通过空间概念化的最热门的法律事件表现为法律话语中的互动、社会地位的实现、限制和义务的释放。

关键词：法律话语、空间概念化、隐喻术语。

Abstract. *This research focuses on the Russian legal metaphorical terms their representation via spatial conceptualization. The aim of the article is to identify topical configurations of spatial mapping patterns represented via metaphorical terminology within the Russian legal discourse. The study is based on a combination of several methodologies: the Metaphor Identification Procedure (MIPVU), Conceptual Metaphor Theory. The material for the study was drawn from the Contemporary Russian-English Law Dictionary. The conducted analysis substantiates that numerous non-spatial abstract law concepts within orientational metaphorical terms are conceptualized (structured) via spatial configurations. The analysis illustrates the diversity of events within legal discourse conceptualized through space representations. The most topical law events conceptualized via space appear as interaction within legal discourse, achievement of social status, release from restrictions, obligations.*

Keywords: *legal discourse, spatial conceptualization, metaphorical terminology.*

Discourse as a complex communicative event including text and linguistic factors such as the knowledge of the world, ideas, beliefs, attitudes and aims of the recipients is shaped through the main dimensions of “language use, the com-

munication of beliefs (cognition) and interaction in social situations" [1]. Any institutional discourse is less free than any real-life conversation; therefore, the choice of words for professional discourse is strictly measured and weighed [2]. The most prominent peculiarity of legal discourse making it distinct and easily recognizable is the terminology composing it. Conceptual metaphors are viewed as a phenomenon of language and thought and determine humans' perception, thinking and behavior. Orientational metaphors deal with spatial orientation which is not arbitrary and may vary in different cultures [3]. Metaphorical models of the terminological system shape the space of any particular research field and represent the specificity of its functioning [4]. From the perspective of the cognitive approach, conceptual models (cognitive models) represent the form of perception, thinking, and the way information is stored and delivered [5]. The empirical data represented by cognitive metaphors in the terminology of legal discourse conceptualize the existing model of the legal professional area as the schemata of social, professional activities, situations and interactions.

Regarding the use of conceptual metaphors within terminology, numerous studies have focused on a variety of scientific fields: Mishankina analyses metaphorical terminology of astronomy, genetics, linguistics, philosophy, physics, treating metaphorical terminology of a particular scientific area as a gnoseological structure of the determined phenomenon [4-5]. Khizhnyak suggests to view the notions of law as part of concept within cognitive paradigm and points to specificity of terminological concepts that may reveal evaluation component as the main aim of law is to judge and value social events from legal perspective but ideology may influence the evaluation [6]. Kraevskaia, Mishankina, analyzing oil and gas processing terms [7] state that metaphorical terms "arrange" the semantics of terms from other conceptual areas that are significant for topical field. Due to the polysemy of terms, frame structures of other scientific areas become involved where among the most significant appear the knowledge about food products (properties of a substance), physical actions (the result of an action), artifacts (structure and function), basic social actions. Within medical sphere Mishlanova [8] analyses the peculiarities of metaphorization that she views as a universal process of sign development spread to the whole continuum of signs implementation in the discourse. The notion "metaphor" in that case is spread to mechanism, process, separate phase and its results as well as to a separate discourse level fulfilling the unification of discourse events with different theoretical basis.

The present research aims to explore topical configurations of spatial conceptualizations relevant to the metaphorical terminology of the Russian legal sphere. To investigate the conceptual spatial models represented via the metaphorical terminology of the Russian legal sphere, the study focuses on the conceptualization and structuring of the abstract notions of legal discourse through the already existing interpretation model of the inner mental embodied world of speakers.

The methods of cognitive analysis applied in the current study represent a combination of several methodologies: the Metaphor Identification Procedure (MIPVU) [9], Conceptual Metaphor Theory [3], categorization principles formation within Prototype theory [10], and frame structure analysis [11], [12].

First, the manual selection of the legal terms that I suspected to be metaphorical was conducted using the Contemporary Law Dictionary [13] and was initially based purely on my native speaker linguistic intuition. Further, to exclude the terms that are not metaphorical I applied MIPVU [9] which guaranteed the selection of notionally purely metaphorical terms. The main principle in applying the Metaphor Identification Procedure (MIPVU) is based on the fact that a metaphor is indicated through a contrast between the contextual sense (specifically, within the area of jurisprudence) in a special professional dictionary and a more basic sense (literal meaning) of the terms in a general language dictionary: *The Dictionary of the Russian Language* [14]. The example illustrates how I used MIPVU while identifying the conceptual metaphor in the term *storony po delu (parties to the case):*

1. The basic contemporary (literal meaning) or "general understanding" [9. P. 5] of the lexical unit *Storony (pl.) – storona (sg.)* is "space, a place located in some direction from something, as well as this direction itself" [14].
2. The law dictionary defines the lexical unit *storony (pl.) –storona (sg.)* as "a person, a group of people, organization, etc., opposed in some respect to another person, another group of people, organization, etc."

The contrast between the basic meaning and the specific law dictionary meaning indicated that the legal term *storony po delu (parties to the case)* might be considered as metaphorical term because the lexical unit *storony* was used metaphorically.

Later followed the distribution of all the empirical data i.e. (991) metaphorical terms identified with MIPVU to (semantic) categories: OBJECT, HUMAN, SPACE and others, 'where each member of the category (a metaphorical term) fit the image of the meaning of the category name (SPACE) and had similar prototype structure of the category based on the family resemblance' [10]. The current study analysis has been focused at the category of SPACE, which comprises 256 Russian legal metaphorical terms.

Space being the first reality of existence which is perceived and differentiated by a person is considered as one of the basic philosophical categories that reflects the essential aspects of human existence. The reference of the space category to the basic ones might be explained by the fact that time and space are the main forms of substance existence a person interacts with from his birth. Moreover, the ability of a person for visual perception, i.e. to see and to observe surroundings

refers to the primary, basic operations of a human brain. Space defines the most important properties and characteristics of mental, physical, and social objects. The mind of a person while perceiving the space applies different knowledge types through cognitive operations weighing different parameters and signs within space interpretation. Among the authors focusing their research on the identification of specific features and finding universals of spatial representation in various languages [15-17] should be mentioned. In this regard, linguists are interested in the language variant – the result of a person's perception of the space of the external world and its reflection in the language. The SPACE category membership is represented by a wide variety of conceptual representations provided by frames. This fact determined the necessity to implement the frame structure analysis of the metaphorical term from SPACE category which could allow me to discover topical mechanisms and patterns of space configurations. Frame, as a cognitive structure determines and reasons the belonging of the slot [11], scenario [16, P. 114] to the definite category. For example, some frames, representing the category of SPACE, which appear to be topical are those, highlighting path, goal and destination: *vstupat' v prava* (come into power, property) or those which refer for location of entities in space: *vozlozhit' otvetstvennost'* (to assign responsibility), *storony po delu* (parties to the case). Frames attributes represent slots which are not independent but conceptually relate to each other, which result in the reflection of the conceptual data and co-occurrence [11, P. 35]. The cognitive view to terminology [18] combined with the frame structure analysis [11] contributed to the identification of the gnoseological specificity of the universal models and structural invariants [12, P. 35] that govern and structure the conceptualization of the Russian legal discourse. Conceptual metaphors are not the matter of words or language but they are the matter of thoughts that structure the understanding of one kind of phenomenon, especially an abstract one, in terms of another, where within two domains the inference is applied from the 'source domain' to the 'target domain'. The abstract notion and thought is revealed through the conceptual metaphor via 'concrete and sensory-motor concepts' [15]. Conceptual metaphor, being defined by the authors of the Conceptual Metaphor Theory as the cognitive process that underlines the differentiation of linguistic means of an expression, allows us to concretize complex phenomena, situations because the metaphor is treated as the only means to comprehend the abstract notion [3]. G. Lakoff and M. Johnson differentiate three types of conceptual metaphors, where among structural, ontological and orientational ones, the last one is considered to be prevailing and deals with spatial orientation [3] which, as a rule, is carried out by space arrangement around the person and is being realized through different spatial configurations. Within the rich variety of ways to conceptualize the category of space in reality, identified in different languages of the world, still there exist the common basic parameters and characteristic features that are obvious for the majority.

Within this analysis the conceptual metaphor involves understanding of one domain of law in terms of a different space domain. Viewing identified legal conceptual metaphors terms we distribute the entities of the domain law and the domain space thus forming the systematic mappings which structure the Russian legal discourse.

According to Lakoff and Johnson [3], the conceptual system of a human structures the world within a set of spatial configuration. The following oppositions represented within the type of orientational metaphors are almost universal in different languages: 'in – out', 'up – down', 'left – right', 'center – periphery', but still can vary from culture to culture [3, P. 35]. Moreover, the concepts of ENTITY and CONTAINER appear frequently within the action of moving as a basic one. Lakoff [16] underlines, that the Event Structure Metaphor implies that the metaphorical system EVENT STRUCTURE (LOCATION CASE, CASE SPACE) reflect various aspects of acting and being as the interaction of ENTITY, OBJECT, ORGANIZATION, PARTY, PERSON, SPACE and is rather rich.The analysis of 256 Russian legal metaphorical terms depicts how Russian legal metaphorical terminology is tied with human's cognition and spatial orientation performance through different space configurations. Orientational spatial legal metaphor terms represent 17 spatial metaphor models which reveal the legal discourse interactions or enterprise within institutional area through actualizing different spatial configurations. The conceptualization of the legal discourse events' structure components through the configuration of spatial conceptualization via legal metaphorical terminology might be reflected through the following mappings:

1. PROFESSIONAL COMMUNICATION IS MOTION (with/without direction):
   vesti dossier (to keep records);
2. ASSIGNMENT, OBLIGATION or IMPUTATION IS LOCATION of OBJECT IN SPACE (UP-DOWN): *vozlozhit' otvetstvennost'* (to assign responsibility);
3. RELEASE from RESTRICTIONS and OBLIGATIONS, DECISION CANCELLATION IS WAY OF MOTION in SPACE (by OBJECT, ACTOR of DISCOURSE): *ponesti nakazaniye* (be punished);
4. RELEASE from RESTRICTIONS and OBLIGATIONS, DECISION CANCELLATION IS WAY OF MOTION IN SPACE on/from the surface (by OBJECT, ACTOR of DISCOURSE): *snimat' zapret* (to lift the ban);
5. INTERACTION within LEGAL DISCOURSE IS SPATIAL LOCATION (CLOSE/FAR): *tesnoye sotrudnichestvo* (close cooperation);
6. ACTOR of MATERIAL RELATIONS IS ORDINAL LOCATION: *vzyskaniye v pol'zu tret'ego litsa* (penalty in favor of a third party);

7. ACTOR of MATERIAL RELATIONS IS SPACE DIRECTION LOCATION in ACCORDANCE WITH ACTORS of DISCOURSE: *storony po delu* (parties to the case);
8. ACHIEVEMENT of SOCIAL POSITION, STATUS (RIGHTS/LEGAL CAPASITIES) IS WAY of REACHING DESTINATION: *vstupat' v prava* (come into power, property);
9. LEGAL, POLITICAL, FINANCIAL ACTIVITY LIMIT IS SPATIAL LOCATION (inside, outside):*v ramkakh zakona (within the law);*
10. STATE of TRANSITION to a NEW STATE, POSITION, STATUS, AUTHORITY IS SPATIAL BORDER: *granitsa bednosti* (poverty line);
11. RESTRICTION IS MEASURE of ACCESSABILITY in SPACE: *otkrytoye razbiratel'stvo* (open trial);
12. ACTION of LAW within TIME DURATION IS MOTION DIRECTION: *obratnaya ustupka* (return assignment);
13. DEGREE of OBJECT FULFILLMENT in REALITY IS VERTICAL BORDER:
    uroven' zhizni (standard of living);
14. FULFILLMENT of LEGAL DISCOURSE EVENT IS WAY of SPATIAL LOCATION (UP/DOWN):*ustanovit' ottsovstvo* (to state paternity);
15. WAY of LEGAL EVENT FULFILLMENT IS PROCESS of CHANGING LOCATION in SPACE: *denezhnoyoe obrashecheniye* (money circulation);
16. LEGAL EVENT or ACTION DEVELOPMENT IS DURATION AND LENGTH of MOTION (without specifying direction, and aim of transfer):*denezhnyy kurs* (monetary rate);
17. ROLE, STATUS in SOCIETY IS LOCATION in SPACE: *sotsial'noye polozheniye* (social status);

The data analysis reveals that spatial metaphors are applied to reveal legal events, situations, social conditions and ways of actors' interaction, as characteristics of situations within legal discourse. Mapping 1 corresponds with the conduit metaphor [19] (alternative name: Communication is Transfer) [3], [16] – where under PROFESSIONAL COMMUNICATION both oral and written interaction is meant. The basic spatial oppositions become topical within mappings 5, 9, 14 and mainly conceptualize legal events and the degree of its development. The configurations of spatial conceptualization in mappings 2, 3, 4 completely support the idea that 'the law itself is often compared to an object' [20] which might be located in space in up-down configuration or might be passed or moved through the space. ACTING IS MOVING metaphor [3], [16] refers to mapping 8 where change is motion to a new state and where a new state is understood as motion to a new location. Mapping 6 is relevant within the scope of the metaphor IMPOR-

TANCE IS PRECEDENCE within the Event Structure Case [16] when priority matters usually go first. In the mappings where vertical configuration is highlighted the related metaphors More is Up or High Status is up [3], [16] become actual within mappings 13 and 17. The way of vertical configuration becomes also relevant within mapping 14, when the vertical dimension actualizes the hierarchical conceptualization of the legislative system as the highest legislative body. Mapping 12 quite appeals to the idea that space metaphors shape the domain of time and spatial schemas provide configurations for representing events in time [21]. At the same time, it should be noted that within this mapping only one dimension of space, i.e. return (reverse) motion direction, is highlighted. The analysed mapping configurations allow us to trace the close relationship of spatial representations with the main horizontal/ vertical coordinate axes. Thus, SPACE serves as a construct for creating new mental structures based on existing ones. I was able to find the connection between the conceptualization of spatial metaphorical representations in terminology within such an area of professional activity as law.

Results demonstrated widespread use of spatial conceptual metaphor configurations. Finally I conclude that the system of spatial metaphors within legal terminology conceptualizes the professional sphere of legislation and law. Orientational metaphors obeying the embodied metaphor theory are strictly tied with human's cognition, and the performance of spatial configurations produces rich spatial metaphor scenarios.

The results of the analysis have implications for theories of both metaphorical depictions and descriptions and for confirmation how conceptual metaphor is tied to human performance. The analysis has demonstrated a variety of spatial metaphors which provides the directions for further research and will contribute to shared understanding of the Russian legal discourse at a deeper level.

References

1. T.A. van Dijk, Discourse as structure and process, London, Great Britain: SAGE publications, 1997.

2. M.L. Makarov, Basics of discourse theory, Moscow, Russia, Gnozis (2003) 176–177.

3. G. Lakoff, M. Johnson, Metaphors We Live By, Chicago, University of Chicago Press, 1980.

4. N.A. Mishankina, Metaphor in terminology systems: functions and models, Tomsk state university Journal of Philology, 4(20) (2012) 32–45.

5. N.A. Mishankina, Metaphorical models of a linguistic discourse, Tomsk state university bulletin, General scientific periodical, (324) (2009) 41–48.

6. S.P. Khizhnyak, New issues in terminology system research (based on legal terminology), Philology 1 (2008) 92–96.

7. I.O. Kraevskaia, N.A. Mishankina, Term Formation in the Aspect of Epistemological Transparency (Based on the "Oil and Gas Processing" Russian Term System), Tomsk State University Journal, 456 (2020) 36–49.

8. S. Mishlanova, Metaphor in medical discourse. Russian Terminology Science, 1992-2002. IITF Series 12. TermNet Publisher. International Network for Terminology, Vienna, (2004) 266–279.

9. G. Steen et al., Method for Linguistic Metaphor Identification. From MIP to MIPVU, John Benjamins Publishing Company, Amsterdam, Philadelphia, 2007.

10. E. Rosch, Principles of Categorization, UC Berkley (2013) 27–48.

11. L.W. Barsalou, Frames, Fields, and Contrasts, New Essays in Semantic and Lexical Organization, Lawrence Erlbaum Associates, Publishers Hillsdale, New Jersey, (1992) 21–74.

12. N.A. Mishankina, Z.A. Rozhneva, Database of Russian metaphorical terminology: model for term description, Tomsk State University Bulletin, (441) (2019) 34–43.

13. I.I. Borisenko, V.V. Saenko, Contemporary Russian-English Law Dictionary, M, Russo, 2006.

14. A.P. Evgenyeva, Russian language dictionary: 4 volumes, Moscow, Russian language Publ., 1983.

15. G.P. Lakoff, A Cognitive Scientist Looks at Daubert, Public Health Matters, American Journal of Public Health, (95) (Suppl. 1), Washington: American Public Health Association, (2005) 114–120.

16. G. Lakoff, The Contemporary Theory of Metaphor. Cambridge: Cambridge University Press, (1993) 202 –251.

17. L. Talmy, Path to Realization: A Typology of Event Conflation, Proceedings of the Seventeenth Annual Meeting of the Berkley Linguistics Society: General Session and Parasession on The Grammar of Event Structure, (1991) 480–519.

18. S.V. Grinev-Grinevich, Terminology, Academia, 2008.

19. M. Reddy, The conduit metaphor: A case of frame conflict in our language about language, Cambridge, (1979) 284–310.

20. Richard, Metaphors in English for Law: Let Us Keep Them! Journal in English Lexicology, Lexis 8 (2014) 1–19.

21. L. Boroditsky, Metaphoric structuring: understanding time through spatial metaphors, Cognition 75 (2000) 1–28.

DOI 10.34660/INF.2023.90.68.287

中国共产党媒体政策的变迁：二十世纪下半期的关键时刻
CHANGING MEDIA POLICIES OF THE CHINESE COMMUNIST PARTY: A CRITICAL MOMENT IN THE SECOND HALF OF THE TWENTIETH CENTURY

Li Jiani
Master
Ural Institute of Humanities of the Ural Federal University

摘要. 本文旨在探讨中国共产党在二十世纪下半期对媒体政策进行的关键变迁。通过分析从1970年代末期到21世纪初期的时期内中国共产党媒体政策的演变，我们可以更好地理解中国共产党如何应对新的社会、政治和技术挑战，以及这些政策变迁对中国大众媒体和社会的影响。

关键词：大众媒体，二十世纪，媒体政策，政策变迁

Abstract. *This article aims to explore the key changes in media policy undertaken by the Chinese Communist Party in the second half of the twentieth century. By analyzing the evolution of the Chinese Communist Party's media policies over the period from the late 1970s to the early 21st century, we can better understand how the Chinese Communist Party responded to new social, political, and technological challenges and the impact of these policy changes on Chinese mass media and society. Influence.*

Keywords: *mass media, twentieth century, media policy, policy changes.*

The Chinese Communist Party has always attached great importance to media control and management to ensure its influence in ideological dissemination, social control and political stability. In the second half of the 20th century, especially since the late 1970s, the Chinese Communist Party's media policy has undergone many important changes. These changes were not only affected by the domestic and foreign political environment, but also driven by technological innovation and social changes. This article will analyze key moments during this period, including reform and opening up, the advent of the Internet era, and the rise of media convergence, to reveal the main factors and impacts of changes in the CCP's media policy.

1. Lifting the ban on media during the period of reform and opening up

In the late 1970s, China under the leadership of the Communist Party of China ushered in a profound social and economic reform, which also had a huge impact on media policy.

Lifting the ban on television program and film production: During the reform and opening up period, the Chinese Communist Party allowed the production and broadcast of more television programs, as well as the development of the film industry. This allows cultural diversity to be showcased and audiences to be exposed to a wider range of content that is no longer limited to official promotional videos.

Opening up foreign cultural exchanges: The Communist Party of China began to actively participate in international cultural exchanges, introducing foreign cultural works and films, allowing Chinese audiences to be exposed to international culture. This promotes interaction and understanding between China and the outside world.

Expanding the content scope of newspapers and publishing industries: The Chinese Communist Party has gradually loosened its control over the news and publishing industries, allowing more news reports and book publishing, including discussion of some sociopolitical issues. This encourages independence and diversity in the news media.

Promote the development of cultural industries: The Communist Party of China encourages the growth of cultural industries, including music, art, literature and other fields, to provide creators with more opportunities to showcase their talents. to promote cultural diversity and economic growth.

These policy changes during the reform and opening up period helped to enrich the content of China's mass media, increase media diversity, and also provide more opportunities for the dissemination of Chinese culture. Policy changes during this period laid the foundation for the development of Chinese media in the coming decades and reflected the Chinese Communist Party leadership's recognition of the importance of media in shaping society and culture.

2. Challenges in the Internet Era

In the late 1990s, the popularity of the Internet triggered a revolution in the media field. How the Chinese Communist Party responds to the rise of the Internet and how it manages and censors online content has become a key question. In the Internet era, the Chinese Communist Party is facing unprecedented media challenges and opportunities, and the Chinese Communist Party's media policies have undergone significant adaptation and adjustment during this period. Technical control and censorship measures were first taken to ensure that information disseminated on the Internet conformed to the party's ideology and maintained political stability. However, with the popularization of the Internet, the Communist

Party of China has also actively explored the potential of new media and promoted the online transformation and content innovation of party media. Including actively participating in the guidance of online public opinion by establishing its own online media platforms, such as Xinhuanet and People's Daily Online, as well as social media accounts. Behind this policy is the Chinese Communist Party's recognition of the importance of the Internet in the dissemination of information and the challenges of maintaining the party's media control in the digital age. Therefore, the adaptation and adjustment of the Chinese Communist Party's media policies in the Internet era reflects the party's efforts in information control, and it also has a significant impact on information freedom and network governance.

3. Media convergence and the rise of new media

At the beginning of the 21st century, media convergence brought about the convergence of different media forms, such as television, the Internet, and mobile applications. Media convergence has had a profound impact on the media policy of the Chinese Communist Party. With the development of new technologies, traditional media, the Internet and mobile communications are gradually integrated, forming a new media ecosystem. This change has promoted various adjustments to the Chinese Communist Party's media policy:

First, the Communist Party of China actively promotes media integration and builds a series of cross-platform media organizations, such as Xinhua News Agency and CCTV. These institutions integrate traditional and digital media to improve the efficiency and impact of information dissemination. The rise of new media has broken the time and geographical restrictions of traditional media, making information dissemination faster, covering a wider range, and achieving instant interaction. This makes it easier for the Chinese Communist Party to guide and shape public opinion, quickly respond to social events, and better understand public opinion and social dynamics. Secondly, media convergence has changed the speed and scope of information dissemination, allowing the Chinese Communist Party to communicate policies and promote ideologies more quickly. The rise of the Chinese Communist Party's new media has improved the efficiency of information dissemination, better served domestic and foreign audiences, promoted the dissemination and influence of China's culture, values, and policies on the international stage, and strengthened its international communication power. In short, the rise of the Chinese Communist Party's new media has completely changed the way and pattern of information dissemination, and has become a key force in shaping China's public opinion and international image.

In summary, media convergence has had a broad and profound impact on the media policy of the Communist Party of China, allowing it to continuously adapt to the new media environment, while also triggering numerous challenges and

discussions. This trend will continue to shape China's media landscape and information dissemination methods.

4. The social impact of changes in the Chinese Communist Party's media policies

Changes in the Chinese Communist Party's media policies have had a profound impact on Chinese society, especially on information freedom, cultural expression, and social participation. This process reflects the Chinese Communist Party's trade-off between maintaining the party's political rule and social stability. The changes in the Chinese Communist Party's media policy have had a dual impact on information freedom. With the advancement of reform and opening, Chinese media has gradually expanded the scope of information and allowed discussion of some non-political topics. However, politically sensitive topics remain tightly controlled, especially in the internet age. Changes in media policy have affected cultural expression. China's arts and culture sector experienced a wave of renaissance during the reform and opening-up period, but the government still censored content to ensure it was consistent with the party's ideology. This has resulted in some creators facing challenges in cultural expression, especially on politically and socially sensitive issues. Adjustments in media policy have had complex effects on social participation. The CCP encourages the public to participate in social affairs. The Internet and social media have made public participation and expression easier, but they also face information censorship and suppression. While maintaining political stability and social control, changes in the Chinese Communist Party's media policies have also had a multifaceted impact on Chinese society. This reflects the relationship between freedom of information, cultural expression, and social participation. Chinese society continues to evolve in this context, showing complex and diverse characteristics.

In conclusion:

In the second half of the twentieth century, changes in the Chinese Communist Party's media policies had far-reaching consequences at the social, political, and technological levels. By unblocking media, responding to Internet challenges, promoting media convergence, and managing the tension between free speech and control, the Chinese Communist Party has shaped a complex and diverse media environment. The impact of this change is not limited to the media field, but also profoundly affects the development of Chinese society and politics. The future direction of the Chinese Communist Party's media policy will continue to be affected by domestic and foreign factors and technological evolution, which will have an important impact on Chinese society and the global media landscape.

References

1. Secretariat of the Central Committee of the Communist Party of China. Since the Sixth National Congress: Secret Documents within the Party [M]. Beijing: People's Publishing House, 1981.

2. Editorial of "Liberation Daily". Letter to readers [N]. Liberation Daily, 1942-04- 01 (1).

3. Propaganda Department of the Central Committee of the Communist Party of China. Notice on reforming the party newspaper [N]. Liberation Daily, 1942-04-01(1).

4. Institute of Journalism, Chinese Academy of Social Sciences. Compilation of News Work Documents of the Communist Party of China (Part 2) [M]. Beijing: Xinhua Publishing House, 1980.

5. Editorial of "Liberation Daily". The first thousand issues of this newspaper [N]. Liberation Daily, 1944-02-16(1).

6. General Office of the Propaganda Department of the Central Committee of the Communist Party of China. Overview and Documents of the Party's Propaganda Work Conference (1951 ~ 1992) [M]. Beijing: Party School Press of the Central Committee of the Communist Party of China, 1994.

7. Sun Xupei. Acceptance and transformation of old journalism in the early days of liberation [J]. Journalism Research Materials, 1988(3):48-63.

DOI 10.34660/INF.2023.30.88.288

教育中的游戏化：对其学习成果影响的社会学分析
GAMIFICATION IN EDUCATION: A SOCIOLOGICAL ANALYSIS OF ITS EFFECTS ON LEARNING OUTCOMES

Bondareva Alisa Aleksandrovna
Student
Financial University under the Government of the Russian Federation

Mudarisova Alina Ilnarovna
Student
Financial University under the Government of the Russian Federation

Mudarisov Ruslan Ravilevich
Student
Financial University under the Government of the Russian Federation

注解。 本文调查了游戏化对教育环境的社会学影响，并探讨了其对学习成果的影响。 它探讨了游戏元素和机制如何提高学生的参与度、动机和知识获取。本文还讨论了教育游戏化的潜在方法。

关键词：游戏化、教育、学生动机、提高参与度、更好的学生表现、学习策略。

Annotation. *This article investigates the sociological effects of gamification on educational settings and examines its impact on learning outcomes. It explores how game elements and mechanics can enhance student engagement, motivation, and knowledge acquisition. The article also discusses the potential ways to gamify education.*

Keywords: *gamification, education, student motivation, improved engagement, better students' performance, learning strategies.*

One of the biggest problems schools face nowadays is that there's too little engagement and that pupils are not motivated enough. Their attention span lasts for three to five minutes and then they reach for their phones to find entertainment elsewhere. We are convinced there is a way to keep all the pupils engaged while also teaching them, and the key is gamification of some aspects of an educational process. Moreover, according to some research, challenge-based gamification in education leads to an increase of 34.75% in student performance [2].

Games have many elements that make them powerful vehicles for human learning. They are commonly structured for players to solve a problem, think both

critically and creatively and in some cases - for building resilience. All of these are essential skills needed in nearly every sphere of our lives. Many games promote communication, cooperation, and even competition amongst players. They can be used not only for teaching, but also for learning and assessment.

As for the importance of understanding the sociological implications of gamification in education, it is essential for harnessing its benefits while reducing potential drawbacks. By critically evaluating the impact on communication patterns, social interaction, relationships, knowledge retention, educators can make informed decisions about integrating gamification into educational settings. Since a game is always a social activity, all of the above must be taken into consideration which is what we will do in this article.

Gamification can be defined as applying game design elements to an educational setting to make learning more engaging. Nowadays there are many examples of gamification in education, some of them more popular than others.

There are several gamified learning strategies. For example, implementing the most basic elements of the game into school subjects, whether it is turning chapter reviews into competition on who can answer teacher's question faster, or dedicating five minutes at the beginning of each History class to describe (or even show) elements of life that would have surrounded students if they lived in certain century.

There's also an portion of going one step further: create yearlong leaderboards and to get to the top of that pupils would have to be as accomplished as they can (in a way this strategy is already implemented by some universities - there are ratings of all students of same major and top students get rewarded, sometimes by decreased tuition cost).

One of the most advanced options of gamification is creating classroom avatars, so the class becomes a game in itself. In that case pupils can accumulate various resources (that they receive from teachers for completing tasks), 'unlock' different modifications and receive awards (like higher rank or title). Setting up spaces like that and thinking through the details may look like a lot for a teacher to handle, however there is every reason to believe that results will be rewarding: data suggests that students who were educated with challenge-based gamification raised their performance by up to 89.45% compared to those who only received lectures [2].

Moreover, some gamification tools require very little extra work from educators. For instance, Kahoot! which is 'is a game-based learning platform that makes it easy to create, share and play learning games or trivia quizzes in minutes' [4]. You can either create a quiz yourself (which is easy with a user-friendly interface) or choose one of thousands that other users have downloaded. In fact, Kahoot! is used by approximately over 8 million teachers globally, hundreds of millions

of students and families, and in 97% of Fortune 500 companies. Every educator knows how hard it is to keep students engaged, but what they also know is how you don't have to ask twice for them to join the game.

There is no doubt that gamification in education has a profound impact on interpersonal communication. It offers numerous advantages for both students and educators.

First of all, gamification empowers students by giving them a sense of ownership over their learning journey [7]. This approach creates a relaxed atmosphere where learners know that failure is not the end but an opportunity to try again. It triggers the release of dopamine. Ultimately, gamification transforms the perception of learning from a chore ("have to learn") into a desire ("want to learn").

Furthermore, gamification introduces 'progress indicators' [5] which make the learning process more transparent and trackable. This visibility not only motivates students to achieve their goals but also helps uncover intrinsic motivations for learning. The gaming environment fosters a sense of comfort that is often lacking in traditional classroom settings.

Finally, gamification hone valuable skills that extend beyond the classroom [5]. Students learn how to learn and think critically, skills that are highly important for the contemporary world such as time-management, competition, and effective communication. Gamification also promotes collaboration and boosts cognitive function when students engage in group activities, enhancing their confidence and fostering healthy brain activity.

In a nutshell, gamification in education is a versatile and effective method that encompasses education, learning, and assessment within a dynamic and engaging learning environment. It not only empowers students to take control of their learning but also nurtures vital skills for their future success.

It is vital to mention that gamification significantly enhances students' motivation and engagement in the learning process, thereby positively impacting communication within the classroom. By incorporating elements of competition and achievement, gamification fosters a sense of motivation among students, encouraging them to actively participate and communicate with peers to accomplish shared goals [1]. Moreover, it creates a collaborative atmosphere where students exchange feedback and strategies. Furthermore, the fun and immersive nature of gamification increase students' enthusiasm for learning, making them more involved in classroom discussions and interactions.

Talking about the role of rewards, it creates a powerful motivational tool. As students work towards earning rewards, they tend to communicate more openly, sharing strategies, experiences, and insights with their peers. This collaborative exchange of information not only strengthens their understanding but also fosters a sense of community.

Challenges are functional in elevating student engagement too [1]. When students encounter tasks that require critical thinking, problem-solving, or creative solutions, they become active participants in the learning process. These challenges provoke curiosity and encourage students to explore and communicate ideas with their peers. Students often collaborate, discuss, and seek assistance from one another when faced with complex challenges.

Moreover, competition may help students to step out of their comfort zones, take risks, and communicate effectively to negotiate and collaborate in competitive environments. This not only improves participation but also prepares students for real-world situations where effective communication is essential for success.

In summary, rewards, challenges, and competition collectively contribute to a dynamic and engaging learning environment that fosters active participation and communication among students. When leveraged effectively, these elements inspire motivation, teamwork, and communication skills that extend beyond the classroom and into various aspects of students' lives.

Undoubtedly, gamification has many positive effects on the educational process. Alongside increasing students' motivation and developing their interpersonal communication skills, gamification promotes knowledge retention.

An experiment comparing a non-gamified and a gamified group found that gamification led to positive results both in the short and long term. However, if in the short-term gamified group outperformed non-gamified (69.7% as opposed to 35.5%), in the long term no significant difference was found. Moreover, the research revealed a correlation between type of school and assessment results. Students from higher educational schools achieve better performance than those from vocational schools [6].

Another case study was conducted by a math teacher at an elementary school. According to this experiment, gamification had a huge effect on students' performance increasing their average test score by 34% [7].

Creative thinking and problem-solving are two more crucial skills developed by implementing gamification elements in education. The research aimed to examine the effect of gamified STEM activities on students showed positive and significant improvement in students' critical thinking, however, no substantial difference in perceptions of problem-solving skills was found (it is worth mentioning that the participants' average score was high enough before the beginning of the experiment) [8] . The results of another study also proved that gamification has a positive influence on the development of these two skills [9].

In conclusion, there is a need to mention that gamification in education is an approach for encouraging learners' motivation and engagement by incorporating game design principles in the learning environment. The importance of sustaining students' motivation has been a long-standing challenge for educators. This ex-

plains the substantial attention that gamification has gained in educational context - its potential to motivate students. This study covers different aspects of the gamification concept. Using the data from various sources, we analyzed gamification's impact on students' performance, knowledge retention, collaborative skills, etc. - the trend is always the same. Undoubtedly, gamification has a positive effect in educational context. Moreover, this study contains recommendations for teachers on implementing some gamification tools (from Kahoot! to classroom avatars).

References

1. Gamification in Education: What, How, Why bother. - Access mode: https://www.researchgate.net/publication/258697764_Gamification_in_Education_What_How_Why_Bother

2. Statistics of gamification in education. - Access mode: https://www.bluetea.eu/post/statistics-of-gamification-in-education

3. Gamification of communication and documentation processes in project teams. - Access mode:https://www.researchgate.net/publication/346066420_Gamification_of_communication_and_documentation_processes_in_project_teams

4. Kahoot! Offical site. – What is Kahoot. – Access mode:https://kahoot.com/what-is kahoot/#:~:text=Kahoot!%20is%20a%20game%2Dbased,Sign%20up%20for%20free

5. How Gamification And Social Networking Impact Learning: Communication Is The Key. - Access mode: https://elearningindustry.com/social-networking-impact-learning-gamification-communication-key

6. Increasing Knowledge Retention through Gamified Workshops: Findings from a Longitudinal Study and Identification of Moderating Variables. – Access mode: https://www.researchgate.net/publication/329128965_Increasing_Knowledge_Retention_through_Gamified_Workshops_Findings_from_a_Longitudinal_Study_and_Identification_of_Moderating_Variables

7. 5 Stats That Prove Gamification Boosts Retention. – Access mode: https://www.storyly.io/post/5-stats-that-prove-gamification-boosts-retention

8. Asigigan, S. I. & Samur, Y. (2021). The effect of gamified STEM practices on students' intrinsic motivation, critical thinking disposition levels, and perception of problem-solving skills. International Journal of Education in Mathematics, Science, and Technology (IJEMST), 9(2), 332-352. – Access mode: https://doi.org/10.46328/ijemst.1157

9. Effectiveness of Gamified Instructional Media to Improve Critical and Creative Thinking Skills in Science Class. – Access mode: https://www.researchgate.net/publication/360913748_Effectiveness_of_Gamified_Instructional_Media_to_Improve_Critical_and_Creative_Thinking_Skills_in_Science_Class

DOI 10.34660/INF.2023.37.39.289

文化建设有没有进步?
IS THERE ANY PROGRESS IN THE DEVELOPMENT OF CULTURE?

Chernyakova Natalia Stepanovna
Doctor of Philosophical Sciences, Professor
Herzen State Pedagogical University of Russia

抽象的。 文章认为文化的渐进发展是文化主体朝着充分发挥其潜力、趋向其自身理想的方向变化的过程。 不同类型文化的发展水平可以通过不同类型文化中价值观的体现程度来比较，因为价值观作为人类生活的最终目标，在文化中具有一定的普遍内容和功能。 尽管存在一些不可否认的进步痕迹，但人类文化的发展是从最低类型或阶段到最高类型或阶段的渐进继承的结论是有问题的。

关键词：文化； 进步；发展；文化类型； 价值观。

Abstract. *The progressive development of culture is considered in the article as the process of cultural changing in the direction of full disclosure of the potential of the subject of this culture, tending to its own ideal. The levels of development of different types of culture could be compared on the degree of embodiment the values in each type of culture, since the values as the ultimate objectives of human life have some universal content and functions in culture. Despite some undeniable traces of progress, a conclusion that development of human culture is a progressive succession from the lowest to the highest types or stages is more than problematic.*

Keywords: *culture; progress; development; types of culture; values.*

The question about progress in the development of culture could get more or less reasonable response only within a particular concept of culture. This means that understanding of the essence of culture determines a solution of the question about the possibility, feasibility and criteria of its progressive development: that which is seen as progressive in terms of one concept might be not regarded as so within a different concept.

In my understanding of culture (Chernyakova, 2020, p.240-247) I assume that the term “culture” is introduced in humanitarian research to show the specific features of existence of the various subjects: individuals, social groups, communities. In other words, there is the reality, referred to as “culture”, because there are

different subjects exploring in different ways various fields of natural and social worlds. So, we can say that culture is a special (unique) way of sociality inherent in a particular subject and inseparable from his existence.

Culture arises, exists, changes, and disappears, along with its subject. The subject of culture is its creator and, so to say, its system-forming factor. The number of material and spiritual products of any culture significantly exceeds the number of real subjects of culture, since whatever the subject of culture is doing, in whatever variety of activities shows himself, whatever products of culture produces, he remains the same (identical to himself) subject and his culture characterizes his own way of obtaining the world.

A particular attention should be paid to the fact that culture of a person, group, society, or humanity is characterized by those and only those features that express the specificity of the subject of culture. So there is no identity between culture of a person and culture of a group, between cultures of different ethnic groups or different classes, between cultures of different social groups and culture of society as a whole.

It means that culture as a way of existence of a society, on the one hand, is not reducible to cultures of different subjects coexisting within this society, and, on the other hand – is not identical with the structure and functions of the components of the social structure of society. Speaking about the culture of society as an integral subject, we mean not the identity of the cultures of the different subjects, but cultural paradigm that underlies all types of culture which are included in this totality.

Since each subject of culture carries out one type of culture, the emergence of a new subject entails the emergence of a new type of culture, and the diversity of types, their uniqueness and originality are due to the existence of many original and unique subjects of culture.

It follows that culture of one subject does not turn into culture of another subject, and that different types of culture cannot be regarded as stages in relation to each other. Culture of one person is not a stage of development, leading to culture of another person; antique culture is not transformed into a medieval one, and culture of a child is not go into culture of an adult.

Is it correct in this case to talk not only about development, i.e. natural, directional changes of culture, but also about the progressive development of culture, i.e. natural changing from the lowest stage to the highest?

Obviously, if the progressive development of culture really exists, it could be nothing other than changes of each type of culture in the direction of full disclosure of the potential of the subject of culture of this type, tending to its own ideal. This progressive development of culture of a specific subject would be manifested in raising of awareness, appropriateness, meaningfulness of goal setting, in im-

proving of techniques, tools, and methods of operation, in increasing of the degree of moral responsibility and of self-realization of a person or members of social groups as carriers of certain social roles and subjects of this type of culture. In other words – in increasing of the value potential of culture and in getting to the maximum extent of the embodiment of values.

So, culture of a social group is developing towards an ideal implementation of the social function, which is the reason for existing of this social group in the structure of society. And progressive development of human culture as a whole goes along the lines of transition to higher levels of exercising conscious, reasonable, productive, socially regulated activities of mankind and of increasing the diversity of culture in general. The latter means that the increasing of complexity of social structure and the formation of new subjects of culture are going on.

Certain types of culture can be compared with each other on various grounds: the level of development of material or technological base, the content and the level of development of each of the elements of culture, etc. A comparative analysis of different types of culture may reveal contradictions between ultimate objectives of culture and means of their achievement or specific historical forms of their embodiment in different cultures, between different cultural phenomena, which develops by its own laws, has an internal logic of development (Chernyakova, 2021, p.69-77), etc.

However, if a comparison of the levels of development of different types of culture as whole systems is really possible, the basis of this comparison could be only universal. Just because the values are not only universal elements of culture, but have some universal content and functions, we can try to compare different types of culture on the value criteria, i.e. on the degree of embodiment in each type of culture the ultimate objectives of human life.

But can we compare different types of culture on the universal value basis, if we know that subjects of these cultures have different forms and methods of realization of value orientation and that representatives of one culture may not give any importance to the cultural phenomena that representatives of the other culture evaluate above anything else?

In searching of a theoretical explanation of this rather obvious fact many researchers are inclined to the assumption that there are not so much the universal as many different “value systems” in culture, the clash between which generates conflicts between individuals and social groups.

How based this assumption is?

In my opinion, if anything unites opposing social forces, it is a sincere belief in the existence of one and the same values for all people and a confidence of the representatives of each of the warring parties that only their own way of life and thinking is truly beautiful, true, and good. It is just this belief in the existence of

the same for all values encourages people to disputes and real struggle with opponents, nourish their hopes to convince all the others and to make them love and hate the same things that they love and hate themselves.

The mere presence in culture of not simply different, but just conflicting value orientations suggests that the essence of value regulation is an exact opposite of a simple assessment in accordance with certain "standards" of preferences or tastes. Tastes really differ, but if we argue, it is not about tastes, but about that which determines any tastes, that goes beyond the narrow confines of any of the standards and samples, and that may not be "ours" or "theirs", "my" or "your".

Trying to formulate criteria of the degree of embodiment of values in different types of culture, we, obviously, ought to proceed from the fact that all beautiful creations are equally beautiful, all good deeds are equally good, and all true ideas are equally true. However:

- The degree of embodiment of Good in one culture is higher then in another, if there is the deeper moral regulation in all spheres of life of the subject of this culture, and if this subject includes the wider circle of individuals in the number of similar to himself, i.e. in the number of people on which the same moral standards that govern himself do extend;
- The degree of embodiment of Truth in one culture is higher then in another, if there are the more extensive field of researching the world in this culture and the higher degree of the willingness of its subject to discuss any hypotheses that claimed to be true;
- The degree of embodiment of Beauty in one culture is higher then in another, if the higher degree of aesthetic attitude permeates all spheres of life of the subject of this culture, and the more products of this culture are evaluated on aesthetic grounds.

If these value criteria would be applied to different well known types of culture, it would be seen that, despite some undeniable traces of progress (Chernyakova, 2022, p.311-314), a conclusion that development of human culture is a progressive succession from the lowest to the highest types or stages is more than problematic.

References

1. Chernyakova N.S. (2021). Knowledge society as myth and reality. // Culture and civilization. Volume 11, No. 3A. P.69-77.

2. Chernyakova N.S. (2022).Technocratic euphoria as a real threat to humanity. // Greater Eurasia: development, security, cooperation. Yearbook. Vol. 5. Part 1. P.311-314. http://ukros.ru/archives/29188,

3. Chernyakova N.S. (2020).Terminological aspects of cultural knowledge. // Bulletin of Culturology, No. 4(95). P.240-247.

DOI 10.34660/INF.2023.12.89.290

关于阿塞拜疆的建筑问题。 地毯中建筑物的景观和结构元素
ON THE PROBLEM OF ARCHITECTURE OF AZERBAIJAN. LANDSCAPE AND STRUCTURAL ELEMENTS OF BUILDINGS IN CARPETS

Amenzade Raiha
Doctor of Architecture, Full Professor, Head of Department
Institute of Architecture and Art, National Academy of Sciences of Azerbaijan

抽象的。 地毯是一个极其重要的组成部分——无论是功能性还是艺术性（艺术品）——无论是任何规模的室内装饰——从简陋的小屋到豪华的宫殿公寓。 它们是社会各个阶层内部不可分割的一部分。 地毯覆盖了宗教、纪念馆和民用建筑的地板，从而与建筑的概念联系在一起。 地毯的特点是清晰的构成结构、分区节奏的理念、颜色、装饰品（几何、花卉）、装饰设计特征、服从建筑学、技术技巧，所有这些都促成了地毯的出现 地毯无与伦比的美丽 – 高品质的装饰和应用艺术作品。 本文主要关注来自阿塞拜疆的地毯，特别是来自大不里士地毯编织学校的地毯，

关键词：阿塞拜疆、地毯、纪念性建筑、建筑、花园。

Abstract. *Carpets are an exceptionally important component - both functional and artistic (art object) - of any size interior - from a poor shack to luxurious palace apartments. They were an integral part of the interiors of various social strata of society. Carpets covered the floors of religious, memorial and civil buildings, thus becoming associated with the very concept of architecture. The carpets are characterized by a clear compositional structure, the idea of the rhythm of divisions, color, ornaments (geometric, floral), features of decorative design, subordinated to architectonics, technical tricks, and all this contributed to the emergence of the unparalleled beauty of carpets - high-quality works of decorative and applied art. The article focuses mainly on the carpets from Azerbaijan, in particular from Tabriz carpet weaving school,*

Keywords: *Azerbaijan, carpets, monumental buildings, constructions, gardens.*

Carpets are an exceptionally important component - both functional and artistic - of any size interior - from a poor shack to luxurious palace apartments. Carpets covered the floors of religious, memorial and civil buildings, thus becoming associated with the very concept of architecture [3, p.44-51]. Carpets are always

admired; they are characterized by a clear compositional structure, the idea of the rhythm of divisions, color, ornaments (geometric, floral), features of decorative design, subordinated to architectonics. This is a color range of unprecedented beauty, technical techniques, and all this contributed to the emergence of unprecedented beauty of carpets, high-quality works of decorative and applied art. This article discusses carpets that can be divided into 2 groups: a)) carpets with structural elements, b) carpets with “charbagami”. The focus was mainly on carpets from the Tabriz group of carpets, the so-called. story carpets. This article discusses carpets that can be divided into 2 groups: a)) carpets with architectural elements, b) carpets with “charbags”. Carpets of group a) contain structural elements of architectural structures, including arches, domes, columns, etc. Carpets of group b) include carpets with “charbags”, conventionally depicting architecturally planned parks, integral parts of both free-standing buildings and structures (keshki, cult)

Carpets are invariably admired, they are characterized by a clear compositional structure, the idea of the rhythm of divisions, color, ornaments (geometric, floral), features of decorative design, subordinated to architectonics, unparalleled beauty of color range, technical techniques, and all this contributed to the emergence of unparalleled beauty of carpets - high-quality works decorative and applied arts/ Carpets were mainly taken into consideration, mainly from the Tabriz group of carpets, the so-called. story carpets (Chicago). This article discusses carpets with, which can be divided into 2 groups: a)) carpets with architectural elements, b) carpets with “charbags”. Carpets of group a) contain structural elements of architectural structures, including arches, domes, columns, etc. Carpets of group b) include carpets with “charbags”, conventionally depicting architecturally planned parks, integral parts of both free-standing buildings and structures (keshki, religious, etc.), and architectural complexes (cult, palace, civil). The study of these groups and carpets convinces the viewer of the deep awareness and clear understanding of talented carpet weavers to perceive phenomena as a whole, knowledge of the fundamentals of architectural art, means of harmonizing the composition of monumental buildings, including proportions, meter and rhythm, scale, color.

At the same time, these emotionally rich, majestic canvases are the result of the creative collective work of unknown heroes who created brilliant works of art. The study of miniature paintings and carpets, their scientific analysis is of "outstanding interest for elucidating the general picture of architecture and related areas of creativity," notes Full Prof. A. Salamzade [2, p.209].

As true works of architectural art, they have an aesthetic value that goes far beyond the boundaries of the era and country. They trace innovative developments that were ahead of their time, revealed in subsequent eras, traditions that met the assigned tasks, elements and motifs that became universal. The compositional development of carpets, in which one or another structural unit or part of a structure is given, has a rich variety of examples - columns, arches, domes, stalactites, dome structures. It is the designs that make it possible to understand the inexhaustibility of ideas and the diversity of engineering and technical techniques, and their improvement certainly entailed changes in the spatial design of buildings, being a direct source of artistic and imaginative influence...

The richness of dome modifications was determined by the type of structure, the chosen structural system with a whole range of tasks, the aesthetic views of the era, and the skill of the architect. In the selection of the dome ceiling, the under-dome structures acquired significant importance, to which exceptional attention was given, as an important link in the entire structural system, to the tectonics of the building, on which the stability of the structure and its reliability depend. The transition from the walls of the building body to the domed ceiling is carried out through dome structures, among which there are several main leading lines that have a variety of options - trompe l'oeil, stalactite and shield-shaped sails, intersecting arches. Innovative trends in the field of dome structures significantly replenished and enriched the range of their options, which consisted of architectural ideas of the era.

All the sophistication of the design of the dome resting on the sub-dome structures is conveyed by equally rich decorative means. The entire composition is

solved through exquisitely drawn arches resting on columns without or with bases and capitals, the images of which are often somewhat far from real. In the development of cities, especially in architectural complexes, a huge place was given to gardens and parks. In the development of the composition the so-called “garden carpets” she is extremely strict, laconic and taciturn. They schematically depict the “charbagh” composition, with clear linear boundaries and clearly defined components. The regular type of spatial construction of the “charbagh” is characterized by geometrized development using axial systems. The principles of spatial organization of numerous garden and park complexes are based on the symmetry of divisions, on rational scale relationships with the rhythms of the placement of its components, at the same time they are devoid of monotony and boring perception. The uniqueness of the park complexes was due to the specific conditions of place and time, based on the constantly changing variability of nature, in the dynamics of the rhythms and stages of the long-term formation of the landscape. The composition of the carpets corresponds to the realities of the canonized type of landscape gardening composition that has been formed over centuries, although there are many options. The composition of the gardens consisted of a sequential alternation of lawns, combined with picturesque vistas of alleys, evergreen, broad-leaved and fruit clumps of trees and a fragrant sea of flowers, intricate ponds with waterfowl, with a keshk (country palace) located in the center of the garden, clearly visible in the thick of the emerald foliage[1, pp. 191-194]. Such a scheme conventionally conveys the symmetry of the park’s layout, and the multi-part nature (the parts are “strung” on the main axis) indicates the scale of the park, which served as a prototype for carpet weavers. In the organization of their internal space, canonically established techniques and symbols conventionally designate a tree, a bush, flowers, a body of water, and even fish swimming in them

References

1. Raiha Amenzade. Compositional patterns of monumental structures of Azerbaijan centuries. XI-XVII centuries. Baku, 2007

2. Salamzade A. V. Architecture of Azerbaijan XVI-XIX centuries. Baku, 1964

3. The 5-th International Symposium on Azerbaijani Carpets . Baku, 2017

DOI 10.34660/INF.2023.45.47.291
UDC 612.084

改进的阶梯测试法评价秋明市大学生体力劳动能力水平
ASSESSMENT OF THE LEVEL OF PHYSICAL WORKING CAPACITY OF UNIVERSITY MALE STUDENTS IN TYUMEN BY A MODIFIED STEP TEST

Prokopyev Nikolai Yakovlevich
Doctor of Medical sciences, Full Professor
Tyumen State University, Tyumen, Russia

Ananiev Vladimir Nikolaevich
Doctor of Medical Sciences, Full Professor
SSC Institute of Biomedical Problems of the Russian Academy of Sciences, Moscow, Russia

Semizorov Evgeniy Alekseevich
Candidate of Pedagogical Sciences, Associate Professor, Master of sports in kettlebell lifting
Northerm Trans-Ural State Agricultural university, Tyumen, Russia

Gurtovoy Elisey Sergeevich
Student
Tyumen State Medical University, Tyumen, Russia

注解。 在现代体育实践中，PWC V.L. 卡普曼台阶测试在我国广泛用于确定体力劳动能力，根据年龄，包括不同高度和强度的攀爬台阶，并允许其在各种条件下使用。 完成两次负载中的第一个负载（每次持续 5 分钟）后，坐在台阶上休息 3 分钟，期间休息 10 秒。 仅进行心率（HR，心跳/分钟）的计算，未进行中枢血流动力学功能状态的其他研究。 第二次负荷后，仅评估运动员的心率。

我们提出的台阶测试修改的本质在于，在休息时，坐在台阶上进行两次相同的身体活动后，不仅通过心率研究，还通过研究收缩压（SBP）来监测运动员的中枢血流动力学。 ，mmHg）和舒张压（DBP，mmHg）。

关键词：学生、体力工作能力、台阶测试、中心血流动力学、A.A. 优势 乌赫托姆斯基。

Annotation. *In modern sports practice, the PWC V.L. Karpman step test is widely used in our country to determine physical working capacity, depending on age, consisting in climbing steps of various heights and intensity and allowing it to be used in a variety of conditions. After performing the first of two loads with a duration of 5 minutes each, a 3-minute rest is provided, sitting on a step,*

during which for 10 sec. only the calculation of the heart rate (HR, beats / min) is carried out and no other studies of the functional state of central hemodynamics are carried out. Immediately after the second load, only the athlete's heart rate is evaluated.

The essence of our proposed modification of the step test lies in the fact that after performing two identical physical activities while resting, sitting on a step, the athlete is monitored for central hemodynamics not only with the study of heart rate, but also systolic (SBP, mmHg) and diastolic (DBP, mmHg) blood pressure.

Keywords: *students, physical working capacity, step test, central hemodynamics, dominance of A.A. Ukhtomsky.*

Introduction. Achieving high sports results is unthinkable without careful implementation of medical control of the FWC during the training and competitive process [9, 13, 14]. Without competent medical control of the training process, especially in young athletes, it is possible to form chronic fatigue and even "overwork", the appearance of various pathological conditions associated with excessive non-dosed physical exertion [2]. In this regard, it is relevant to be able not only to promptly, but also to objectively obtain information about the level of functional state and FWC of both those engaged in physical education and athletes. [3, 4, 8, 10, 12], and then, based on reliable data, predict and adjust the training process. The above is especially important with an additional increase in the level of motor activity that took place, for example, in physical education classes at school or at a university [5].

It is known that FWC represents the potential ability of a person to exert maximum physical effort in static, dynamic or mixed work [6, 7]. Naturally, any of the tests used to evaluate the PWC has its advantages and disadvantages, which should be taken into account when examining sportsmen and athletes [1].

Objective: to assess the functional state of the central hemodynamics of the athlete and the sportsman both during a 3-minute rest after the first metered load, and after the end of step testing.

Material and methods. 36 young men of Tyumen universities aged 18.47±0.93 years (the main group – MG) with sports qualifications of the first sports category (21), candidate for master of Sports (9) and Master of Sports of the Russian Federation (6), specializing in cross-country skiing, biathlon, martial arts, kettlebell lifting and athletics were examined by random sampling (fig. 1).

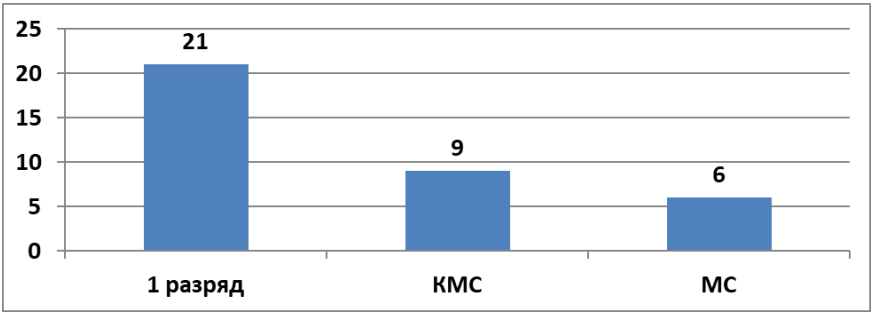


Figure 1. *The numerical composition of youth students with sports qualifications.*

The control group (CG) consisted of 22 young men 18.62±0.86 years old from Tyumen universities who are not involved in sports. The evaluation of the FWC was carried out according to the step test of V.L. Karpman.

It should be noted that for the first time in the practice of physical culture, during the 3-minute rest period after the first metered physical activity and immediately after the second load, during the first and last 10 seconds of each minute, heart rate was calculated, and in the interval between them, blood pressure was measured according to the standard non-invasive method of N.S. Korotkov. We emphasize that all the young men have never complained about the state of health and during an in-depth medical examination were assigned to the first health group.

The studies met the ethical standards of the Biomedical Ethics Committees, developed in accordance with the Helsinki Declaration adopted by the WMA, as well as the Order of the Ministry of Health of the Russian Federation No. 226 of 19.06.2003 “Rules of Clinical Practice in the Russian Federation”. The principles of voluntariness, individual rights and freedoms guaranteed by Articles 21.2 and 22.1 of the Constitution of the Russian Federation have been observed. The study was carried out with the oral consent of each student.

Results and discussion. When assessing the central hemodynamics in young men, it was found that after climbing the first step with a height of 25 cm with a frequency of ascents 20 times per minute in 29 young men, the heart rate did not exceed 100% of the initial level, while 7 had a hypertensive type of reaction to physical exertion (Fig. 2).

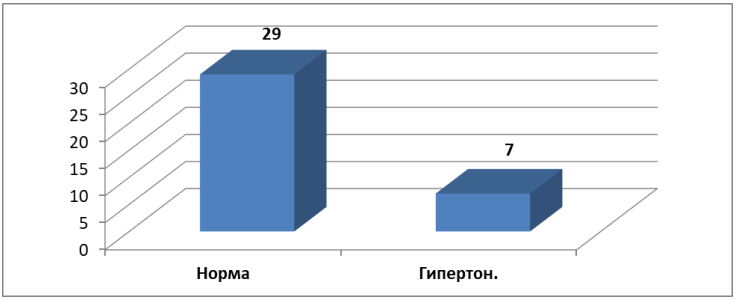


Figure 2. *Heart rate in young men of the main group.*

It should be especially noted that during a 3-minute rest sitting on a step in young men we revealed rhythmic work of the heart, when the range of heart rate fluctuations varied within 5-7 beats. When studying SBP in 6 young men, its increase was revealed by more than 35 mmHg in relation to the baseline level, which was also regarded by us as a hypertonic type of *cardiovascular system* reaction to physical exertion.

DBP behaved in two ways: in 32 boys it retained the initial values before the load, and in 4 it decreased by 4-8 mmHg.

The study of central hemodynamics for 10 minutes after the second exercise indicated that for 5-8 minutes there was a violation of the heart rhythm, which normalized only by 10 minutes of rest. As for the SBP, we noted its normalization, i.e. restoration to the original value, only at 7 minutes after the load.

In 13 boys of the control group after the first dosed physical activity, the heart rate did not exceed 100% of the baseline level, in 5 the hypertensive type of *cardiovascular system* reaction was detected, and in 4 the hypotonic type (Fig. 3).

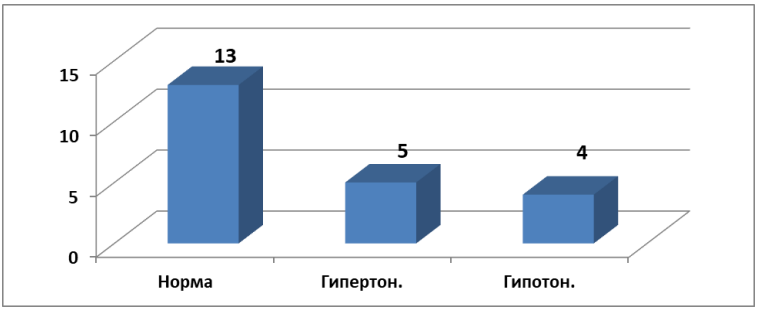


Figure 3. *Systolic blood pressure in young men of the control group.*

Discussion. The unstable state of central hemodynamics is regarded by us as, firstly, a manifestation of hormonal restructuring in accordance with the transition-

al period of human ontogenesis from the period of adolescence to the period of the first mature age. Secondly, we assumed that from a physiological point of view, physical exertion, especially during overtraining, in accordance with the doctrine of the dominant of academician A.A. Ukhtomsky, does not give a rigid interaction of the respiratory and *cardiovascular system*, i.e. their kind of "coupling" during rest, which most likely leads to a decrease in the tone of the nervous system. These changes, in our opinion, are associated with fatigue of the nerve centers that regulate the activity of the *cardiovascular system* and the work of muscles. We believe that during physical exertion, the functional circulatory system and muscle regulation, as the dominant systems, are informationally actively interconnected. But with fatigue of the nerve centers (for example, during overtraining), the regulatory role of the dominant of achieving the goal according to the physiological teaching of academician A.A. Ukhtomsky [11] (muscle load) is weakened, therefore, we believe, the circulatory system tends to get out of subordination of the dominant of the goal of muscle work. We believe that sportsmen, even with initial signs of overtraining or under significant stress, which is especially pronounced after 2 loads for 10-35 minutes, have wave-like fluctuations in pulse and blood pressure.

Thirdly, we assumed that the young men had hidden overtraining during testing, manifested by high heart rate and increased SBP. Thus, when assessing the FWC on the step test, an analysis of central hemodynamics should be carried out during the rest period sitting on the step both after the first physical activity and after the end of the test.

Conflict of interest. The authors declare that there is no conflict of interest.

Transparency of the study. The study had no sponsorship. The authors are fully responsible for submitting the final version of the manuscript to the press.

Declaration of financial and other relationships. All authors participated in the development of the topic, the design of the study and the writing of the manuscript. The final version of the manuscript was agreed and approved by all the authors. The authors did not receive a research fee.

References

1. Andrianova E.Yu. Advantages and disadvantages of tests to assess the level of general physical working capacity of athletes and persons engaged in physical culture / E.Yu. Andrianova // Science and sport: modern trends. – 2022. – Part 10, No. 3. – pp. 6-13. DOI: 10.36028/2308-8826-2022-10-3-6-13

2. Balberova O.V. Model characteristics of training and competitive activity of cyclical sports athletes with different specifics of the training process (review) / O.V. Balberova, E.V. Bykov //Scientific and Sports Bulletin of the Urals and Siberia. – 2022. – № 1 (33). – Pp. 3-13.

3. Non-loading assessment of physical working capacity // S.A. Zavarukhina, E.V. Zvyagina //Scientific notes of the P.F. Lesgaft University. – 2023. – № 1 (215). – Pp. 164-169.

4. Ibragimov I.F. Physical culture as a regulator of students' working capacity / I.F. Ibragimov, S.A. Semenova //Trends in the development of science and education. - 2023. – No. 93-1. – pp. 116-119.

5. Changing the physical performance of university students taking into account the implementation of the program of additional motor activity / I.Sh. Mutaeva, Z.M. Kuznetsova, L.F. Ismagilova, G.Z. Khalikov //Man. Sport. Medicine. – 2023. – Part 23. – No. 1. – pp. 87-95.

6. Karpman V.L. Investigation of physical working capacity in athletes / V.L. Karpman, Z.B. Belotserkovsky, M.A. Gudkov. – M.: Physical culture and sport. – 1974. – pp. 23-34.

7. Karpman V.L. Testing in sports medicine / V.L. Karpman, Z.B. Belotserkovsky, I.A. Gudkov – M.: Physical culture and sport. 1988. – 206 p.

8. Krikunov G.A. Physical performance and the influence of physical culture on its increase / G.A. Krikunov //Innovation. The science. Education. - 2021. – No. 28. – pp. 747-751.

9. Levshin I.V., Medical and biological support of the training process in sports / I.V. Levshin, V.S. Cherny //Actual problems of physical and special training of power structures. – 2023. – No. 1. – pp. 225-229.

10. Mezhman I.F. The role of monitoring the physical working capacity of students in physical culture classes / I.F. Mezhman, Yu.A. Gordeev, A.A. Gordeev //Successes of the humanities. – 2021. – No. 2. – pp. 24-27.

11. Ukhtomsky A.A. Dominant. Articles of different years. 1887-1939. / A.A. Ukhtomsky – St. Petersburg.: Piter. – 2002. – 448 p.

12. Physical performance of children of primary school age / S.P. Levushkin, A.I. Laptev, O.F. Zhukov, V.D. Sonkin //Theory and practice of physical culture. – 2023. – No. 4. – pp. 64-66.

13. Physical performance of students in the conditions of a mixed format of training in the discipline "Physical culture and sport" / Zh.B. Safonova, T.V. Koltoshova, I.N. Sheveleva, O.A. Melnikova // Theory and practice of physical culture. – 2022. – No. 6. – pp. 106-108.

14. Physical working capacity of youth students of specialized universities of Tyumen at the initial stage of training / E.A. Semizorov, N.Ya. Prokopyev, D.G. Gubin, D.S. Rechapov, S.A. Utusikov //Scientific notes of the P.F. Lesgaft University. – 2020. – № 2 (180). – Pp. 339-344.

DOI 10.34660/INF.2023.87.98.292

氨基酸合成的生物物理学
BIOPHYSICS OF AMINO ACID SYNTHESIS

Makarov Leonid Mikhailovich
Candidate of Technical Sciences, Professor
St. Petersburg State University of Telecommunications named after Prof. M. A. Bonch-Bruevich

Pozdnyakov Alexander Vladimirovich
Doctor of Medical Sciences, Professor
St. Petersburg State Pediatric Medical University

Ivanov Dmitry Olegovich
Doctor of Medical Sciences, Professor
St. Petersburg State Pediatric Medical University

抽象的。 首次确定了参与所有生物体生物结构合成的主要氨基酸的自然形成原理。 创造 20 种基本氨基酸的自然过程的数学形式已经建立。 确定了参与细胞结构合成的非必需氨基酸的合成原则和形式规则，这些细胞结构决定了生命过程表现的功能特征。

获得的结果计划用于创建新的剂型，以及制定在整个生命过程中保护具有战略意义的身体功能系统的建议。

关键词：氨基酸、化学元素原子簇、模型。

Abstract. *For the first time, the principles of natural formation of the main amino acids involved in the synthesis of biological structures of all living organisms have been determined. The mathematical formalism of the Natural process of creating the basic 20 amino acids has been established. The principles and formal rules for the synthesis of non-essential amino acids involved in the synthesis of cellular structures that determine the functional features of the manifestation of vital processes are determined.*

The obtained results are planned to be used in the creation of new dosage forms, as well as in the development of recommendations for the preservation of strategically important functional systems of the body throughout life.

Keywords: *amino acid, cluster of atoms of chemical elements, model.*

All living organisms on planet Earth have a set of unique principles for the synthesis of cellular structures. The creation of living cellular formations is car-

ried out using amino acids (AA) based on amine and carboxyl groups. The natural origin of AA, as the primary component of living matter, has been discussed for a long time. Currently, two thematic lines are distinguished: the random process of formation of the AA complex and the emergent process [1], which has functionality over the chemical set of AA elements.

It should be recognized that the unifying basis of these theories is the idea of the chaotic distribution of a certain limited set of chemical atoms in Natural space. Relatively simple studies of this thesis in 1953 were carried out on a series of full-scale experiments by Stanley Muller, in which the fact of the possibility of spontaneous formation of a set of ACs in a laboratory installation simulating the Earth's atmosphere was established [2]. The presence of a positive result of the experiment is currently complemented by astronomical observations and real data obtained from the study of meteorites falling to the Earth.

In the general formulation of the problem, two questions about the origin of AK stand out. In the first case, an exogenous version is distinguished, according to which AKs were synthesized outside the Earth and delivered to the surface of the planet by dispersed dust of various chemical elements. In the second case, the endogenous version is considered, which allows for the possibility of reproducing the synthesis of AA under the conditions of the earth's atmosphere.

To solve this problem, we will use mathematical modeling methods in terms and concepts of matrix analysis.

Modern biophysics declares the presence of certain properties of AKs, distinguishing two groups. One group of AA is constantly synthesized in a living organism, and the other group enters the food chain from the environment. There is a group of irreplaceable AKs, the number of which is (10) and replaceable AKs, the number of which is (10). Two groups of AKs ensure normal functioning of the body. In both cases, the formation of AA occurs using biosynthesis processes.

Currently, about 500 naturally occurring AKs are known. [3] Amino acids can be considered as derivatives of carboxylic acids in which one or more hydrogen atoms are replaced by amino groups.

The biophysics of the biosynthesis of AAs necessary for the human body is characterized by a complex set of processes in which several atoms of chemical elements are present: hydrogen, oxygen, carbon, nitrogen and sulfur. The modern canonical list of AK is represented by 20 items.

While maintaining the generality of judgments about the structure of AA, which contains two functional groups: amine and carboxyl. Next, we consider a mathematical model of the AC structure, in which we distinguish two clusters. Let us assume that the first cluster is represented by the single element hydrogen (Q1), and the other cluster (Q2) contains the chemical elements oxygen, carbon, nitrogen and sulfur in different proportions. In this case, this condition defines the

basic structural concept of AK as a matrix structure. Variations of elements in any of the clusters generate the AC variety.

Let us introduce into consideration the identifiers μ(Q1) and μ(Q2) of clusters, which can be considered as the coordinates of the position of a mathematical object in phase space at the moment of observation time (t0). In this case, the materialistic idea of the object allows us to consider the processes of evolutionary development of the synthesis of AK. Then we note that, provided that the structural elements of the selected clusters are compact, the phase trajectory S1(μ1, μ2) deterministically characterizes the evolution of the object both in the past (t< t0) and in the future (t> t0).

Obviously, this judgment is correct, since if we set other initial conditions for the moment of time (t1=t0+1) for clusters (Q1) and (Q2), we will obtain new values of the identifiers μ3(Q1) and μ4(Q2). And therefore, the phase trajectory S2 (μ1, μ2) will be different. Formally, this means: S1(μ1, μ2) ≠ S2 (μ1, μ2).

In terms and concepts of the model under consideration, we state:

• an arbitrarily selected group of organic objects can be positioned in clusters of chemical elements;

• the uniqueness of the cluster is created by different ratios of chemical elements;

• structural differences of clusters in a group are characterized by the "remoteness" indicator (U), for example, in the Cartesian coordinate system.

The introduced concepts declare the presence of a formal rule: any structure of the main ACs has minimum values of the cluster elements, and they are equal.

Let's carry out mathematical modeling of the structures of some AKs. Let us consider the hypothesis about the uniqueness of the structure of AK, for which there is a unique identifier U. The hypothesis under consideration is based on the thesis about the "compactness" of the structure of a chemical formation created on the basis of only a few atoms of chemical elements. Biological thermodynamics, operating with the concept of "compactness," declares the condition for the formation of the chemical structure of elements with minimal energy consumption. At the same time, in terms of computational topology, which operates with procedures for formally constructing an image of events on a group of elements, the possibility of discovering the conditions for creating a single, unique matrix image is declared.

Expanding this representation, we introduce into consideration a matrix characterizing a set of chemical elements, for example, those forming AA. In such a set we will fix several indicators: the mass of each chemical element, the number of neutrons and protons. Then, taking into account the basic definitions of matrix analysis, we declare the possibility of detecting a matrix structure that has minimal values of elements and, at the same time, has equal indicators for all elements.

Let's consider AK - sirin (a group of interchangeable AKs) with various finishing elements.

Table 1.

Variable indicators of the Sirin cluster

Amino acid	Formula	Cluster		Indicator U
Sirin	C3H7O3N	Finishing element - Nitrogen		405.879
		287	287	
		-287	-287	
Sirin	C3H7O3F	Finishing element - Fluorine		430.656
		308	301	
		-301	-308	
Sirin	C3H7O3Si	Finishing element - Silicon		475.176
		336	336	
		-336	-336	

By analogy, consider AK - valine (a group of non-replaceable AKs) with various finishing elements.

Table 2.

Variable indicators of the valine cluster

Amino acid	Formula	Cluster		Indicator U
Valine	C3H7O3N	Finishing element - Nitrogen		824.487
		583	583	
		-583	-583	
Valine	C3H7O3F	Finishing element - Fluorine		863.412
		616	605	
		-605	-616	
Valine	C3H7O3Si	Finishing element - Silicon		933.381
		660	660	
		-660	-660	

A comparison of the calculated indicators of different ACs allows us to state: the indicators of different ACs found in cluster models are unique. In Nature, there is an explicit formalism for the process of synthesizing AKs from a chaotic set of atoms of chemical elements; AKs of different structures are synthesized.

Essentially, the obtained result of the model reproduction of the essential indicators of any AK creates good and reliable prerequisites for the development of therapeutic agents aimed at supporting homeostasis and good functional state of the human body for a long period, regardless of the current age.

The pharmacological line of this direction is well known in medical practice [4], but required updating of work in the field of mathematical biophysics, which makes it possible to create technologies for the synthesis of AKs with the necessary properties.

Expansion of the list of AKs with specified therapeutic effects is based on existing experience, although obtained over a long period of clinical trials with an element of heuristic judgments. The general principle of the work processes of non-standard AKs is manifested in the possibility of participation not only in all stages of cellular synthesis, but also in the further transformation of the cellular pool. One of the typical representatives of this group of AAs is selenocysteine and pyrrolysine, which are included in proteins when the stop codon is read by specialized tRNAs. [5].

Selenocysteine (C3H7NO2Se - Sec) is structurally similar to cysteine (C3H7O2NS). The structure of selenocysteine contains selenium instead of sulfur. Sec is found in different organisms: from bacteria to humans. The typical location of Sec is in the active center of the protein, but it reaches this location invariably at the end of cellular synthesis. This unique property is useful in the treatment of certain disorders of the body. For example, selenoproteins are involved in restoring the acid-base balance of the cell, saving it from death due to overoxidation. Another example is the participation of Sec in the normalization of the working processes of the thyroid gland.

Table 3.

Variable indicators of the selenocysteine cluster

Amino acid	**Formula**	**Cluster**		**Indicator U**
Selenocysteine	C3H7NO2Se	Finishing element - Selenium		798.767
		602	525	
		-525	-602	
Selenocysteine	C3H7NO2F	Finishing element - Fluorine		499.949
		357	350	
		-350	-357	
Selenocysteine	C3H7NO2Si	Finishing element - Silicon		544.472
		385	385	
		-385	-385	

Despite the obvious differences in the results of the structural analysis of sirine, valine and selenocysteine presented in Table. 1, table. 2 and table. 3, selenium-forming compounds have a significant impact on the functional development of the human body [3].

As a note, it should be noted that the discovered effect for selenocysteine was discussed in clinical practice for a long time, since it had the ability to manifest itself after some time. In the presented material of the article, this effect is well predicted and allows planning the therapeutic process.

Another difference between selenocysteine and standard amino acids is that it does not exist in a free form inside the cell, since its high reactivity can harm the cell. This fact is clearly evident in the calculated U value. Instead, the cell stores selenium in the form of the less active selenide H2Se for which U = 112.8.

Selenocysteine is an essential component in the biosynthesis of many proteins. The non-replaceable microelement Se plays a huge role in human life. Selenium enters the body with food, both plant and animal origin. Selenocysteine is a structural and functional analogue of cysteine, in which the sulfur atom is replaced by a selenium atom. Selenocysteine is the 21st proteinogenic amino acid and is encoded by the UGA codon, which is usually a stop signal to stop protein synthesis.

Another accompanying AK, pyrrolysine, is not synthesized at the cellular level, but is borrowed from the intestinal bacteria Bilophila wadsworthia, which form a symbiosis of biochemical reactions. Modern research convincingly proves that in Nature there are hundreds of non-protein-forming amino acids that can penetrate the body, imitate native amino acids and be incorporated into proteins. This technology for changing the functional state of the body can be used purposefully as a therapeutic procedure. It should be noted that the implementation of such a process is possible only if there are mathematical models that have the property of adequately describing the observed processes in a living organism.

For example, the presented material on the subject of AKs made it possible not only to establish the uniqueness of each AK in a known set of 20 pieces, but also to create new technologies for solving problems known in medical practice. By designing new atypical AKs, it is possible to achieve better results in practical medicine, naturally in a shorter time.

For example, the amino acid azetidine-2-carboxylic acid (Aze) is found in sugar beets (Beta vulgaris), lilies of the valley (Convallaria Majali's) and is a structural analogue of the protein-encoded amino acid proline (Pro). Naturally, such an AK can enter the body, triggering a long chain of events, including changing the myelin protein surrounding the processes of nerve cells. This process can cause neurodegenerative disorders: destruction of the myelin layer, and therefore a decrease in the speed of transmission of nerve impulses. In this case, individual fragments of the neural network change, the coordination of neural flows is disrupted, which clearly demonstrates a disorder that is correlated with either depression or multiple sclerosis [6]. Along with these manifested disturbances of neural activity, they affect the work processes of numerous functional subsystems of the body.

The formal methods for constructing logically related judgments highlighted in the materials of the work indicate the complexity of the Natural rules of formation of all components of a biological system, which are possible to isolate and analyze in several fields of concepts of different scientific disciplines.

Modern technologies for the synthesis of pharmacological agents are purposefully moving toward creating models for manipulating proteins by launching AKs of the required action profile into the human body. This approach opens up broad opportunities for supporting the homeostasis of the formation of conditions for the renewal of cellular formations adequate to the external environment.

The presented materials in the article demonstrate the possibility of implementing such an approach in medical practice. Indeed, using known basic AAs as a basis, it is possible to reproduce a large number of atypical AAs, the effect of which on the body can be established in advance using computer modeling. By establishing new promising directions for the manifestation of the chemical properties of atypical AAs, it seems possible to solve complex practical problems in supporting the normal functional activity of the body.

Literature

1. Makarov L. M. Formalism for calculating the assessment of emergence Science, technology and education. 2020. No. 1 (65). pp. 5-8. DOI: 10.24411/2312-8267-2020-10101

2. Miller, SL. (1953). "Production of amino acids under possible primitive terrestrial conditions." The science. 117(3046):528–529. Bibcode:1953Sci...117..528M. DOI:10.1126/science.117.3046.528. PMID 13056598. S2CID 38897285.

3. Dimas A M Which amino acids should be used in prebiotic chemistry studies PMID: 18925425 DOI: 10.1007/s11084-008-9150-5

4. Celia Maria Curieses Andres The influence of active forms on amino acids - biological significance for proteins and induced pathologies PMID: 36430532 PMCID: PMC9692786 DOI: 10.3390/ijms232214049

5. Rajavel Elango Tolerable upper intake levels of selected amino acids in humans: a narrative review of recent clinical studies PMID: 37062432 PMCID: PMC10334138 DOI: 10.1016/j.advnut.2023.04.004

6. Makarov L.M., Pozdnyakov A.V. EMERGENCE OF A CLUSTER OF MULTIPLE SCLE-ROSIS PARAMETERS SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION. Proceedings of the International Conference. Beijing, 2023. pp. 98-103. DOI 10.34660/INF.2023.98.79.118

DOI 10.34660/INF.2023.39.64.293

老年患者慢性肾脏病与阻塞性睡眠呼吸暂停综合征的关系
ASSOCIATION OF CHRONIC KIDNEY DISEASE AND OBSTRUCTIVE SLEEP APNEA SYNDROME IN ELDERLY PATIENTS

Inshakova Kristina Yurievna
Postgraduate
Research University "Belgorod State University", Belgorod, Russia
Doctor
City Clinic No. 18, Voronezh, Russia

Khachaturov Arthur Nikolaevich
Postgraduate
Research University "Belgorod State University", Belgorod, Russia
City Clinic No. 18, Voronezh, Russia

Gosteva Elena Vladimirovna
Doctor of Medical Sciences, Associate Professor, Full Professor
Voronezh State Medical University named after N.N. Burdenko, Voronezh, Russia
Full Professor
Research University "Belgorod State University", Belgorod, Russia

抽象的。 老年患者的特点是存在共病，特别是慢性肾病（CKD）和阻塞性睡眠呼吸暂停综合征（OSAS）。 本研究的目的是探讨一组老年患者中 OSAS 与 CKD 早期阶段的关系。 共检查患者186例，平均年龄68.5±3.2岁。 老年患者OSAS患病率为54.8%，其中54.9%合并有CKD。 患有 OSAS 和 CKD 的患者比没有 CKD 的患者有更高的呼吸暂停/呼吸不足指数 （p=0.046）。 人体测量结果显示，OSAS 患者的体重指数（Δ19.8%，p<0.01）和腰围（Δ10.9%，p<0.05）高于非 OSAS 患者。 在分析代谢特征时，发现患有 OSAS 和 CKD 合并症的患者的血脂（总胆固醇 （p<0.05）、LDL 胆固醇 （p<0.01）、甘油三酯 （p<0.01） 和碳水化合物）的紊乱更为明显。 概况 （p<0.01） 和炎症小体 （NLR、PLR、SII）。结论：OSAS 在老年患者中非常普遍。患有 OSAS 的老年患者有较高的 CKD 患病率。在我们的分析中，较高的 AHI 是导致 OSAS 患病率的一个因素 CKD 由于 OSAS 和 CKD 合并症，患者的脂质和碳水化合物代谢紊乱以及炎症更加明显。

关键词：慢性肾脏病，阻塞性睡眠呼吸暂停综合征。

Abstract. *Elderly patients are characterized by the presence of comorbid pathology, in particular chronic kidney disease (CKD) and obstructive sleep apnea syndrome (OSAS). The purpose of this study was to examine the relationship between OSAS and early stages of CKD in a group of elderly patients. 186 patients were examined, the average age of which was 68.5±3.2 years. The prevalence of OSAS in elderly patients was 54.8%, of which 54.9% had comorbidity with CKD. Patients with OSAS and CKD had a higher apnea/hypopnea index than those without CKD (p=0.046). Anthropometric measurements revealed that patients with OSAS had a higher body mass index (Δ19.8%, p<0.01) and waist circumference (Δ10.9%, p<0.05) than patients without OSAS. When analyzing the metabolic profile, it was found that patients with comorbidity of OSAS and CKD had more pronounced disorders of both lipid (total cholesterol (p<0.05), LDL cholesterol (p<0.01), triglycerides (p<0.01), and carbohydrate profile (p<0.01) and inflammasome (NLR, PLR, SII). Conclusions: OSAS is highly prevalent in elderly patients. Elderly patients with OSAS have a higher prevalence of CKD. In our analysis, higher AHI was a factor in the prevalence of CKD With comorbidity of OSAS and CKD, patients have more pronounced disorders of lipid and carbohydrate metabolism and inflammation.*

Keywords: *chronic kidney disease, obstructive sleep apnea syndrome.*

The growing number of older people today is one of the most important demographic problems throughout the world. Chronic kidney disease (CKD), including the initial stages, is increasingly common among the elderly, as evidenced by the results of large-scale epidemiological studies [1]. Elderly patients are characterized by the presence of comorbid pathology, in which different diseases can have a single pathogenetic mechanism of development and form a vicious circle [2]. Chronic kidney disease (CKD) is structural kidney damage that is characterized by a decrease in estimated glomerular filtration rate (GFR) and the presence of biomarkers of damage (urine albumin and serum creatinine) for three months or more. The generally accepted leading risk factors for CKD are type 2 diabetes mellitus and arterial hypertension, while at the same time, atherosclerosis and obesity play an important role, the prevalence of which has increased sharply in recent decades [3,4].

The most common form of sleep apnea is obstructive sleep apnea syndrome OSA, accounting for ≥90% of all cases [5].

Among the pathogenetic mechanisms associated with both CKD and obstructive sleep apnea syndrome (OSAS) one can highlight inflammasome, activation of the renin-angiotensin-aldosterone system (RAAS), and endothelial dysfunction [6].

Modern studies have shown that sleep apnea is observed in patients at various stages of CKD, the prevalence of OSAS increases as the stage of CKD increases. However, there is an underestimation of the prevalence of OSAS [7].

Despite the increasing incidence of CKD, to date there have been few studies on the relationship between the early stages of CKD and OSAS in older people.

The purpose of this study was to examine the relationship between OSAS and early stages of CKD in a group of elderly patients.

Methods and results. 186 elderly patients (60-74 years) were examined, the average age was 68.5±3.2 years. Of these, 123 are men, 64 are women. The initial clinical data, echocardiography, ultrasound examination of the kidneys, determination of the estimated glomerular filtration rate, Holter ECG monitoring with determination of the apnea-hypopnea index (AHI) were assessed.

The criteria for inclusion in the study were old age (60-74 years) and the presence of CKD no higher than C3A, A2.

For all examined patients, we assessed the presence and severity of CKD risk factors, including arterial hypertension, diabetes mellitus, atherosclerotic vascular disease, hyperlipidemia, musculoskeletal and connective tissue diseases, gout and obesity.

Statistical processing was carried out using the STATISTICA 10.0 program. Quantitative variables are presented as Me - median, Q25% - 25th percentile, Q75% - 75th percentile (Me; Q25%, Q75%), continuous - as M±SD, where M is the mean, SD - standard deviation . Qualitative variables are presented as frequencies (%). Differences were considered statistically significant at $p<0.05$.

During the examination, OSA was detected in 54.8% (102 people), CKD C3A, A2 – in 48.4% (90 people). Of the 102 patients with OSA, the presence of CKD was established in 56 people. (54.9%), without CKD – 46 people. (45.1%). In patients without OSAS (84 people), CKD was diagnosed in 34 people. (40.5%), without CKD – 50 people. (60.5%). In the group of patients with CKD, the incidence of OSAS was 70 people. (77.8%), OSAS was not detected in 20 people. (22.2%), while out of 96 patients from the group without CKD, the presence of OSAS was established in 32 people. (33.3%), without OSA in 64 people. (66.7%). When assessing the severity of OSAS, it was revealed that patients with CKD had a higher apnea/hypopnea index (12.3±2.1) than those without CKD (7.2±1.4) ($p=0.046$).

Using anthropometric measurements, we found that patients (102 people) with OSAS had a higher body mass index of 33.9 (30.2; 36.1) kg/m2 and waist circumference of 115.9 (102.7; 121.8)) cm than patients without OSAS - BMI was 27.2 (24.4; 33.8) kg/m2 (Δ19.8%, $p <0.01$), waist circumference 103.3 (85.4; 112, 6) (Δ10.9%, $p<0.05$). Patients with comorbidity of OSAS and CKD were relatively older (69±3 years) than with OSAS without CKD (64±2 years) ($p<0.05$).

When analyzing the metabolic profile, it was found that patients with comorbidity of OSAS and CKD had more severe disorders (total cholesterol 6.8 (5.7; 7.5) mmol/l, LDL cholesterol 3.4 (3.0; 4.1) mmol/l, triglycerides 3.3 (2.6; 3.5) mmol/l, HOMA-IR index - 5.42 (4.22; 6.55)) compared to patients with CKD but without OSAS (total cholesterol 6.0 (5.2, 7.4) mmol/l (Δ11.8%, $p<0.05$), LDL cholesterol 2.6 (2.1, 3.8) mmol/l (Δ23, 5%, $p<0.01$), triglycerides 2.5 (2.2, 3.5) mmol/l (Δ24.2%, $p<0.01$), HOMA-IR index - 4.25 (3. 86; 6.28) (Δ21.6%, $p<0.01$)).

We studied the state of inflammation in elderly patients depending on the comorbidity of OSA and CKD (Table 1). Neutrophil to lymphocyte ratio (NLR) and platelet to lymphocyte ratio (PLR) are currently considered as markers of inflammation, but the relationship between NLR in elderly patients depending on OSAS and comorbidity with CKD has not been studied.

Table 1

Indicators of flaming in elderly patients depending on the comorbidity of OSAS and CKD

Indicator, unit of measurement	**OSAS (+) (n=102 per.)**		**OSAS (-) (n=34 per.)**
	CKD (+) (n=56)	**CKD (-) (n=46)**	**CKD (+)**
	1	2	3
IL-1β, pg/ml	34,6 **# (22,5; 43,4)	24,6 (20,1; 32,2)	29,2 (22,5; 35,3)
NLR	3,8**# (2,8, 5,1)	2,9 (1,9, 3,8)	3,2 (2,2, 4,9)
PLR	157,3** # (130,2, 195,8)	126,7 (115,3, 169,2)	145,1 (115,3, 195,8)
SII	881,1**# (608,4, 1306,2)	671,3 (382,7, 1033,7)	797,5 (402,4, 1284,2)

Note: **$p<0.01$ between group 1 and 2; # $p<0.05$ - between groups 1 and 3; NLR – neutrophil/lymphocyte ratio; PLR - platelets/lymphocytes, SII - ratio of platelets × neutrophils/lymphocytes

It was found that the most pronounced flaming was observed in patients with comorbidity of OSAS and CKD

Conclusions. OSAS is widespread in elderly patients. Older patients with OSAS have a higher prevalence of CKD. In our analysis, higher AHI was a factor in the prevalence of CKD. With comorbidity of OSAS and CKD, patients have more pronounced disorders of lipid and carbohydrate metabolism and inflammation.

References

1. Maw, T. T., Fried, L. Chronic kidney disease in the elderly. Clinics in geriatric medicine, 2013;29(3), 611–624. https://doi.org/10.1016/j.cger.2013.05.003

2. Murkamilov I.T. Chronic kidney disease in elderly and senile people: risk factors and opportunities for early diagnosis / General Medicine, 2019;4;108-114. doi:10.24411/2071-5315-2019-12164].

3. Evaluation of Renal Function in Alzheimer's Disease and Geriatric Patients: Results from a Turkish Two-center Study / Z. Erbayraktar, E. A. Turan, G. Yilmaz, et al. // Journal of medical biochemistry. – 2017. – V. 36, №1. – P. 54–61. doi: 10.1515/jomb-2016-0028.

4. Heaf J. Current trends in European renal epidemiology. Clin Kidney J. – 2017 – V.10, №2. – P.149-153. doi: 10.1093/ckj/sfw150.

5. Sleep apnea and the risk of chronic kidney disease: a nationwide population-based cohort study / Lee, Y. C., Hung, S. Y., Wang, H. K., et al. // Sleep, 2015;38(2), 213-221. https://doi.org/10.5665/sleep.4400

6. Bidirectional association between chronic kidney disease and sleep apnea: a systematic review and meta-analysis / Hansrivijit, P., Puthenpura, M. M., Ghahramani, N., et al. // International urology and nephrology, 2021; 53(6), 1209–1222. https://doi.org/10.1007/s11255-020-02699-1

7. Prevalence of sleep apnoea in non-dialysis chronic kidney disease patients: A systematic review and meta-analysis /Huang, Z., Tang, X., Zhang, T., et al. // Nephrology (Carlton, Vic.), 2019; 24(10), 1041–1049. https://doi.org/10.1111/nep.13546

DOI 10.34660/INF.2023.14.18.294

人工智能在乳腺癌诊断中的应用
USE OF ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS OF BREAST CANCER

Zakharova Polina Vitalievna
Research assistant
Patrice Lumumba Peoples' Friendship University of Russia, Moscow, Russia

Kosova Violetta Alexandrovna
Student
Patrice Lumumba Peoples' Friendship University of Russia, Moscow, Russia

Alieva Sema Ilgarovna
Student
Patrice Lumumba Peoples' Friendship University of Russia, Moscow, Russia

抽象的。 本文简要概述了人工智能的任务和方法，并对致力于人工智能在肿瘤疾病（特别是乳腺癌）诊断领域中的应用的工作进行了回顾。 为了降低死亡率和并发症，有必要及时进行筛查并改进疾病的诊断方法。 早期诊断并开始治疗尤为重要。 目标是研究和总结利用人工智能各种方法及时诊断乳腺癌的数据。对有关该主题的科学出版物进行了分析。 考虑了 Watson 超级计算机、Microsoft Healthcare NExT、放射组学流程、自动检测系统、乳房智能检测的方法。 使用人工智能作为筛查方法的前景，它可以更好地检测早期的形成，并实现这一过程的自动化，从而降低乳腺癌的死亡率。 研究人员将人工智能系统在乳腺癌筛查中的表现与 101 名放射科医生个人的表现进行比较，发现前者的表现优于 61% 的放射科医生。 目前，出现了人工智能的各种变体。 有必要指定方法并创建一个用于医生实践的单一程序。

关键词：人工智能、乳腺、筛查、癌症、乳房X光摄影、放射组学、诊断、自动检测系统、超声、分期。

Abstract. *The paper presents a brief overview of the tasks and methods of artificial intelligence, as well as a review of works devoted to its use in the field of diagnostics of oncological diseases, in particular, breast cancer. To reduce mortality and complications, it is necessary to conduct timely screening and improve methods of diagnosing the disease. It is especially important to diagnose*

and start treatment in the early stages. The goal is to study and summarize data on the use of various methods of artificial intelligence in the timely diagnosis of breast cancer. The analysis of scientific publications on this topic was carried out. The methods of Watson supercomputer, Microsoft Healthcare NExT, radiomics processes, automatic detection systems, Smart Detect for Breast are considered. The prospect of using artificial intelligence, as a screening method, it can allow for better detection of formations at an early stage, as well as lead to automation of this process, which entails a decrease in mortality from breast cancer. Comparing the performance of the artificial intelligence system in breast cancer screening with that of 101 individual radiologists, the researchers found that the former performed better than 61% of the radiologists. Currently, variations of artificial intelligence are presented. It is necessary to specify the methods and create a single program for use in the practice of a doctor.

Keywords: *artificial intelligence, breast, screening, cancer, mammography, radiomics, diagnostics, automatic detection system, ultrasound, stages.*

Introduction. Currently, breast cancer occupies a leading position in statistics according to the World Health Organization. In 2020, over 2.2 million cases of this disease were registered. It is also noted that approximately every twelfth woman will suffer from breast cancer during her life. Breast cancer is the leading cause of cancer death in women. In 2020, approximately 685,000 women died from this disease.

To reduce mortality and complications, it is necessary to conduct timely screening and improve methods of diagnosing the disease. It is especially important to diagnose and start treatment in the early stages. According to the data for 2021 in Russia, breast cancer is diagnosed at the insitu stage in only 0.2% of cases [1].

The need for early diagnosis also lies in the prevention and minimization of surgical intervention, which improves the quality of life of patients with breast cancer. Currently, for screening, the method of digital mammography is being widely introduced, which is performed for women aged 35 to 49 once every 1-2 years, for women over 50 every year. However, it should be noted that the mammography method has a variable sensitivity from 67.3% to 93.3% [2, 3].

Also, in the diagnosis, additional methods are used, such as ultrasound and MRI of the breast. The combined approach makes it possible to more accurately determine the nature and prevalence of education [4-6].

Today, thanks to the development of computer technology and the digitization of mammography images, it has become possible to use artificial intelligence in breast cancer screening. Thanks to artificial intelligence, the detection of formations in the early stages is increased. In developed countries, it is becoming increasingly important to study this area for diagnosis, including cancer [7-9].

The aim of the work is to study the possibilities of timely diagnosis in the case of breast cancer using artificial intelligence methods.

Patients and Methods. The analysis of scientific literature on the topic of the possibilities and advantages of artificial intelligence in the diagnosis of formations was carried out. A variation of methods has been studied. The methods of Watson supercomputer, Microsoft Healthcare NExT, radiomics processes, automatic detection systems, Smart Detect for Breast are considered.

Results. AI data was first published in the 1950s, and application spread in the 1990s. Currently, global companies are developing their projects.

IBM has developed research projects using the Watson supercomputer to diagnose and improve treatment regimens for various diseases, including cancer. Also, Microsoft announced the launch of the Microsoft Healthcare NExT project, aimed at combating cancer. Google is implementing a number of diagnostic projects: "smart lenses", which will include a chip that analyzes the state of the environment and the wearer's body and provides information about health threats.

In 2017, British scientists published a report entitled "Artificial Intelligence in the UK National Health System", in the United States in December 2017, a group of leading American technology scientists JASON published a report "Artificial Intelligence for Health and Healthcare". These papers discuss the use of AI to provide highly qualified medical care to the population [10, 11].

Artificial intelligence includes machine learning and deep learning. The data obtained by the neural network is based on the processes of radiomics. Radiomics is the extraction of quantitative properties, named features from an image. Stages of radiomics: acquisition and reconstruction of images, selection of a zone and determination of its features, creation of a database [12].

This feature extraction operation is usually implemented using object recognition algorithms and results in a set of numbers, each of which represents a quantitative description of a particular geometric or physical property of the part of the image in question.

For oncological formations, the signs are size, shape, intensity and texture, which together provide a complex characteristic of the pathology, called the radiomic signature of the tumor. There is also a hypothesis that the selected features reflect the mechanisms that occur at the genetic and molecular levels [13, 14].

The first step involves image acquisition and reconstruction with loading of radiological images. After image adjustment, the second stage includes segmentation and feature extraction. The data is then sorted and collected in a database before analysis. After the segmentation is completed, the selected areas are converted to three dimensions to obtain volumetric images.

Special software then extracts the quantitative characteristics from the received data to create a report that is synchronized with a database based on various sample values.

The second stage in the implementation of artificial intelligence is machine learning, which includes a deep learning method. Deep learning allows you to train a model to predict an outcome given a set of input data.

Various deep irradiation architectures have been published in the literature, but most of these networks are based on some basic and similar neural network building blocks called “layers”. The neural network consists of successive layers including an input layer (raw mammogram pixels), a hidden layer, and an output layer (prediction: benign/malignant) [15].

The earlier layers of deep irradiation act in a similar way to simple human brain cells that study low-level objects. Higher levels of abstraction are the result of layering multiple times. The information is propagated through the deep irradiation architecture and more complex features are extracted. These functions are then passed through the last layer of the network architecture for prediction and classification [16].

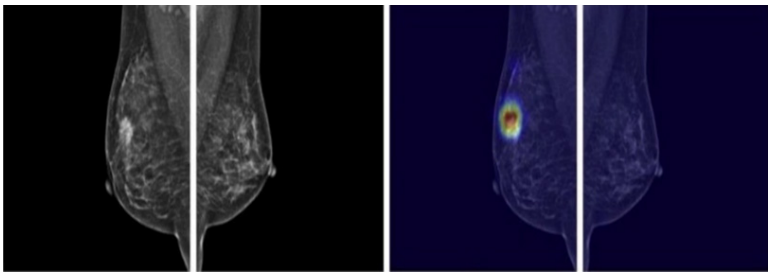
Automated detection systems can be used to provide second and follow-up opinions to radiologists for more accurate staging of breast cancer [17]. Ding et al proposed a new deep learning method for differentiating tumors into benign and malignant. The results of the experiment showed that the proposed method has an accuracy of 91%, high performance, and it can be useful for automatic irradiation systems in ultrasound examination of the mammary glands [18, 19].

Han et al used GoogLeNet to classify the breast image, with an accuracy of 90%. To train the deep neural network, the authors analyzed 4254 samples of benign tumors and 3154 samples of malignant tumors. The data obtained was sufficient to achieve acceptable performance.

Ultrasound manufacturers are introducing automated detection systems to assist clinicians. S-Detect Breast (Smart Detect for Breast) - a program for the automatic detection and analysis of breast formations in women, measurement and classification according to the BIRADS (Breast Imaging Reporting and Data System) system. The S-Detect™ technology showed agreement (91.2%) with the assessment of the breast radiologist in interpreting the nature of the formations in the mammary glands [20].

Discussion. Comparing the performance of the artificial intelligence system in breast cancer screening with that of 101 individual radiologists, the researchers found that the former performed better than 61% of the radiologists [21].

Kim et al used a dataset of over 4,000 cancer cases and nearly 25,000 normal cases, all without pixellevel annotations, to train, validate, and test deep learning of an ultraprecise neural network that could classify images as malignant or not, and generate heat maps highlighting the area that contributed the most to the final classification (Fig. 1) [22].



A *B*

Figure 1. *(A) Digital mammography of a 44-year-old woman with invasive ductal carcinoma in the right breast, with (B) an overlaid heat map highlighting the area that most strongly contributed to the final classification decision. Reprinted with permission from Kim et al. Applying Data-driven Imaging Biomarker in Mammography for Breast Cancer Screening: Preliminary Study. Sci Rep. 2018;8(1):1–8.*

Published in the journal Nature, the results of an international study led by a research team led by McKinney in the US and UK demonstrate the advantages of an artificial intelligence model over a radiologist in both productivity and overall accuracy of screening mammography cases [23-25].

Conclusions. The prospect of using artificial intelligence as a screening method can make it possible to better detect formations at an early stage, as well as lead to automation of this process, which entails a decrease in mortality from breast cancer. Scientific literature data show that when comparing the work of diagnosticians and the capabilities of artificial intelligence, the prerogative is the use of artificial intelligence. Further research is needed in this area for standardized data sets and the creation of a single method with implementation for widespread use in medical practice.

References

1. Samala RK, Chan H.P., Hadjiiski L.M. Multi- task transfer learning deep convolutional neural network: application to computer-aided diagnosis of breast cancer on mammograms, Phys. Med. Biol. 2017; 62 (23): 8894–8908.

2. Sechopoulos I, Teuwen J, Mann R. Artificial intelligence for breast cancer detection in mammography and digital breast tomosynthesis: State of the art. Semin Cancer Biol. 2021; 72 (6): 214-225.

3. Almasni MA, Alantari MA, Park J-M. Simultaneous detection and classification of breast masses in digital mammograms via a deep learning YOLO- based CAD system, Comput Methods Programs Biomed. 2018; 157: 85-94.

4. Qiang Guo, Zhiwu Dong, Lei Zhang, Chunping Ning, Ziyao Li, Dongmo Wang, Chong Liu, Ming Zhao, Jiawei Tian. Ultrasound Features of Breast Cancer for Predicting Axillary Lymph Node Metastasis. J Ultrasound Med. 2018; 37(6): 1354-1353.

5. Walid Al-Dhabyani, Mohammed Gomaa, Hussien Khaled, Aly Fahmy. Dataset of breast ultrasound images. 2019; 28 (21): 104863.

6. Kim H-E, Kim H-E, Han B-K. Changes in cancer detection and false- positive recall in mammography using artificial intelligence: a retrospective, multireader study. The Lancet Digital Health. 2020; 3 (2): 138-148.

7. Sechopoulos I, Teuwen J, Mann R. Artificial intelligence for breast cancer detection in mammography and digital breast tomosynthesis: State of the art. Semin Cancer Biol. 2021; 72 (6): 214-225.

8. McKinney SM, Sieniek M, Godbole V. International evaluation of an AI system for breast cancer screening, Nature. 2020; 577 (7788): 89–94.

9. Conant EF, Toledano AY, Periaswamy S. Improving accuracy and efficiency with concurrent use of artificial intelligence for digital breast tomosynthesis, Radiology: Artificial Intelligence. 2019; 4 (1): e180096.

10. Gantsev ShKh, Franz MV. Artificial intelligence as a decision support tool for diagnosing oncological diseases, Medical Bulletin of Bashkortostan, 2018.

11. Smistad E, Lövstakken L. Real-time automatic ejection fraction and foreshortening detection using deep learning. IEEE Trans Ultra son Ferroelectric Freq Control 2020; 16: 2981037.

12. Valdora F, Houssami N, Rossi F. Rapid review: radiomics and breast cancer. Breast Cans Res Treat. 2018; 169 (2): 217-229.

13. Rodriguez-Ruiz A, Lång K, Gubern-Merida A., Stand-alone artificial intelligence for breast Cancer de-tection in mammography: comparison with 101 radiologists, JNatl. Cancer Inst. 2019; 111 (9): 916–922.

14. Arieno A, Chan A, Destounis SV. A review of the role of augmented intelligence in breast imaging: from automated breast density assessment to risk stratification, AmJ Roentgenol. 2018; 212 (2): 259-270.

15. Kizildag YI, Koyluoglu YO, Seker ME. Diagnostic Performance of AI for Cancers Registered in A Mammography Screening Program: A Retrospective Analysis. Technol Cancer Res Treat. 2022: 15330338221075172.

16. Schaffter T, Buist DSM, Lee CI. Evaluation of Combined Artificial Intelligence and Radiologist As-sessment to Interpret Screening Mammograms. JAMA Netw Open. 2020; 3 (2): 1-15.

17. Crivelli P, Ledda RE, Parascandolo N. A new challenge for radiologists: radiomics in breast cancer. BioMed Res Int. 2018: 6120703.

18. Zhong Liu, Shing-Chow Chan, Shuai Zhang, Zhiguo Zhang, Xin Chen. An automatic muscle fiber ori-entation tracking algorithm using Bayesian Kalman Filter for ultrasound images. IEEE Trans Image Process 2019; 28 (8): 3714-3727.

19. Lång K, Dustler M, Dahlblom V, Andersson I, Zackrisson S. Can Artificial Intelligence Identify Normal Mammograms in Screening population be using artificial intelligence. Eur Radiol. 2021; 31(3): 1687-1692

20. Lebedev G.V. Deep machine learning (artificial intelligence) in ultrasonic diagnosis. Journal of Tele-medicine and eHealth. 2020; 6 (2): 22-29.

21. Aboutalib SS, Mohamed AA, Berg WA, Zuley ML, Sumkin JH, Wu S. Deep learning to distinguish re-called but benign mammography images in breast Cancer screening, Clin. Cancer Res. 2018; 24 (23): 5902–5909.

22. Kim E-K, Kim H-E, Han K. Applying data-driven imaging biomarker in mammography for breast cancer screening: preliminary study. 2018; 8 (2): 2762.

23. Solodkiy V.A, Kaprin A.D. Artificial intelligence in breast cancer screening (literature review). Journal Bulletin of the Russian Scientific Center for Roentgen Radiology. 2022;

24. Cleland T, Mainprize JG, Alonzo-Proulx O. Use of convolutional neural networks to predict risk of masking by mammographic density, Proceedings of SPIE 10950 (2019) 109501X.

25. Mann RM, Hooley R, Richard GB. Novel Approaches to Screening for Breast Cancer. Radiology. 2020; 297(2): 266-285.

DOI 10.34660/INF.2023.61.79.295

无催化剂过氧化物脱木素及碱预处理麦秆和麻屑
DELIGNIFICATION OF WHEAT STRAW AND HEMP SHIVE WITH PEROXIDATE WITHOUT CATALYST AND ALKALINE PRETREATING

Pen Robert Zusievich
Doctor of Technical Sciences, Full Professor
Shapiro Ida Lvovna
Doctor of Technical Sciences, Senior Research Officer
Marchenko Roman Aleksandrovich
Doctor of Technical Sciences, Head of Department
Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, Russia

抽象的。 将麦秆茎和大麻雀用1N NaOH溶液在93℃的温度下处理2小时。 并用过氧化氢和乙酸的水溶液在不使用催化剂的情况下在93℃的温度下脱木质素3.5小时。 在实验过程中，过氧化物和酸的浓度是变化的。 一些实验是在没有碱预处理的情况下进行的。 在所有情况下，均在未蒸煮不足的情况下获得工业纤维素，产率为 32.8...52.3%，聚合度为 191...597。

关键词：纤维素、麦秆、大麻、脱木质素、过氧化氢、过氧乙酸。

Abstract. *Wheat straw stems and hemp shive were treated with 1 N. NaOH solution at a temperature of 93°C for 2 hours. and delignified with an aqueous solution of hydrogen peroxide and acetic acid without catalysts at a temperature of 93°C for 3.5 hours. During the experiment, the concentrations of peroxide and acid were varied. Some experiments were performed without alkaline pretreatment. In all cases, technical cellulose was obtained without undercooking with a yield of 32.8...52.3% and a degree of polymerization of 191...597.*

Keywords: *cellulose, wheat straw, hemp shive, delignification, hydrogen peroxide, peracetic acid.*

The work was carried out within the framework of the state assignment of the Ministry of Education and Science of Russia for the implementation by the team of the scientific laboratory “Deep processing of plant raw materials” of the project “Technology and equipment for chemical processing of biomass of plant raw materials” (topic number FEFE-2020-0016).

The equipment of the Krasnoyarsk Regional Center for Collective Use of the Federal Research Center KSC of SB RAS was used. We express our gratitude to the staff of the shared use center for their assistance during the research.

Introduction

Previously, the possibility and feasibility of using stems of annual plants, in particular wheat straw and hemp shive, as plant raw materials for the production of technical cellulose using the peroxide method was discussed [1]. It has been established that hemp shive can be successfully delignified with an aqueous solution of hydrogen peroxide and acetic acid without the use of catalysts [2].

One of the characteristics of wheat straw is the presence of a waxy layer on the surface of the stems, which may hinder delignification. To remove it, it is recommended to treat the straw with a solution of sodium hydroxide at a relatively high temperature – up to 120°C [3].

Purpose of the study: to evaluate the effectiveness of alkaline pretreatment of raw materials at temperatures below 100°C and atmospheric pressure.

Methodology and results of the study

The object of the study was stalks of wheat straw (Triticum sh.) and brome of industrial hemp (Cannabis sativa) of the Surskaya brand, harvested in the southern regions of the Krasnoyarsk Territory at the end of the growing season. The straw stems were cut into pieces 20–30 mm long. The bonfire was taken away after the decortication of hemp at an industrial enterprise.

The chemical composition of plant raw materials (mass fractions of components, table 1) is established by generally accepted analytical methods: cellulose - according to the Kürschner-Hoffer method, lignin - by the sulfuric acid method in the Komarov modification, extractives - by extraction with an ethanol-toluene azeotrope in a Soxhlet apparatus, ash - by combustion and calcination at 600°C.

Prepared air-dried plant raw materials (dryness 94...95%) were treated with sodium hydroxide solution. Processing conditions: mass of raw materials for one experiment 6 g; the initial concentration of the NaOH solution is 1 g-mol/dm3; hydraulic module 5; isothermal treatment temperature 93°C, duration 120 minutes.

Table 1.

Chemical composition of plant materials

Plant raw materials	Mass fractions of components in raw materials, %			
	cellulose (fiber)	lignin	extractives	ash
Wheat straw	46,8	22,6	1,22	5,10
Hemp shive	41,2	23,4	4,64	1,10

The solid residue, washed with water from the alkali, was delignified with a solution of “acetic acid - hydrogen peroxide - water”. The cooking solution was

prepared by mixing the listed components immediately before cooking. Delignification (cooking) conditions: liquid module 6; isothermal treatment temperature 93°C, duration 210 minutes. Some experiments were carried out without alkaline pretreatment.

The experiment was carried out according to a three-factor analysis of variance plan with two observations per group [4].

Factor A – type of plant material, two levels of variation:

A1 – wheat straw;

A2 – hemp shive.

Factor B – alkaline pretreatment, two levels of variation:

B1 – cooking without preliminary alkaline treatment;

B2 – cooking with alkaline pretreatment.

Factor C is the initial concentration of hydrogen peroxide and acetic acid, the same for both components, three levels of variation:

C1 – 4 g-mol/dm3;

C2 – 5 g-mol/dm3;

C3 – 6 g-mol/dm3.

The results of the experiments were assessed by three indicators (output parameters) Y:

Y1 – cellulose yield, percent by weight of the feedstock;

Y2 – degree of polymerization of cellulose (viscometry of solution in ZhVNK, GOST 25438);

Y3 – the proportion of residual hydrogen peroxide from its initial amount, percent.

Table 2.

Experimental plan and observational results (average of two experiments)

Experiment numbers	Levels of variable factors			Output parameters		
	A	B	C	Y_1, %	Y_2	Y_3, %
1	A1	B1	C1	52,3	534	54,0
2	A1	B1	C2	47,5	597	37,8
3	A1	B1	C3	45,7	541	42,9
4	A1	B2	C1	41,5	446	53,4
5	A1	B2	C2	40,6	282	41,6
6	A1	B2	C3	38,0	191	37,0
7	A2	B1	C1	40,7	365	42,2
8	A2	B1	C2	38,7	418	31,6
9	A2	B1	C3	38,0	328	25,2
10	A2	B2	C1	32,8	140	32,0
11	A2	B2	C2	37,5	218	29,2
12	A2	B2	C3	35,7	228	24,1

Variable experimental conditions and observation results are given in Table 2, statistical characteristics of the output parameters - in Table 3.

Table 3.

Statistical characteristics of observation results

Characteristics	Y_1	Y_2	Y_3
Number of experiments	24	24	24
Average value	40,7	357	37,6
Minimum value	32,1	134	23,3
Maximum value	52,8	604	55,4
Standard deviation	5,32	148	9,70

To perform analysis of variance, the Statgraphics Centurion program and the Multi-Factor Categorical procedure were used. Figures 1, 2 and 3 present the values of the output parameters (mean values and 95% confidence intervals) at different levels of variable factors.

The average (according to all observations) yield of technical cellulose from wheat straw is higher than from hemp shive (Fig. 1, a). This is consistent with the results of chemical analysis (Table 1): the mass fraction of fiber in straw is greater than in hemp shive. Alkaline pretreatment significantly reduced the yield of cellulose (Fig. 1, b), and to a greater extent during straw cooking (Fig. 1, d). An increase in the concentration of cooking reagents (hydrogen peroxide and acetic acid), as expected, is accompanied by a decrease in cellulose yield, but the effect is relatively small (Fig. 1c).

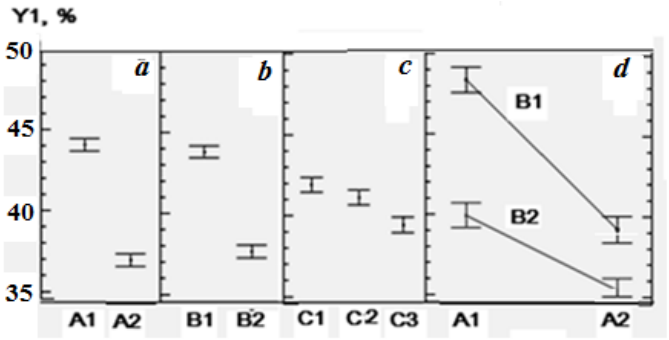


Figure 1. *Dependence of pulp yield on cooking variables (95 percent confidence intervals)*

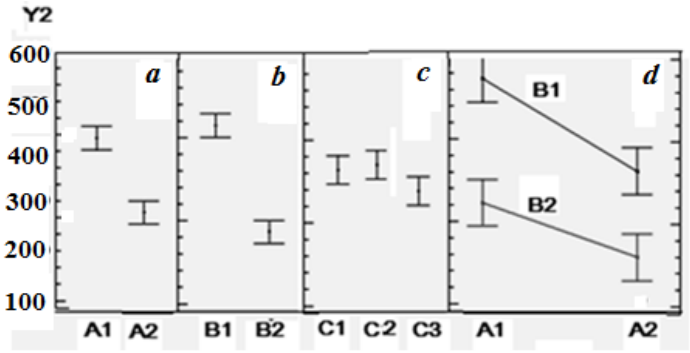


Figure 2. *Dependence of the degree of polymerization of cellulose from variable cooking factors*

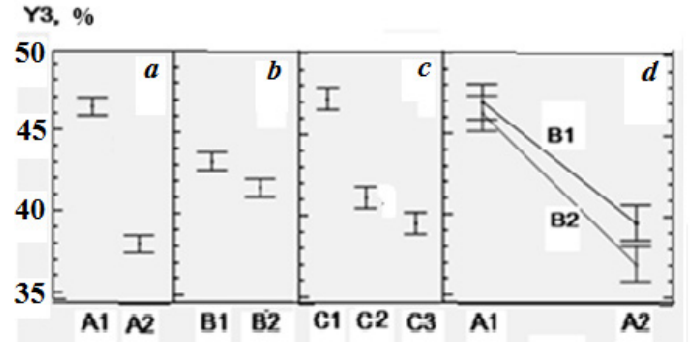


Figure 3. *Dependence of the proportion of residual hydrogen peroxide in the liquor on variable cooking factors*

The patterns of changes in the degree of polymerization of cellulose under the influence of variable factors (Fig. 2) are symbatic with respect to the yield of cellulose (Fig. 1). Note that the degree of polymerization of cellulose from brome is significantly lower than that of straw cellulose. Alkaline pretreatment in all variants of the experiments was accompanied by a decrease in the degree of polymerization of cellulose, in some cases - to the maximum degree of polymerization of 200 ... 250.

The dependences of the proportion of residual hydrogen peroxide in the liquor on variable cooking factors (Fig. 3) are in general similar to both dependences discussed above, which is quite natural - they are all correlated with the depth of delignification of plant raw materials.

Conclusion

All raw material processing modes used in the study made it possible to obtain cellulose without undercooking. Preliminary alkaline treatment is accompanied by a decrease in the degree of polymerization of cellulose to a level characteristic of powder and microcrystalline cellulose. Technical pulp for the production of many types of paper and cardboard can be obtained from hemp shive and wheat straw stalks by one-stage peroxide cooking without catalysts and without alkaline pretreatment, which greatly simplifies the technological process.

References

1. Pen R.Z., Shapiro I.L., Karetnikova N.V., Marchenko R.A. Cellulose peroxide from annual plants. Krasnoyarsk, Siberian State University named after. M.F. Reshetneva, 2022. 144 p.

2. Pen R.Z., Shapiro I.L., Marchenko R.A. Delignification of hemp shive with peroxo compounds without catalysts // Higher school: scientific research. Materials of the Interuniversity International Congress (Moscow, June 23, 2023). M., "Infinity" Publishing House, 2023, p. 120–125. DOI 10.34660/INF.2023.90.58.185.

3. Kuznetsov B.N., Danilov V.G., Sudakova I.G., Yatsenkova O.V., Garyntseva N.I., Ibragimova E.F. Delignification of wheat straw with a mixture of acetic acid and hydrogen peroxide in the presence of a sulfuric acid catalyst // Chemistry of plant raw materials. 2009. No. 4. pp. 39-44.

4. Pen R.Z., Pen V.R. Statistical methods of mathematical modeling, analysis and optimization of technological processes. St. Petersburg, Lan, 2020. 308 p.

DOI 10.34660/INF.2023.63.32.296
UDC 678.021.31

基于晶须晶体的环氧复合材料CaSO4•2H2O
EPOXY COMPOSITE BASED ON WHISKERS CRYSTALS $CaSO_4 \cdot 2H_2O$

Nikulicheva Tatiana Borisovna
Candidate of Physico-mathematical Sciences, Associate Professor, Head of Laboratory

Zakhvalinskii Vasilii Sergeevich
Doctor of Physico-mathematical Sciences, Full Professor, Leading Research Worker

Nikulin Ivan Sergeevich
Candidate of Physico-mathematical Sciences, Head of Laboratory

Vyazmin Vitaly Vladimirovich
Research assistant
Belgorod National Research University, Belgorod, Russia

抽象的。 本报告介绍了 $CaSO_4 \cdot 2H_2O$ 晶须增强环氧树脂机械性能的研究结果，该晶须采用原始技术从柠檬酸生产的工业废物中获得。

关键词：环氧复合材料，机械性能，$CaSO_4 \cdot 2H_2O$晶须。

Abstract. *This report presents the results of a study of the mechanical properties of epoxy resin reinforced with $CaSO_4 \cdot 2H_2O$ whiskers, obtained using original technology from industrial waste from the production of citric acid.*

Keywords: *epoxy composite, mechanical properties, $CaSO_4 \cdot 2H_2O$ whiskers.*

Introduction

An attractive area of application for industrial waste is its use after special processing and use as a reinforcing filler in composite polymer materials. The applications of epoxy matrix composites are expanding due to their availability, low cost, and properties that meet the requirements of aerospace, automotive, and other industrial applications [1]. This use of waste from technological processes is beneficial from the point of view of increasing the reliability and durability of materials with an epoxy matrix and reducing the technogenic impact on the environment. Many materials filling composites exhibit poor adhesion to polymer matrices and a tendency to agglomerate the filler [2]. For example, to increase the

affinity for polymer matrices and improve dispersibility in widely used composites based on carbon nanomaterials, their surface is chemically modified by various methods. The search for new materials that do not require additional modification to create polymer composites with desired properties is an important scientific and technical task. The use of mechanical properties of composites requires more attention to the study of the deformation phenomenon [3].

This article is devoted to the use of citrogypsum (CaSO4□2H2O), which is a waste product from the technological process for the production of food-grade citric acid [4, 5], as a reinforcing filler material in an epoxy matrix, which requires modification of its physical properties.

Materials and methods

Whiskers $CaSO_4 \cdot 2H_2O$ were obtained from waste from the biochemical production of citric acid using a method similar to [6].

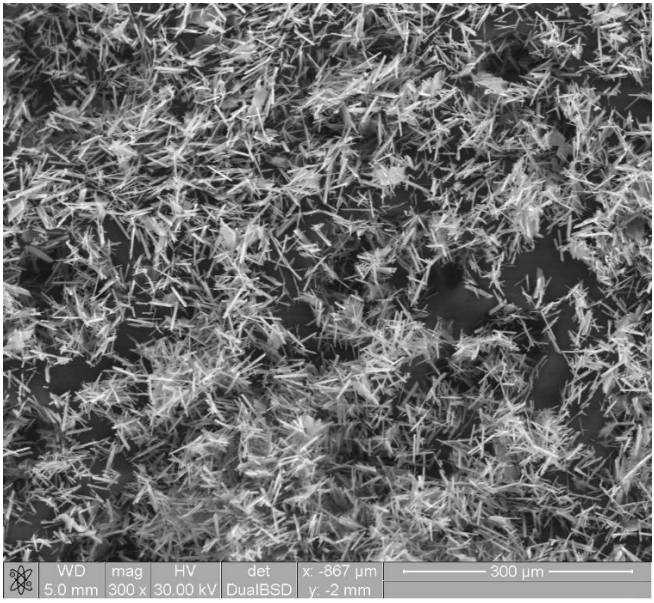


Figure 1. *SEM micrograph of $CaSO_4 \cdot 2H_2O$ whiskers obtained on an FEI Quanta 600 FEG (a).*

A study using a scanning electron microscope FEI Quanta 600 FEG (Fig. 1a) showed that whiskers of different sizes are obtained. Based on the constructed histograms, the average length (Fig. 2a) and average width (Fig. 2b) were estimated as 23.2±0.3 μm and 1.9±0.1 μm, respectively

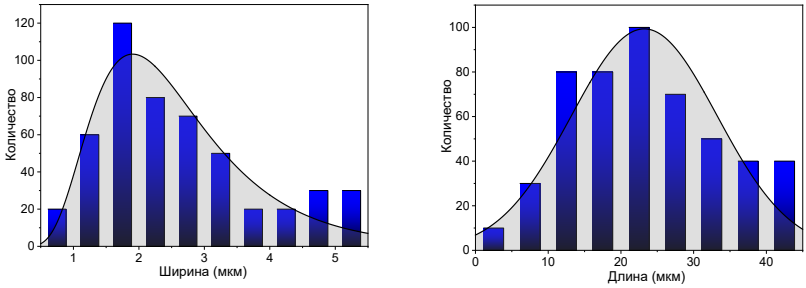


Figure 2. *Histograms of particle (whisker) size distribution obtained from SEM images: length (a) and width (b), respectively.*

Quality control of the $CaSO_4 \cdot 2H_2O$ material was carried out using X-ray phase analysis on a Rigaku SmartLab diffractometer, CuKα radiation (λ = 1.5406 Å, U = 50 kV, I = 60 mA) at room temperature. in the range 2θ = 10 – 100°. X-ray phase analysis showed that the spectrum of the obtained $CaSO_4 \cdot 2H_2O$ whiskers coincides with the spectrum of $CaSO_4 \cdot 2H_2O$ from the ICDD database (01-070-0982). $CaSO_4 \cdot 2H_2O$ whiskers were used as filler in ArtEpoxy epoxy resin. The mustache was pre-washed with alcohol and dried at 75 °C for 2 hours. Composite samples containing 0%, 5%, 10% and 15% whiskers were poured into polyethylene molds and polymerized for 60 hours at a temperature of 50°C. Tensile and compressive stresses were studied on samples of an epoxy resin composite with a filler in the form of $CaSO_4 \cdot 2H_2O$ whiskers, prepared for measurements on an Instron 3369 universal testing machine. The tensile samples were flat dumbbells and had a length of the narrow part of ~40 mm, a width of ~5 mm and thickness ~2 mm, respectively. The total length was 75 mm. The compression samples were parallelepiped-shaped and had a length of ~6 mm, a width of ~5 mm, and a thickness of ~3 mm, respectively. The strain rate was 0.1 mm/s.

Results and discussion

Figure 3 shows the results of a study of the tensile stress of samples of an epoxy resin composite with a filler in the form of CaSO4•2H2O whiskers of compositions 0%, 5%, 10% and 30%.

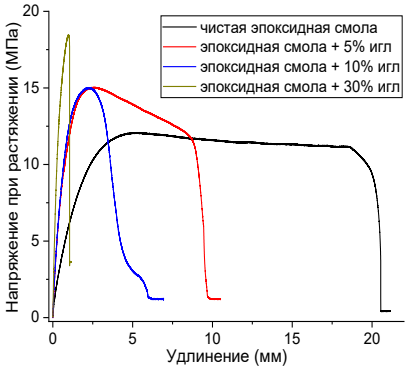


Figure 3. *Tensile-strain curve of epoxy composite samples with 0%, 5%, 10% and 30% $CaSO_4 \cdot 2H_2O$ whisker content.*

As the filler content increased, a transition from ductile to brittle material was observed. Following the same sample preparation procedure, the neat epoxy composite exhibited ductile strength values of 11.08 MPa and yield strength values of 12.07 MPa. The addition of 5% $CaSO_4 \cdot 2H_2O$ whiskers slightly changes the tensile strength equal to 11.64 MPa, and increases the yield strength to 15.03 MPa. A further increase in the content of $CaSO_4 \cdot 2H_2O$ whiskers to 10% leads to an increase in brittleness, with ductile fracture occurring at a deformation stress of 2.44 MPa, and the yield (brittleness) limit is 15.02 MPa. The deformation curve for a sample with 30% filler content completely corresponds to the dependence characteristic of a brittle material with a brittleness limit of about 18.43 MPa.

Conclusions

Thus, $CaSO_4 \cdot 2H_2O$ whiskeys were obtained from waste from the biochemical production of citric acid, their geometric dimensions were determined by electron microscopy, and the correspondence of the whiskers' X-ray spectrum to the $CaSO_4 \cdot 2H_2O$ compound was determined by X-ray phase analysis. The use of citrogypsum $CaSO_4 \cdot 2H_2O$ whiskers as a filler in an epoxy composite did not require additional chemical modification of their surface. It has been established that for epoxy composite samples in the composition range of 0 – 5% whiskers, viscous behavior is observed when stretched. A further increase in the content of $CaSO_4 \cdot 2H_2O$ whiskers leads to an increase in fragility and at 30% a dependence characteristic of a brittle material is observed.

Financing the work

The research was carried out within the framework of the state task for the creation of new laboratories in 2021, including under the guidance of young promising specialists of the national project "Science and Universities", on the scientific

topic “Development of scientific and technological foundations for the creation of an integrated technology for processing gypsum-containing waste from various industrial enterprises” , (FZWG-2021-0017).

References

1. Nassima Radouane and Abdelkrim Maaroufi, Fiber Inclusions-Based Epoxy Composites and Their Applications, Chapter, (E-Book) Epoxy-Based Composites, Edited by Samson Jerold Samuel Chelladurai, Ramesh Arthanari and M.R.Meera,(2022), P.126, ISBN 978-1-80355-161-6, DOI: 10.5772/intechopen.104118.

2. Zaitsev I.A., Blokhin A.N. Strengthening epoxy resins with carbon nanomaterials // Materials Science. Energy. (2021) Vol. 27, No. 1, pp. 74–86. DOI: 10.18721/JEST.27106

3. Abdellaoui, H., Raji, M., Bouhfid, R., & Qaiss, A. el kacem. Investigation of the deformation behavior of epoxy-based composite materials. Failure Analysis in Biocomposites, Fibre-Reinforced Composites and Hybrid Composites, (2019) 29–49. doi:10.1016/b978-0-08-102293-1.00002-4

4. Sirimahasal, T., Kalhong, Y., Simasatitkul, L., Pranee, S., Seeyangnok, S.. The Effect of Solvent Polarity on Phase Transformation of Citrogypsum via Hydrothermal Process. Key Engineering Materials, (2019) 803, 351–355. doi:10.4028/www.scientific.net/KEM.803.351

5. N. I. Alfimova et al. Binders from gypsum-containing waste and products based on them. IOP Conf. Ser.: Mater. Sci. Eng. (2020) 945 012057. doi:10.1088/1757-899X/945/1/012057

6. R.J. Hand. Calcium sulphate hydrates: a review. Br. Ceram. Trans., (1997) 96(3), 116-120. (ISSN: 0967-9782)

DOI 10.34660/INF.2023.24.17.297

中和前后含有 TiF3、HF 和 HCl 的废酸蚀刻液的毒性评估

ASSESSMENT OF THE TOXICITY OF SPENT ACID ETCHING SOLUTIONS CONTAINING TIF3, HF AND HCL BEFORE AND AFTER NEUTRALIZATION

Bykovsky Nikolay Alekseevich
Candidate of Technical Sciences, Associate Professor
Kantor Evgeniy Abramovich
Doctor of Chemical Sciences, Full Professor
Fanakov Vadim Ctanislavovich
Assistant
Ufa State Petroleum Technological University

抽象的。 本文评估了钛产品生产过程中使用氢氟酸和盐酸混合物进行蚀刻过程中形成的废酸蚀刻液 (SAES) 的毒性。 SAES 中 TiF3、HF 和 HCl 的含量分别为 21.9 g/L、1.7 g/L 和 6.2 g/L。 为了确定SAES的毒性，使用了植物测试方法。豆瓣菜品种 Zabava 被用作植物生态指标。 试验按照测定饮用水、地下水、地表水和废水、化学物质溶液毒性的方法进行，通过测量豆瓣菜幼苗的发芽率、平均长度和平均干重。 测定SAES在碱中和前和碱中和后的毒性。 研究表明，SAES在碱中和前后均具有急性毒性作用。 为了确定安全稀释比例，研究了SAES稀释对种子发芽、幼苗平均长度和平均干重的影响。 结果发现，幼苗平均长度对稀释程度的依赖性方程最可靠地描述了实验数据。 根据这些依赖性计算出的安全稀释系数对于未中和的 SAES 为 669.2，对于用碱中和的 SAES 为 382.5。

关键词：钛制品生产； 蚀刻； 废酸洗液； 中和； 植物测试； 豆瓣菜； 种子发芽； 幼苗的平均长度； 幼苗的平均干重； 毒性；回归方程； 相关系数；安全稀释比例。

Abstract. The article evaluates the toxicity of spent acid etching solution (SAES), formed in the production of titanium products during its etching with a mixture of hydrofluoric and hydrochloric acids. SAES contained TiF3, HF and HCl in amounts of 21.9 g/L, 1.7 g/L and 6.2 g/L, respectively. To determine the toxicity of SAES, the phytotesting method was used. Watercress variety Zabava was used as a phytoecoindicator. The experiment was carried out according to the method of determining the toxicity of drinking, groundwater, surface and waste water, solutions of chemical substances by measuring germination rates, average length and average dry weight of watercress (Lepidium sativum) seedlings. The

toxicity of SAES was determined before its neutralization with alkali and after neutralization with alkali. It has been shown that SAES has an acute toxic effect both before and after neutralization with alkali. To determine the safe dilution ratio, the effect of SAES dilution on seed germination, average length and average dry weight of seedlings was studied. It was found that the equations for the dependence of the average length of seedlings on the degree of dilution most reliably describe the experimental data. The safe dilution factor calculated from these dependencies is 669.2 for non-neutralized SAES and 382.5 for SAES neutralized with alkali.

Keywords: production of titanium products; etching; spent acid pickling solution; neutralization; phytotesting; watercress; seed germination; average length of seedlings; average dry weight of seedlings; toxicity; regression equations; correlation coefficients; safe dilution ratio.

The widespread use of titanium in various fields of industry is due to its unique properties, such as low density, high mechanical strength, resistance to various aggressive environments, high melting point, etc. The manufacture of titanium products involves the removal of the oxide film on its surface. Most methods for removing the oxide film involve etching the titanium surface with various acids [1-4]. When a mixture of hydrofluoric and hydrochloric acids is used as an etching solution, a spent acid etching solution (SAES) is formed, containing TiF3, HF and HCl and having strong toxicity. A number of researchers suggest neutralizing it with alkali before diluting or processing SAES [5,6]. This produces a effluent containing NaF and NaCl.

Recently, various phytoecoindicators are increasingly used to determine the toxicity of wastewater, one of which is watercress [7-9]. The advantage of using the latter as a phytoecological indicator is due to the responsiveness of three parameters (germination, length of seedlings and dry weight of seedlings) to environmental toxicity.

The article presents the results of studies of the toxicity of SAES containing TiF3, HF and HCl before and after neutralization with NaOH. The watercress variety Zabava, registered in the State Register of Breeding Achievements, was used as an indicator. SAES contained 21.9 g/l titanium fluoride, 1.7 g/l hydrofluoric acid and 6.2 g/l hydrochloric acid. Neutralization of SAES was carried out until the latter reached a pH of 7.6.

The experiment was carried out according to the method [10]. 30 plant seeds were placed in Petri dishes on filter paper. After this, the filter paper was wetted with 5 ml of the test solution. The test solution used was undiluted SAES before and after neutralization, as well as SAES before and after neutralization with different dilution ratios. Distilled water was used as a control sample. Each experi-

ment was repeated 3 times. On the eighth day after the start of the experiment, seed germination, length and dry weight of seedlings were determined [10]. In this case, the relative measurement error was calculated using the Student distribution for a confidence level of 95%. In accordance with [11], the dependence of the analyzed parameters on the dilution factor was processed by straight line equations.

The results of measurements of seed germination, average length and average dry weight of watercress seedlings in a sample with SAES before neutralization are presented in Table 1.

Seed germination was determined as the average value in three parallel experiments.

Before neutralization, watercress seeds in the test with SAES begin to germinate at a 128-fold dilution. At the same time, with increasing dilution, seed germination increases. Starting from a 512-fold dilution, the germination of watercress is almost equal to the control sample. It should be noted that the error in measuring germination ranges from 51% to 9.2%. According to the method [10], the error in determining germination should not exceed 35%. Therefore, it is not

Table 1

Germination, length of seedlings and dry weight of watercress in SAES before neutralization

Breeding	Germination rate, %	Error, %	Length, mm	Error, %	Weight, mg	Error, %
128	62,22	42,7	27,24 21,27 26,85	17,5 25,7 21,1	0,93 0,97 0,91	20,0 18,2 25,3
256	65,55	51,0	81,36 51,20 65,73	16,3 21,5 18,5	0,88 1,09 0,71	16,1 14,6 18,7
512	92,22	22,6	122,47 90,44 100,46	12,0 15,7 9,4	1,24 1,16 1,09	12,2 14,9 9,8
1024	90,0	9,2	149,11 146,15 139,69	10,6 10,8 12,0	1,38 1,45 1,27	10,6 9,4 11,7
Control	91,06	24,0	111,96 113,25 100,84	12,8 14,4 10,9	0,98 1,09 1,03	13,2 16,1 12,8

correct to use this parameter to determine the safe dilution factor (the dilution factor at which the value of the analyzed parameter is equal to the parameter in the control sample).

The average length of seedlings was determined only by the number of sprouted seeds and varied from 21.27 mm at 128-fold dilution to 149.11 mm at 1024-fold dilution. At the same time, with an increase in the dilution rate, the length of the seedlings increases. It should be noted that the length of the seedlings in the sample with 1024 dilution exceeds the length of the seedlings in the control sample by 25%. This indicates that with a 1024-fold dilution, the sample has a stimulating effect on watercress. The error in measuring the length of seedlings ranges from 9.4 to 25.7%. According to the methodology [10], it should not exceed 25%. In this regard, the average length of the seedlings can be used to determine the safe dilution ratio.

The average weight of dry sprouts varies from 0.71 to 1.45 mg. As is the case with the average length of seedlings, starting from a 512-fold dilution of SAES, the average dry weight becomes equal to the average dry weight in the control sample. In this case, in the case of 1024-fold dilution, a stimulating effect is observed. The error in measuring dry weight is the same value as in the case of the average length of seedlings and, in accordance with the method [10], should not exceed 42%. Thus, this parameter can also be used to determine the safe dilution ratio.

Regression equations and correlation coefficients for the dependence of the average length of seedlings and their dry weight on the dilution factor of SAES to neutralization are presented in Table 2.

Table 2

Regression equations and correlation coefficients

Analyzed parameter	Regression equation	Correlation coefficient
Length of sprouts, mm	Y = 25,484 + 0,12433·X	0,94
Weight, mg	Y = 0,83539 + 0,00053·X	0,86

Experiments with each dilution factor were duplicated three times. Thus, the average values of 12 experiments were used to obtain the regression equations. The critical value of the correlation coefficient for 12 experiments with a confidence level of 95% is equal to 0.576 [11]. Thus, the regression equations for the dependence of the average length and dry weight of seedlings on the dilution factor reliably describes the experimental results. This indicates that these parameters can be used to determine the safe dilution factor of non-neutralized SAES.

Since the correlation coefficient for the average length of seedlings is higher than for their dry weight, to determine the safe dilution factor of non-neutralized SAES, we use the dependence of the average length of seedlings on the dilution factor. Thus, the safe dilution factor of SAES before its neutralization is 669.2.

The results of measurements of seed germination, average length and average dry weight of watercress seedlings in a sample with SAES after neutralization are presented in Table 3.

In SAES, after its neutralization with alkali, seed germination is observed starting from a 32-fold dilution. It should be noted that in the case of germination there is no obvious dependence of this parameter on the dilution factor. For the average length of seedlings and their dry weight, an increase in the parameter is observed with increasing dilution ratio. In this case, the error in determining all parameters turns out to be lower than that recommended in the method [10].

Table 3

Germination, length of seedlings and dry weight of watercress in OKTR after neutralization

Breeding	Germination rate, %	Error, %	Length, mm	Error, %	Weight, mg	Error, %
32	46,65	21,6	9,90 11,44 10,44	23,1 17,5 16,9	0,72 0,84 1,13	29,8 28,1 18,7
64	95,53	13,2	96,70 81,87 63,97	15,3 15,8 16,3	1,21 1,21 1,18	14,6 15,0 13,2
128	89,97	18,4	92,48 86,76 103,44	15,5 20,1 15,7	1,04 1,03 1,20	14,0 13,8 11,6
256	95,53	13,2	99,59 131,56 129,17	13,5 12,9 13,1	1,13 1,34 1,17	12,9 11,2 16,6
512	95,54	10,0	130,43 139,30 139,61	16,0 8,7 9,0	1,30 1,25 1,33	12,8 10,1 7,3
Control	96,63	8,6	111,97 124,50 138,11	15,7 13,8 14,7	1,34 1,21 1,46	11,4 10,3 9,3

Regression equations and correlation coefficients for the dependence of seed germination of the average length of seedlings and their dry weight on the dilution factor of SAES after neutralization are presented in Table 4.

Table 4

Regression equations and correlation coefficients

Analyzed parameter	Regression equation	Correlation coefficient
Germination rate, %	Y = 73.540 + 0.5112·X	0,49
Length of sprouts, mm	Y = 45,426 + 0,20775·X	0,81
Weight, mg	Y = 0,96771 + 0,00072·X	0,55

To obtain regression equations for neutralized SAES, 15 experiments were used. The critical value of the correlation coefficient for 15 experiments with a confidence level of 95% is equal to 0.514 [11]. Consequently, the dependence describing seed germination on the dilution factor is not suitable for determining the safe dilution factor. The correlation coefficient for the dependence of the average length of seedlings is 1.5 times higher than the dependence of dry weight on the dilution factor of SAES. Therefore, to calculate the safe dilution ratio, it is necessary to use the dependence of the average length of seedlings on the dilution ratio. Thus, the safe dilution factor for OKTR after its neutralization with alkali is 382.5.

Conducted studies show that SAES has an acute toxic effect both before its neutralization and after its neutralization with alkali. However, to obtain an environmentally safe SAES effluent, it is necessary to dilute the non-neutralized SAES by 669.2 times, and the dilution of the neutralized SAES with alkali by 382.5 times.

References

1. Formanoir C., Suard M., Dendievel R., Martin G., Goden S. Improving the mechanical efficiency of electron beam melted titanium lattice structures by chemical etching // Additive Manufacturing. 2016. Vol. 11, P. 71-76.

2. Liu Z., Tsai I-L., Thompson G.E., Liu H., Donatus U. Chemical etching behavior of bromine-methanol electrolyte // Materials Chemistry and Physics. 2015. Vol. 160, P. 329-336.

3. Marin E., Diamanti M. V., Boffelli M., Sendoh M., Pedeferri M., Mazinani A., Moscatelli M., Curto B., Zhu W., Pezzotti G., Chies R. Effect of etching on the composition and structure of anodic spark deposition film on titanium // Materials & Design. 2016. Vol. 108, P. 77-85.

4. Usova V.V., Plotnikova T.P., Kushakevich S.A. Etching of titanium and its alloys. M.: Publishing house "Metallurgy", 1984. 127 p.

5. Patent 2289638 Russia, MPK C23F1/46 Method for regenerating spent acid pickling solutions formed during the processing of titanium alloys/ Trubin A.N., Gil G.I.; applicant and patent holder: OJSC VSMPO-AVISMA Corporation. - No. 2005122756/02; application 07/18/2005; publ. 12/20/2006, Bulletin. No. 35

6. Pat. 2596564 RF, IPC C23F1/46, C23G1/36. Method for regeneration of spent acidic etching solutions formed during the processing of titanium products / Bykovsky N.A., Nizov V.A., Fanakova N.N.; applicant and patent holder Federal State Budgetary Educational Institution of Higher Professional Education "Ufa State Petroleum Technical University". - No. 2015113659/02; application 04/13/2015; publ. 09/10/2016, Bulletin. No. 25

7. Bykovsky N.A., Puchkova L.N., Fanakova N.N. Study of the toxicity of distiller liquid of ammonia-soda production using various test objects // Ecology and industry of Russia. 2015. T. 19, No. 10. P. 48-51.

8. Daminev R.R., Islamutdinova A.A., Shayakhmetov A.I. Allium test and mathematical model for assessing the toxicity of cyclic ammonium compounds // Ecology of urbanized territories. 2012. No. 2. pp. 80-84.

9. Bykovsky N.A., Ovsyannikova I.V., Puchkova L.N., Fanakova N.N., Khairullin R.M. The use of watercress and wheat as phytoecological indicators for assessing the toxicity of distiller liquid // Modern problems of science and education. 2017. No. 2. URL: https://www.science-education.ru/ru/article/view?id=26377 (access date: 05/18/2017).

10. Methodology for determining the toxicity of drinking, ground, surface and waste water, solutions of chemical substances by measuring germination indicators, average length and average dry weight, seedlings of watercress seeds (lepidium sativum) // PND F T 14.1: 2: 4.19-2013 /Moscow 2013.

11. Urbakh V.Yu. Biometric methods (statistical processing of experimental data in biology, agriculture and medicine) // M.: Publishing House "Nauka", 1964. 415 p.

DOI 10.34660/INF.2023.80.55.298

桥梁结构承重构件的技术状态诊断和剩余寿命评估
TECHNICAL STATE DIAGNOSTICS AND RESIDUAL LIFE ASSESSMENT OF THE BRIDGE STRUCTURES LOAD-BEARING ELEMENTS

Volokhovsky Vasily Yurievich
Candidate of Technical Sciences, Associate Professor
National Research University «MPEI»

Vorontsov Alexander Nikolaevich
Candidate of Technical Sciences, Associate Professor,
Leading Employee
Limited Liability Company «INTRON PLUS»

抽象的。 由于承载结构构件（钢筋混凝土梁、斜拉索等）技术状况的恶化，桥梁结构的运行安全性降低。 桥梁运营中的主要问题之一是斜拉系统和桥梁元件中隐藏缺陷的诊断。 目视测量控制无法获得有关桥梁承重构件内部缺陷的完整定量信息，而这是正确评估其剩余承载能力和剩余使用寿命所必需的。 文章介绍了利用磁力探伤技术诊断桥梁结构承重结构构件——斜拉索和钢筋混凝土梁的技术状况的实践。 控制对象技术状况的判定是根据承载能力（强度）指标进行的。 根据使用磁探伤数据的状态监测结果给出剩余寿命的评估。

关键词：技术状况诊断、磁力探伤、斜拉绳、钢筋混凝土梁、承载能力、剩余寿命。

Abstract. *The operational safety of a bridge structure is reduced due to the degradation of the technical condition of the load-bearing structural elements (reinforced concrete beams, cable-stayed ropes, etc.). One of the main problems in the operation of bridges is the diagnosis of hidden defects in elements of cable-stayed systems and bridge beams. Visual measurement control does not allow obtaining complete quantitative information about the internal defects of load-bearing elements of bridges, which is necessary for a correct assessment of their residual load-bearing capacity and residual service life. The article describes the practice of using magnetic flaw detection in diagnosing the technical condition of elements of load-bearing structures of bridge structures - cable-stayed ropes and reinforced concrete beams. Qualification of the technical condition of controlled objects is carried out on the basis of load-bearing capacity (strength) indicators.*

An assessment of the residual life is given based on the results of condition monitoring using magnetic flaw detection data.

Keywords: *diagnostics of technical condition, magnetic flaw detection, cable-stayed ropes, reinforced concrete beams, load-bearing capacity, residual life.*

Introduction. A bridge structure (BS) is an object of increased danger, because exposed to loads from vehicles, pedestrians, natural and man-made factors. The main technical requirement for MS operation is to ensure a standard level of reliability and acceptable risk. Operational safety decreases with the degradation of the technical condition (TC) of load-bearing structural elements, that is, with the appearance of various types of damage to cable stays and/or reinforced concrete beams (CB). Corrosion of prestressed reinforcement leads to a decrease in the load-bearing capacity of the reinforced concrete beam, loss of concrete compression and sometimes leads to the destruction of the span (Fig. 1).

Figure 1. *Bridge collapse due to corrosion of beam metal with prestressed reinforcement*

Of particular danger are defects that are hidden from inspection and that can appear during heavy traffic on the bridge. An analysis of the BS accidents that have occurred shows that in the case of collapses of large spans, the number of victims sometimes exceeds 100 people per collapse [1]. Thus, when a cable-stayed viaduct collapsed in Genoa on August 14, 2018, 43 people died and dozens were seriously injured [2]. Therefore, diagnostics of the technical characteristics of elements of

load-bearing structures - steel ropes of cable-stayed systems and reinforced concrete beams - is an important part of monitoring the condition of bridges. The main tasks of diagnosing steel ropes and reinforced concrete beams with prestressed reinforcement are obtaining up-to-date information about their current technical condition and compliance with the requirements of regulatory documents [3].

According to world practice [4,5], the main types of cable-stayed systems include: cables of the PSC (Parallel Strand Cable) and PWC (Parallel Wire Cable) types, as well as closed or spiral steel ropes. During the operation of the BS, the cables and anchor devices are affected by unfavorable factors: static and dynamic, and sometimes non-design loads, which can lead to breaks of wires and/or strands of ropes. Environmental conditions or poor protection cause corrosive wear of the cable stays. To detect corrosive wear and other defects in cables and beams, especially in places inaccessible to visual inspection, non-destructive testing (NDT) methods are used [6-8]. Based on the diagnostic data of the vehicle load-bearing elements of the structure, the strength characteristics can be calculated by calculation, making it possible to determine the transport and operational indicator - the load-carrying capacity of the bridge. Knowledge of the current vehicle category makes it possible to assign a safe operating mode for the BS.

There are several approaches to assessing the wear of load-bearing elements of a bridge structure. The first of them requires the development at the design stage of a specialized built-in system for dynamic monitoring of certain parameters. This system must continuously provide diagnostic information, which, using specialized software, is transformed into vehicle performance indicators of the controlled element and the entire structure as a whole. An alternative approach is selective control of load-bearing elements operating in the most severe conditions and monitoring of their vehicle using NDT tools. As in the first case, diagnostic data must be converted into a generalized indicator that makes it possible to judge the change in the state of the element during operation. A suitable parameter for this purpose can be the quantitative loss of strength (bearing capacity) due to the gradual accumulation and development of defects of various natures [10].

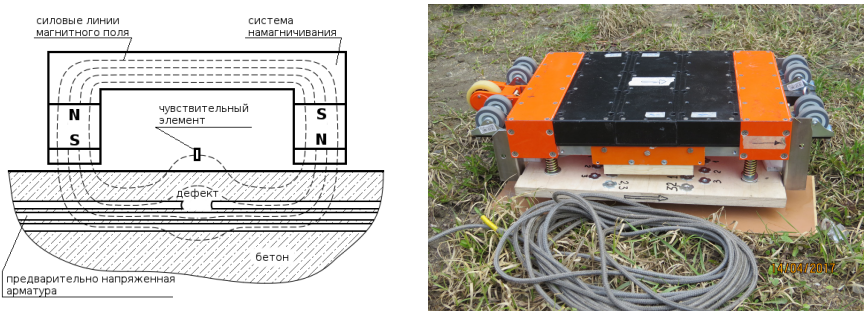
The article presents the results of the assessment of the vehicle according to magnetic flaw detection data of the cable stays of the bridge crossing over the Eastern Bosphorus Strait to the Russky Island (Vladivostok) and the Yugorsky Bridge (Surgut). The results of diagnostics using the INTROARM flaw detector of reinforced concrete beams of the Afanasyevsky bridge across the river are illustrated. Moscow near Voskresensk.

Non-destructive testing of cable cables and reinforced concrete bridge beams using the magnetic method (MFL). The physical foundations of the magnetic NDT method, based on the registration of the magnetic flux leakage field (MFL - Magnetic Flux Leakage), are known. The MFL method allows you to diagnose

distributed defects in products made of ferromagnetic materials - the amount of cross-sectional loss (CS) due to corrosion and/or abrasive wear, as well as local defects (LD) such as number of wire breaks in a specific section. The method is used and effective, including in diagnosing the technical characteristics of cable-stayed cables and reinforced concrete beams of bridges [8,9,11].

The range of models of magnetic flaw detectors from different manufacturers, developed using the MFL method, is quite extensive. There are no industrial designs adapted for diagnosing reinforced concrete bridge beams yet. Their development and pilot industrial operation in the Russian Federation are at an early stage. Abroad, such work is being carried out at the University of Toledo [12,13], the Technical University of Berlin [14] and other research and production centers.

For monitoring prestressed reinforcement of reinforced concrete beams, the best, from a configuration point of view, is a U-shaped magnetization system [11]. In Fig. Figure 2a shows a diagram of the application of such a system to the magnetization of reinforced concrete beam reinforcement, which is implemented in the INTERARM flaw detector.



a) *b)*

Figure 2. *a) U-shaped magnetization system for control prestressed reinforcement in concrete; b) A prototype of the INTROARM flaw detector*

The peculiarities of magnetic NDT of stressed reinforcement of reinforced concrete beams include the presence of an interfering factor - the presence of unstressed reinforcement (both longitudinal and transverse). In this case, there is a large gap between the measuring system and the test object. Additional complications are that unstressed reinforcement is located closer to the surface of the beam than stressed reinforcement. This fact leads to disturbances in the signal of the instrument's measuring system. A prototype of the INTROARM flaw detector produced by the INTRON PLUS company (Fig. 2b) is capable of detecting PS and LD in the form of broken wires in the reinforcement of reinforced concrete beams. The flaw detector includes a magnetization system, a unit of measuring transduc-

ers, a distance sensor, an electronic unit for processing and storing information, which are combined into a single measuring unit - a magnetic head (MH). INTROARM implements the principle of joint operation of two measuring systems. The main measuring system is optimized for measuring the cross-sectional area of longitudinal prestressed reinforcement. However, it is not possible to completely get rid of the influence of unstressed reinforcement on the main measuring system. An additional sensor system, sensitive to the parameters of transverse unstressed reinforcement, helps to tune out the influence of the latter on the readings of the main measuring system.

Assessment of the residual load-bearing capacity and service life of cable stays based on magnetic flaw detection data. To assess the TC of cable stays according to the "load-bearing capacity" criterion, it is natural to use an indicator accepted in the mechanics of materials and structures - the safety factor, determined taking into account the wear of the rope at the current moment [15]. The proposed approach to assessing the load-bearing capacity of cables with defects is based on the theory of steel ropes [17] and consists in calculating the safety factor n for stresses in the most loaded wire of the rope (the "weak link" hypothesis).

The sequence of calculations is as follows. Strength indicators are determined for three rope options: without defects, with diagnosed PS (value ΔS), with identified LDs (number *B*) in a specific section. In each case, the deformations and tensile, bending and torsional stresses in the rope wires are first calculated. Then, using the appropriate strength criterion, the maximum equivalent stresses maxσeq in the most stressed wire are determined and the safety factor is calculated. Under stationary loading, the stress safety factor is determined by the relation

$$n = \sigma_{в}/max\ \sigma_{экв}\ , \qquad (1)$$

where $\sigma_{в}$ - tensile strength of wire material, $max\ \sigma_{экв}$ - the maximum equivalent stress in the wires, calculated from the theory of steel ropes.

Diagnostic parameters ΔS и *B* - generalized indicators of rope defectiveness, since they do not reflect the pattern of defect location along strands and groups of wires. Therefore, the dependence of strength on defectiveness of the rope is analyzed using statistical modeling of the distribution of defects over the section. Selective implementations represent random quantities of remaining intact wires (or their supporting fragments) in strands, which determine the aggregate stiffness coefficients of the rope [17] with diagnosed defects. Based on the obtained implementations, statistical average estimates of safety factors for voltages are independently calculated $\langle n_{\Delta S} \rangle$ and $\langle n_{B} \rangle$. Relative indicators of a decrease in the strength of a rope weakened by the loss of cross-sectional area of the metal Δ*S* and wire breaks numbering *B*, are the parameters

$$\chi_{\Delta S} = 1 - \frac{\langle n_{\Delta S} \rangle}{n_0}, \quad \chi_B = 1 - \frac{\langle n_B \rangle}{n_0}, \tag{2}$$

where n_0 - safety factor of a whole (defect-free) rope.

Thanks to friction forces, broken wires begin to take the same load as intact wires at a distance approximately equal to three rope laying steps from the break point [19]. Relative loss of rope strength in a section with longitudinal coordinates caused by wire breaks in sections ξ_j $(j = 1,...,J)$, is estimated by the value

$$\chi_B(x) = \sum_{j=1}^{J} \left(1 - \frac{\langle n_B(\xi_j) \rangle}{n_0} \right) G(x - \xi_j), \tag{3}$$

where $G(x-\xi)$ - empirical function of the influence of friction forces on the loss of performance of a broken wire [10].

Resulting loss of strength $\chi(x)$ estimated by the amount of losses

$$\chi(x) = \chi_{\Delta S}(x) + \chi_B(x). \tag{4}$$

The load-bearing capacity of a rope in a section *x* is characterized by a generalized strength indicator

$$n(x) = (1 - \chi(x)) \cdot n_0. \tag{5}$$

The safety factor for the residual strength of the rope during its operation *t* is taken to be the minimum value of parameter (5) in a controlled section of length *L*. The condition for reliable functioning of the rope is expressed by the requirement

$$\min_{0 \le x \le L} n(x,t) \ge n_*, \tag{6}$$

where n_* - maximum permissible safety factor for a rope with defects. Violation of condition (6) means failure of the rope. Failure is understood as a situation requiring replacement of a rope with accumulated defects.

Over time, as damage accumulates in the cable cable, the safety factor n may become less than the standard value [n]. As soon as this happens, the rope must be replaced. However, being a statically indeterminate system, the cable-stayed rope is able to continue to perform its functions as long as its current, residual safety margin n_*, will not decrease to a certain maximum permissible value $n_* \le [n]$. Parameter n_* has the meaning of a reserve for the "survivability" of the rope [18]. The survivability margin is understood as the ability of a structure to perform its functions in the event of the destruction of individual elements. This indicator plays a primary role in predicting the remaining life of ropes and planning inspection periods [19].

The load-bearing capacity of a cable-stayed rope with operating time t (calendar operating time) is assessed using the following indicators:

a) safety factor n(t) at the control site in comparison with the permissible value; n_*; b) the value of the current safety margin n(t) in comparison with similar indicators for the previous diagnostic period; c) the dynamics of strength reduction

over several inspections in a quantitative and qualitative sense; d) relative residual strength of the rope $\eta(t)$ at the time of inspection (the ratio of the current safety factor n(t) to the safety factor of the "new rope" n(t = 0)):

$$\eta(t) = \frac{n(t)}{n(t=0)} 100\%; \quad (7)$$

e) the rate of change in relative strength $\eta(t)$ in comparison with the previous diagnostic period.

The final assessment of the TC of the cable-stayed rope based on diagnostic data is expressed in one of six possible categories (from "Workable state" to "Emergency state") [21,22]. Depending on the assigned category, various scenarios can be implemented: restrictions on the intensity of traffic across the bridge are introduced, scheduled repairs are assigned, priority (urgent) repairs, a special control regime, and rope replacement.

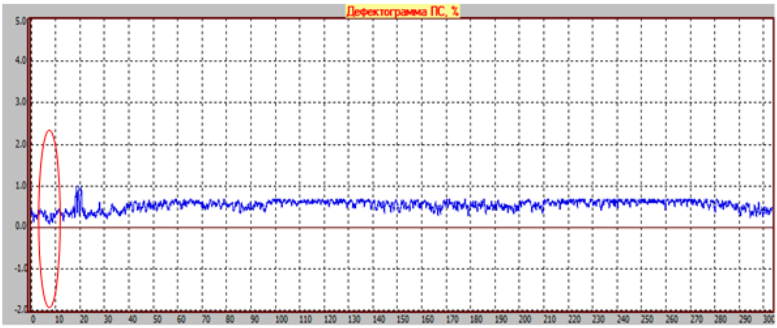
The tasks of predicting the performance and durability of cable-stayed structures are probabilistic in nature. However, due to the lack of statistical information about the limiting state of cable-stayed ropes under specific operating conditions, as well as a priori probabilistic estimates of mechanical properties and loads, as a rule, a deterministic forecast of the individual resource is used. Such a forecast of possible states of the rope based on an analysis of its strength history allows us to estimate: a) the residual life of the rope at the current operating time t; b) the possibility of continuing the operation of the rope with the obtained estimate of its residual life; c) the timing of the next diagnosis and the expected safety factor.

Results of flaw detection of the cable stays of the bridge crossing to Russky Island and assessment of their technical condition. The cable-stayed system of this MS has two planes of obliquely placed cables, arranged in a "Fan" pattern. The cables are attached to two supports using special anchors - the "Northern" and "Southern" pylons. Each pylon contains 84 cables, divided into two symmetrical fans on each side. The cable-stayed system of the bridge consists of cables of the PSC type (diameter 140 mm, manufactured by Freyssinet International et Cie, France; installed in 2006-2009; standard service life - 100 years, warranty period - 10 years). In the central span of the BS, an improved "compact" PSC cable system with more dense placement of strands in the shell is used. These cables (lower inset in Fig. 3) consist of parallel strands with a diameter of 15.7 mm, each of which consists of 7 galvanized wires. The shrouds have from 13 to 85 strands. The length of the shortest cable is 134.33 m, the longest - 579.81 m. The protective shell of each cable is made of high-density polyethylene.

Figure 3. *Moving the INTROS flaw detector (MG 120-300) along the cable stay of the PSC bridge to Russky Island (Vladivostok)*

After completion of the bridge construction, monitoring and assessment of the cable cables' vehicle was carried out in August 2017 and September-October 2018. The initial magnetic NDT of the cable stays was carried out in 2017-2018. The first 50 cables were inspected in August 2017, the remaining 118 cables were inspected in September-October 2018. To carry out diagnostics of the cables, the INTROS flaw detector was equipped with a magnetic head MG 120-300, designed for testing cables with diameters of 120-300 mm (upper insert in Fig. . 4).

In Fig. Figure 4 shows the PS and LD defectograms of the cable VB_12_SZ, indicating that at the mark of 19.2 meters (the vicinity is highlighted with a red oval) there is a defect, and the loss of PS = 1.0%. Analysis of defectograms using the Wintros program (by type and level of signal via the PS channel) made it possible to state that this defect corresponds to a wire break in one of the strands.



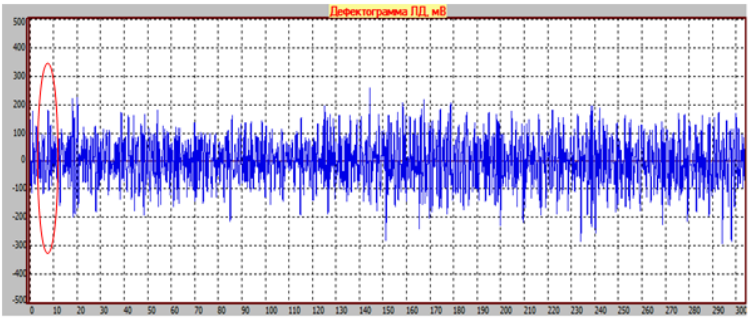


Figure 4. *Defectograms of the cable VB_12_SZ along the PS (upper) and LD (lower) channels. On the abscissa axes the distance is indicated in meters*

In Fig. Figure 5 shows the distribution of the residual strength $\eta(t)$ parameter along the length of the cable VB_12_SZ (the minimum calculated value is marked with a circle).

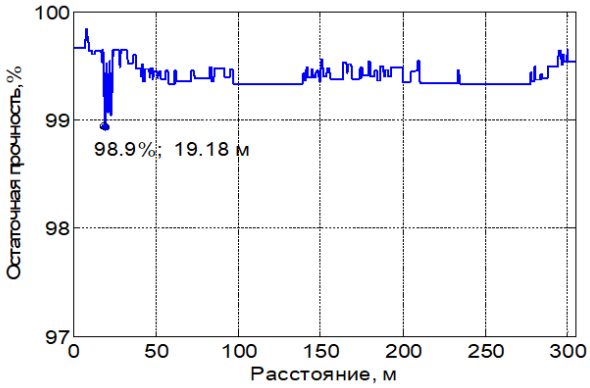


Figure 6. *Relative residual strength of cable VB_12_SZ*

Based on the results of the inspection in 2018, the deadline for the next diagnostic of the cable stays of the bridge crossing to Russky Island across the Eastern Bosphorus Strait (Vladivostok) was recommended - no later than September 2023.

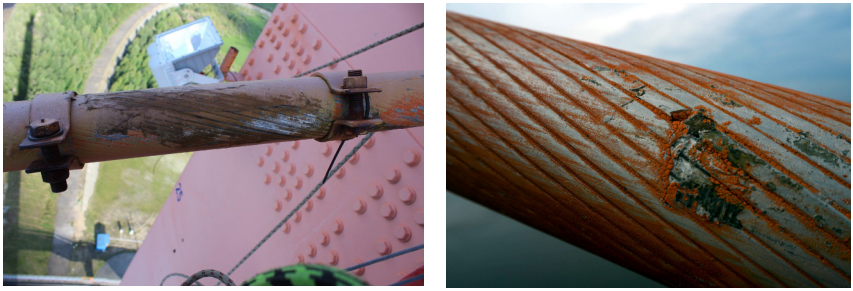
The practice of diagnosing the technical condition and assessing the residual life of the cable stays of the "Yugorsky" Bridge. All 130 cable stays of the «Yugorsky» bridge across the Ob River near the city of Surgut are closed-type steel ropes (manufacturer: Bridon, rope diameter D=72 mm, design: 1+7+7/7+14+24+33z+ 34z+41z - a core of round wires and three layers of z-shaped wires). Since its commissioning in 2000, magnetic flaw detection of the

bridge cables has been carried out several times. The first control was carried out in August - September 2009, subsequent ones - in 2017/2018 and 2020. Diagnostics of the cable stays was carried out using an INTROS flaw detector with MG 60-85 (Fig. 6).

Figure 7. *Diagnostics of cable stays of the "Yugorsky" bridge (INTROS flaw detector (MG 60-85))*

In relation to the results of inspections of 2009-2017/2018, in 2020, 9 new defects were discovered on the cables - exits from the lock of the Z-shaped wires of the outer layer. Such defects were found on the cables of both the "Beregovoy" (BV3, BV24, BN9, BN12, BN15, BN34) and "River" (RV27, RN5, RN31) spans. In total, 99 places where wires exited the lock were found on the inspected cables. The increase in rope PS values diagnosed in 2020, relative to 2009 data, does not exceed 0.6%, and compared to the results of the 2017/2018 inspection, does not exceed 0.2%.

When analyzing the PS and LD defectograms of cable 26RV, in addition to the previously identified wire exits from the locks (Fig. 8a), a single break of the outer wire was diagnosed at the 111m mark (Fig. 8b), which was absent or not detected during the inspection in 2017/2018 year.



a) *b)*

Figure 8. *Diagnosed defects on cable stay 26PB of the Yugorsky Bridge*

The safety factor was calculated based on the results of flaw detection in 2009, 2017/2018 and 2020, taking into account data on cable tension forces. With the design safety margins of cable-stayed ropes [n]=2.0 – 2.5, due to the random nature of damage accumulation and for reasons of ensuring a 30% survivability margin relative to one, n*=1.3 was accepted.

The diagnostic history of cable 26PB (cable length L=334 meters) is as follows. In 2009, in the upper part at the level of 331 meters, a break in 4 wires of the outer layer was detected and the wires came out of the lock at the levels of 224, 236 and 315 meters, the maximum value of PS = 2.1% at the level of 331 meters. In 2017/2018, the following was additionally identified: a break in the 1st wire at 106 m; breaks of 3 wires at marks 111 and 112 meters; 1st wire at 113 meters; maximum PS value = 2.5% at 331 meters. When diagnosing cable 26RV in 2020, at 331 meters, a break in 4 wires was detected, and the maximum PS value was 2.7%. The results of the calculated assessment of the degradation of the load-bearing capacity of cable stay 26PB (according to inspection data in 2009, 2017/2018 and 2020) are shown in Fig. 9.

The majority of cable stays inspected in 2020 had a residual life of at least 50 years. The estimated residual life of some cable stays is somewhat less. So, for example, for a 26PB cable it is 32 years, for a 27PB - 41 years. The reduction in the calculated residual life of cable stays 24БВ, 9БН, 26PB is associated with the appearance of new defects in the period between inspections, and for stay cables 25PB, 29PB, 31PB, 18PH, 21PH, 24PH, 28PH - and due to an increase in their tension compared to the data of the previous control.

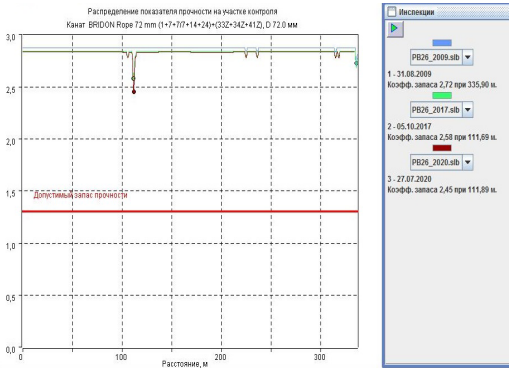


Figure 9. *Strength indicator in the control section of cable stay 26PB according to inspection data in 2009, 2017/2018 and 2020*

In Fig. 10 shows the change in the residual load-bearing capacity of cable 26PB over 20 years of operation.

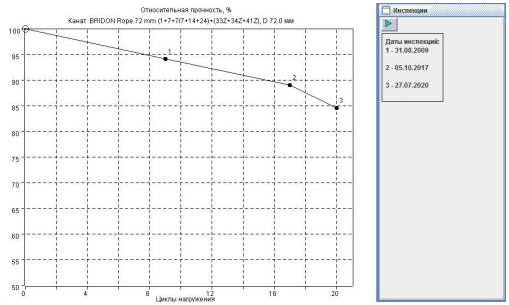


Figure 10. *Change in the residual strength of cable 26PB over 20 years (it is assumed that the time scale is 1 year)*

Based on the inspection data in 2020, the recommended date for the next diagnosis of the cable stays of the Yugorsky Bridge is no later than September 2023.

Experience in using magnetic flaw detectors to monitor the technical condition of reinforced concrete bridge beams. To confirm the effectiveness of identifying zones of corrosive wear of the reinforcement of reinforced concrete bridge beams using magnetic flaw detectors, field experiments were carried out. The beam under examination was removed from a road bridge that had been dismantled after prolonged use. In Fig. 11 shows a photograph of a beam inspection section with a trolley on which an INTROS flaw detector with an MG 233 magnetic head is installed.

Figure 11. *Bridge beam inspection section*

As a result of beam diagnostics, six defective zones of reinforcement were identified (marked with numbers 1 – 6, Fig. 11): 1st zone - reinforcement PS ~10%; 2nd zone - PS ~10% and breaks in reinforcement wires; 3rd and 5th zones - PS reinforcement ~8% and wire breaks; 4th and 6th zones - PS of reinforcement ~15% and breaks of reinforcement wires. The presence of wear corrosion and breaks in the reinforcement wires in the 2nd, 4th and 6th zones was confirmed upon inspection of the corresponding areas of the beam freed from concrete (photo of the 4th zone is shown in the inset of Fig. 11).

As an example of the pilot industrial application of the INTROARM flaw detector, we present data from flaw detection of beams on the Afanasyevsky Bridge across the river. Moscow near Voskresensk (Fig. 12).

Figure 12. *Diagnostics of beams of the «Afanasyevsky» Bridge using the INROARM flaw detector*

According to the diagnostic data, the following were found:

- on beam No. 2 (left side) there is a zone of corrosion wear with a length of 0.5 meters with PS reinforcement in separate bundles up to 10%; - on beam No. 2 (right side) there is a zone of corrosion wear with a length of 0.4 meters with PS reinforcement in separate bundles up to 15%; - on beam No. 4 (left side) there is a zone of corrosion wear with a length of 0.3 meters with PS reinforcement in separate bundles up to 15%; - on beam No. 4 (right side) there is a zone of corrosion wear with a length of 0.5 meters with PS reinforcement in separate bundles up to 50%.

In Fig. 13, 14 there was illustrated the diagnostic data for beam No. 4.

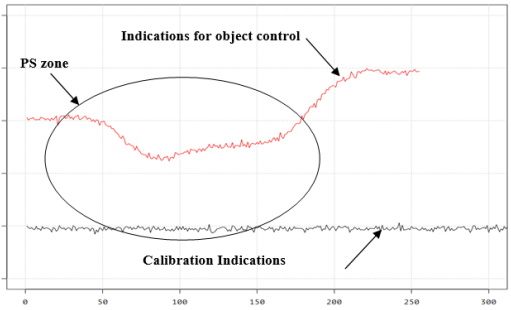


Figure 13. *Indications of the main INTROARM measuring system (on the abscissa axis the distance is indicated by the number of scanning steps 5 mm long; the signal scale on the ordinate axis is mV.)*

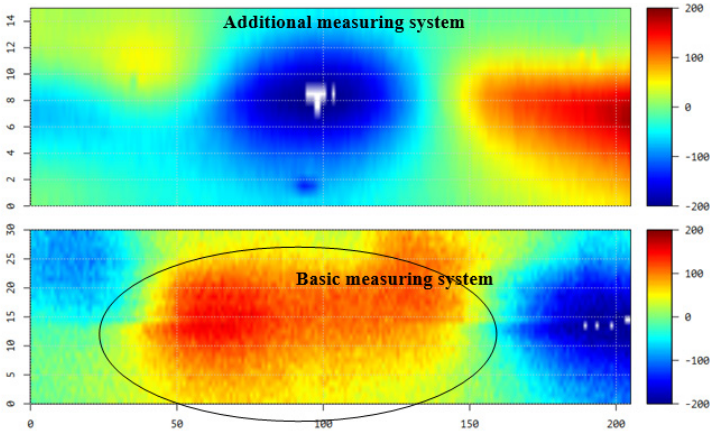


Figure 14. *Magnetogram of the left side of beam No. 4 (the sensor number is indicated along the ordinate axis, the scale of signal amplitudes on the right scale is mV)*

The results of monitoring the condition of the beams are taken into account by the operating organization when planning work on supervision and maintenance of the bridge.

Conclusion. Objective information about the current TC of ropes and shrouds is provided by the use of magnetic NDT (MFL method). GOST R 59629-2021 “Public automobile roads. Cable-stayed bridge systems. Requirements for operation.»

Carrying out magnetic flaw detection of cables and load-bearing beams of MS requires the involvement of highly qualified personnel both for carrying out work on site and for desk processing of control data. To obtain complete and objective information about the current TC of BS elements, it is necessary to use all available information, including PS and LD defectograms of previous inspections, as well as visual inspection data. The reliability of the conclusion about the current TC of the cable-stayed bridge system depends on the professional training of the specialists performing the diagnostics, and, first of all, on their practical experience.

Expanding the fleet of diagnostic equipment and the regulatory framework for rejecting load-bearing elements (cable cables, reinforced concrete beams), as well as the development of magnetic NK technology will improve the safety of BS operation. The proposed integrated approach, including magnetic NK and determination of strength indicators of load-bearing elements (cable cables and reinforced concrete beams) based on flaw detection data, makes it possible to qualify the bridge’s TS category. As a result, specialized services receive information that should be used to correct the operating mode of the BS and when prescribing repair and restoration measures.

Acknowledgments The authors express their gratitude to the employees of the INTRON PLUS company - K.V. Myakushev and V.V. Tsukanov for providing materials on the diagnostics of load-bearing elements of bridges.

References

1. Proske D. Bridge Collapse Frequencies versus Failure Probabilities /Springer International Publishing AG, 2018. - P. 126.

2. Calvi G.M., Moratti M., O’Relly G.J. et al. Once upon a time in Italy: the tale of the Morandi bridge // IABSE Journal of Structural Engineering International (SEI) - 2019. – No. 2. P.198–216.

3. GOST 27751-2014 Reliability of building structures and foundations. Basic provisions. - M.: Standartinform, 2019.

4. Cable stays. Recommendations of French inter-ministerial commission on Prestressing. Setra: Service d'Etudes Techniques des Routes et Autoroutes. - 2002. - P. 197.

5. Fib Bulletin No. 89: Acceptance of stay cable systems using prestressing steels. Recommendations. – 2019. – P. 116.

6. GOST R 56542-2019 Non-destructive testing. Classification of types and methods. - M.: Standartinform, 2019.

7. The Manual for Bridge Evaluation. Second edition, 2011, Washington, DC.

8. Sawade G., Krause H-J. Inspection of Prestressed Concrete Members Using the Magnetic Leakage Flux Measurement Method – Estimation of Detection Limit. Advances in Construction Materials. Springer. Berlin, 2007, pp. 639-649.

9. Sukhorukov V., Sukhorukov D., Slesarev D., Mironenko A. Nondestructive Testing of Bridge Stay Cables. Proceedings of NDE/NDT for Highways and Bridges, New York, New York, 21-24 August 2012, pp.347-352.

10. Sukhorukov V., Slesarev D., Vorontsov A. Electromagnetic inspection and diagnostics of steel ropes: technology, effectiveness and problems. Materials Evaluation (ME), American Society of Nondestructive Testing, 2014, 72(8), pp.1019-1027.

10. Vorontsov A.N., Volokhovsky V.Yu. Mechanical model for assessing the strength and service life of steel ropes of lifting machines based on diagnostic data.//Handbook. Engineering magazine. — 2012. — No. 10 (187). — P.37-43.

11. Vorontsov A.N. Myakushev K.V., Mironenko A.S., Shpakov I.I. Magnetic flaw detection of reinforcement and assessment of the bearing capacity of reinforced concrete bridge beams. Roads. Innovations in construction, 2015, No. 44. P.36-39.

12. A. Vorontsov, V. Volokhovsky and D. Slesarev, "Combined approach to damaged wire ropes life-time assessment based on NDT results and rope mechanics", Proceedings of the 9th International Conference on Damage Assessment of Structures, 11-13 July 2011, University of Oxford, UK (Journal of Physics: Conference series, Vol. 305, 2011).

13. Vorontsov, A., V. Volokhovsky, J. Halonen and J. Sunio, "Prediction of operating time of steel wire ropes using magnetic NDT data", How to get the most out of your ropes, Proceedings of the OIPEEC Conference, 11-15 September 2007, Johannesburg, South Africa, pp. 145-154.

14. Nims D. K. "Magnetic Sensor for Nondestructive Evaluation of Deteriorated Prestressing Strand – Phase II, Final Report." University of Toledo, August 2011.

15. Titus M. D. "Development of Induced Magnetic Field Procedure for Nondestructive Evaluation of Deteriorated Prestressing Strand." University of Toledo, May 2011.

16. Maierhofer C., Reinhardt H.-W., Dobmann G. "Non-destructive evaluation of reinforced concrete structures". Woodhead Publishing Limited, Vol.2, pp. 215-243, July 2010.

17. Glushko M.F. Steel hoisting ropes. – Kyiv: Technika, 1966. (reprint edition. Odessa: Astroprint, 2013). – 328 p.

18. Bolotin V.V. Forecasting the service life of machines and structures. – M.: Mechanical Engineering, 1984. – 312 p.

19. Pokholchenko A.S. Experimental determination of the loss of strength of worn ropes.//Sb. Steel ropes. Kyiv: Technology, 1967. – Issue 4. – P.114-116.

20. A. Vorontsov, V. Volokhovsky and D. Slesarev, "Combined approach to damaged wire ropes life-time assessment based on NDT results and rope mechanics", Proceedings of the 9th International Conference on Damage Assessment of Structures, 11-13 July 2011, University of Oxford, UK (Journal of Physics: Conference series, Vol. 305, 2011).

21. ODM 218.3.042-2014 Recommendations for determining parameters and assigning categories of defects when assessing the technical condition of bridge structures on highways. Federal Road Agency (ROSAVTODOR), M.: 2015. - 137 p.

22. ODM 218.3.014-2011 Methodology for assessing the technical condition of bridge structures on highways. Federal Road Agency (ROSAVTODOR), M.: 2013. - 80 p.

DOI 10.34660/INF.2023.25.41.299

确定低压网络系统不对称性的方法的改进

IMPROVEMENT OF METHODS FOR DETERMINING SYSTEMATIC ASYMMETRY IN LOW-VOLTAGE NETWORKS

Zyazin Yakov Yurievich
Master's student
Nevinnomyssk State Humanitarian and Technical Institute

Chebanov Konstantin Alexandrovich
Candidate of Pedagogical Sciences, Associate Professor
Nevinnomyssk State Humanitarian and Technical Institute

Burlyaeva Victoria Arsentievna
Doctor of Sociological Sciences, Professor
Nevinnomyssk State Humanitarian and Technical Institute

抽象的。 这项工作致力于研究和开发低压电网不对称监测系统。 工作对系统不对称性、其原因以及对设备运行的影响进行了理论研究。 考虑了确定系统不对称性的各种方法，包括使用特殊仪器和软件解决方案。 电网中的故障和不对称可能会产生严重后果，包括设备效率降低、能源成本增加、设备损坏和紧急情况。 随着电力需求的不断增长和新技术的引入，有效监测和分析电网不对称性对于确保系统稳定可靠运行变得越来越重要。

关键词：不对称、电气设备、三相网络元件、无功功率、效率、运行可靠性。

Abstract. *This work is devoted to the research and development of a system for monitoring asymmetry in low-voltage electrical networks. The work carried out a theoretical study of systematic asymmetry, its causes and impact on the operation of equipment. Various methods for determining systematic asymmetry were considered, including the use of special instruments and software solutions. Faults and asymmetries in electrical networks can have serious consequences, including reduced equipment efficiency, increased energy costs, equipment damage and emergency situations. With the growing demand for electricity and the introduction of new technologies, effective monitoring and analysis of asymmetries in electrical networks is becoming increasingly important to ensure stable and reliable system operation.*

Keywords: *asymmetry, electrical equipment, three-phase network elements, reactive power, efficiency, operational reliability.*

Systematic asymmetry in low-voltage networks is one of the main problems faced by engineers and electrical technicians. It occurs as a result of various factors such as phase mismatch, load imbalance, equipment malfunction and other reasons.

Systematic asymmetry detection is the process of identifying and assessing the level of asymmetry in a network. This is necessary to ensure reliable operation of electrical devices and systems, as well as to reduce the risk of emergency situations.

To determine systematic asymmetry in low-voltage networks, there are several methods that will be discussed below. It is important to note that the choice of method depends on the specific application and the availability of the necessary equipment.

The cause of systematic asymmetry can be, for example, uneven load distribution in the system, the presence of asymmetric components in the system, defects in equipment, incorrect connection of electrical equipment, etc.

Systematic asymmetry is a discrepancy between phases in a three-phase electrical system that can occur for various reasons. Some of the most common reasons include:

- Mismatch between the nominal values of voltage and/or frequency in a three-phase network;
- Failure of one or more elements in a three-phase network, such as wiring, transformers or generators;
- Incorrect connection of three-phase network elements;
- Improper installation or misuse of equipment.

Systematic asymmetry can lead to undesirable consequences, such as equipment damage, inefficient use of electricity, increased energy consumption, etc. Therefore, it is important to correctly identify and eliminate systematic asymmetries in low-voltage networks.

To determine systematic asymmetry in low-voltage networks, various methods are used, which can be divided into three main groups: spectral analysis methods, time interval methods and vector diagram methods. Each of these methods has its own advantages and disadvantages, and the choice of method depends on specific conditions and tasks.

Asymmetry in electrical networks can have various effects on the operation of equipment. Here are some examples of how asymmetry can manifest itself in the operation of various equipment:

Electric motors: Unbalanced phase voltages and currents can cause imbalance in the operation of three-phase electric motors. This can result in uneven load on the windings and rotating mechanical system, resulting in uneven wear, deterioration of work efficiency and possible failure.

Lighting fixtures and lamps: Asymmetry can lead to uneven lighting in rooms. If the phase voltages are unsymmetrical, the light intensity from lamps in different phases may differ, which can create unpleasant lighting conditions.

Transformers: Asymmetry currents can cause uneven heating of transformer windings. This can result in reduced power transmission efficiency, increased temperatures and insulation degradation, which can lead to reduction of transformer service life.

Air conditioning and refrigeration: Asymmetry can lead to uneven operation of compressors and fans in air conditioning and refrigeration systems. This may result in improper cooling or heating, reduced operating efficiency, and increased power consumption.

Electronic equipment: Asymmetry can have a negative impact on the operation of electronic equipment such as computers, servers, controllers and other devices. Asymmetric voltages and currents can cause interference, overload, failure and damage to electronic components.

Combating asymmetry in electrical networks is an important aspect of ensuring efficient and safe operation of the power supply system. There are several methods and technical solutions that help combat asymmetry and minimize its impact. Here are some of them:

Installation of symmetrical components: This approach is based on the use of technical solutions that compensate for asymmetry in the system. An example of such components would be the use of transformers with symmetrical windings or the use of filters and compensators that equalize phase voltage and current values.

Using active filters: Active filters are electronic devices that actively regulate and compensate for asymmetry in a system. They can compensate for uneven phase voltage and current values, reducing their impact on equipment operation.

Reactive power compensation: Reactive power can also be a source of asymmetry. Connecting compensation devices such as capacitors or synchronous compensators can help reduce asymmetry and improve the quality of the power supply.

Grid management: Electrical grid management systems can be an effective way to deal with imbalances. Monitoring and control of phase voltage and current values allow timely detection of asymmetry and take appropriate measures, such as switching to backup power supplies or automatic compensation.

Personnel education and training: Trained personnel working on the electrical system play an important role in combating imbalances. Training personnel in the proper operation and maintenance of equipment, as well as in recognizing and solving problems associated with asymmetry, helps to effectively combat this phenomenon.

The combination of these approaches and technical solutions makes it possible to effectively combat asymmetry in electrical networks and minimize its negative impact on the operation of equipment and the quality of power supply.

Assessing the impact of asymmetry on the efficiency and reliability of equipment is an important task in the field of electrical power engineering. Asymmetry in the electrical system can lead to a number of undesirable effects that can affect the operation of the equipment. Some of them include:

Equipment overload: Asymmetric currents can cause uneven loads on equipment. If one phase is overloaded due to unbalance, it can cause excessive heat and equipment damage.

Uneven wear on equipment: Asymmetric currents can also cause uneven wear on equipment components such as contacts, conductors, and insulation. This may result in poor performance and shortened equipment life.

Increased power losses: Asymmetry can lead to increased active and reactive losses in the electrical system. This may affect the operating efficiency of the equipment and the overall energy efficiency of the system.

Occurrence of resonant phenomena: Asymmetry can lead to the occurrence of resonant phenomena in the system, especially in the presence of reactive elements such as capacitors and inductors. Resonance phenomena can result in increased voltage and current, which can adversely affect the operation of the equipment.

To assess the impact of asymmetry on the efficiency and reliability of equipment, the following methods can be used:

Modeling and simulation: Using software tools to model and simulate electrical networks taking into account asymmetry. This allows you to evaluate the effects of asymmetry on the operation of specific equipment and determine the necessary measures to protect it.

Experimental research: Conducting physical experiments to study the effect of asymmetry on the operation of equipment. This may include measuring currents, voltages, temperatures and other parameters to identify potential problems and determine optimal solutions.

Data analysis: Using system and equipment performance data to analyze and evaluate the impact of asymmetry. This may include statistical analysis of data and identification of relationships between asymmetry and equipment performance.

In general, assessing the impact of asymmetry on the efficiency and reliability of equipment is a complex task that requires an integrated approach and the use of various methods and tools. Identifying problems, analyzing data, and developing appropriate solutions will help minimize the negative impact of asymmetry on equipment operation and ensure more stable and reliable electrical system operation.

References

1. Losev S.B., Chernin A.B. Calculation of electrical quantities in asymmetrical modes of electrical systems. Energoatomizdat 1983. -528 p.

2. Agunov A.V. Power quality control in non-sinusoidal modes of St. Petersburg State Medical University. St. Petersburg, 2009. - 134 p.

3. Grib O.G. Control and regulation of asymmetrical modes in power supply systems - Kharkov: KhNAGH, 2004. - 180 p.

4. Abdullaev A.A., Nematzhonov Kh.Sh., Ibrokhimov I.Z. DETERMINATION OF THE ASYMMETRY COEFFICIENT IN ELECTRIC NETWORKS // Universum: technical sciences: electron. scientific magazine 2022. 12(105). URL: https://7universum.com/ru/tech/archive/item/14820 (access date: 06/01/2023).

5. GOST 13109-97. Standards for the quality of electrical energy in general-purpose power supply systems. - M.: Publishing house of standards, 1998.

6. Zakaryukin V.P., Kryukov A.V. Complex asymmetrical modes of electrical systems Irkutsk: Publishing house Irkut. University, 2005. - 273 p.

7. Zakaryukin V.P., Kryukov A.V., Kryukov E.A. Modeling of limiting modes of electrical networks taking into account longitudinal and transverse asymmetry Irkutsk: ISEM SB RAS, 2006. - 139 p.

8. SIMATIC LOGO! Management. Edition 03. 253 p. [Internet resource] URL: https://www.siemens-ru.com/doc/Manual_LOGO.pdf (access date: 06/05/2023).

9. F.D. Kosoukhov (ed.) - Energy saving in low-voltage electrical networks with an asymmetric load. Publishing house: Lan, 2016. - 280 p.

10. Gavrilov F.A. Quality of electrical energy Priazovsky State Technical University, 2007. - 96 p.

11. Zhezhelenko I.V., Saenko Yu.L. Electric power quality indicators and their control at industrial enterprises M.: Energoatomizdat, 2000. - 252 p.

12. Shcherbakov, E.F. Electricity supply and electricity consumption at enterprises: Textbook / E.F. Shcherbakov, D.S. Alexandrov, A.L. Dubov. - M.: Forum, 2016. - 208 p.

13. Ancharova, T.V. Electrical supply and electrical equipment of buildings and structures / T.V. Ancharova, E.D. Stebunova, M.A. Rashevskaya. - Vologda: Infra-Engineering, 2016. - 416 p.

14. Kudrin, B.I. Electrical supply: textbook / B.I. Kudrin. - RnD: Phoenix, 2018. - 382 p.

15. Kudrin, B.I. Power supply to consumers and modes: Textbook / B.I. Kudrin, B.V. Zhilin, Yu.V. Matyunina. - M.: MPEI, 2013. - 412 p.

DOI 10.34660/INF.2023.27.78.300

量子电导率、布洛赫振荡、量子尺寸纳米晶体中的电子纠缠
QUANTUM CONDUCTIVITY, BLOCH OSCILLATIONS, ELECTRONIC ENTANGLEMENT IN QUANTUM-SIZED NANOCRYSTALS

Zhukov Nikolay Dmitrievich
Candidate of Physico-mathematical Sciences, Leading Researcher
Limited Liability Company "NPP Volga", Saratov, Russia

抽象的。 合成并研究了二元半导体CdSe、PbS、InSb、HgSe的完美纳米晶。 在单个纳米晶体的电流-电压特性中，观察到谐振电流峰值，这是由纳米晶体中电子运动的德布罗意波过程引起的，作为深的、延伸的势阱。 测量结果在量子电导率和布洛赫振荡的物理模型中得到解释。 考虑电子纠缠现象。

关键词。 量子尺寸的纳米晶体、单电子传输、电流振荡、量子电导率、布洛赫振荡、电子纠缠。

Abstract. *Perfect nanocrystals of binary semiconductors CdSe, PbS, InSb, HgSe were synthesized and studied. In the current-voltage characteristics of individual nanocrystals, resonant current peaks are observed, caused by the de Broglie wave process of electron motion in the nanocrystal as a deep, extended potential well. The measurement results are explained in physical models of quantum conductivity and Bloch oscillations. The phenomenon of electronic entanglement is considered.*

Keywords. *Quantum-sized nanocrystal, single-electron transport, current oscillations, quantum conductivity, Bloch oscillations, electronic entanglement.*

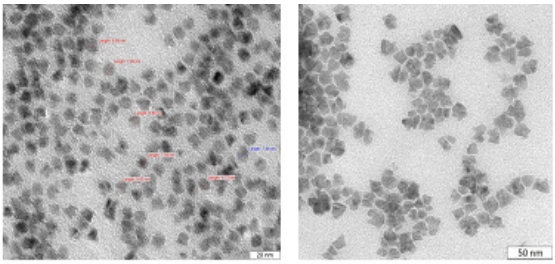
Fundamental manifestations of size quantization in a quantum-sized nanocrystal are associated with its electronic conductivity. Unlike a quasi-zero-dimensional formation, a quantum dot, a nanocrystal (NC) is an extended deep potential well. Its conductivity is complex, determined by several physical processes. We have investigated and substantiated options for stage-by-stage single-electron transport - emission-injection penetration of an electron into a nanocrystal and tunneling from it, a specific process of electron movement in it, like a deep, extended quantum well [1]. We consider the movement of an electron inside a nanocrystal as a steady vibrational de Broglie wave process between its boundaries and crystallographic planes. This movement inside occurs until a probabilistic tunnel transition occurs into the nanogap between the nanocrystal and the electrode. We call the

quantum resonant motion of an electron quantum conductivity with its description by the quantum thread model [2]. The quantum-dimensional nature of conductivity presupposes the passage of a number of little-studied physical processes in the perfect crystalline structure of a nanocrystal, the study of which is the focus of our present work.

Nanocrystals were produced by colloidal synthesis, data on which are given in our works, for example, [2]. Each batch of samples was monitored on a random selection of nanoparticles using scanning electron microscopy (SEM) for stoichiometric composition and transmission electron microscopy (TEM) for shape and size. Experiments were carried out on random samples of a large number (more than 200) of nanocrystals by TEM control on a Libra-120 transmission electron microscope (CarlZeiss, Germany) and measurements of current-voltage characteristics (CVC) of single nanocrystals in a sealed chamber of a SOLVERNano scanning probe microscope, which we use for field emission of electrons from the probe and their injection into the nanocrystal. The work examined nanocrystals based on the most studied binary semiconductors in nanotechnology – CdSe, PbS, InSb, HgSe.

The most important data and the obtained quantitative results are given in Table 1. The parameters of semiconductors, such as the band gap Eg, the ratio of the effective electron mass m to the mass of a free electron m0, the lattice constant a0, are taken from the Internet reference book [http://xumuk.ru /encyklopedia]. Table 1 indicates and shows: an – measured values of nanoparticle sizes, including, am – at the maximum of the distribution curve; $\tilde{E}kn \sim 0.37k^2(m/m0)^{-1}an^{-2}$ – values of the dimensional quantization energy obtained by solving the Schrödinger equation, k – quantum number; energy is in electron volts, dimensions are in nanometers.

For the issues considered here, the degree of crystalline perfection, which we evaluate by the physical properties and polygonal shape of nanocrystals that depend on it, is of fundamental importance. Figure 1 shows a typical picture of TEM images of fragments of random samples from batches of colloidal suspensions.



NC- CdSe NC- InSb

Figure 1. *TEM images of fragments of batches of nanocrystals deposited on a substrate from a colloidal suspension using the drop-drop method.*

For the NC-CdSe sample variant, predominantly four- to six-sided shapes are observed, and for the rest, three to four-sided shapes are observed. This corresponds to data on the lattice systems of semiconductors - hexagonal for CdSe and cubic for PbS, InSb, HgSe. Based on this, it can be assumed that during growth, nanocrystals are formed in the form of hexagonal or triangular prisms. In this case, growth occurs in all crystallographic directions, but not equally directed - faster than those in which the binding energies of the atoms are lower. Therefore, nanoprisms turn out to be geometrically distorted, which is evident in 2D images.

Quantum conductivity

Figure 2a shows typical options for current-voltage characteristics, including those with features in the form of individual large peaks and quasi-periodic current ripples (curves 1 – 3). CVC cr. 1* has the least manifestations of features. Curves 4 and 5 are test ones, showing the absence of observable features for simple (non-quantum-sized) variants. The values of the statistical probability pn of manifestations of features on the current-voltage characteristics were (Table 1) from 15% for relatively wide-gap variants (NC-CdSe) and up to 70% for narrow-gap variants (NC-InSb). In this regard, we further consider mainly the results of studies of the NC-InSb variant, which has the best size quantization parameters.

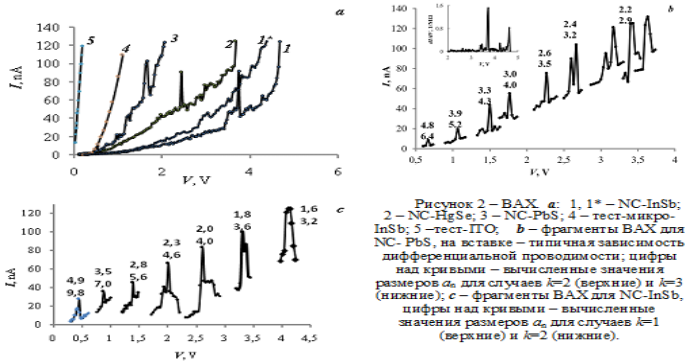


Рисунок 2 – ВАХ. *a*: 1, 1* – NC-InSb; 2 – NC-HgSe; 3 – NC-PbS; 4 – тест-микро-InSb; 5 –тест-ITO; *b* – фрагменты ВАХ для NC- PbS, на вставке – типичная зависимость дифференциальной проводимости; цифры над кривыми – вычисленные значения размеров a_n для случаев k=2 (верхние) и k=3 (нижние); *c* – фрагменты ВАХ для NC-InSb, цифры над кривыми – вычисленные значения размеров a_n для случаев k=1 (верхние) и k=2 (нижние).

We consider conductivity in a quantum-sized nanocrystal in the model of a one-dimensional deep extended quantum well with manifestations of electron injection, transport and emission in it. The motion of an electron inside a nanocrystal is described by the solution of the Schrödinger equation and the de Broglie wave process. The electron energy values $\tilde{E}_{kn}$ are determined by the resonance of the electron de Broglie wave process and are calculated depending on the type of semiconductor (m/m_0 values) and the nanocrystal size an. Formulas for the total energy Ẽkn, and the probability K* of an electron passing through NC in a one-dimensional one-electron model can be obtained in the following form [3]:

$\tilde{E}_{kn} \sim h^2k^2(8ma_n^2)^{-1} \sim 0.37k^2(m/m_0)^{-1}a_n^{-2}$; (1)

$K^* \sim \exp[-4\pi a_n(2m\tilde{E}_k)^{1/2}/h] \sim \exp[-4(k^2\text{-}2.7Va_n^2m/m_0)^{1/2}] \sim \exp[-4V^*]$ (2)

where: h – Planck's constant; $\tilde{E}_k \sim (\tilde{E}_{kn}\text{-}V)$ – electron kinetic energy; $V^* \sim (k2\text{-}2.7Va_n^2m/m_0)^{1/2}$ – dimensionless parameter depending on V – voltage drop across the nanocrystal and determining the resonance condition $(V^*=0)$; $\tilde{E}_k$, $\tilde{E}_{kn}$, V – in electronvolts, an – in nanometers.

Formula (2) is obtained as the probability of an electron passing through an extended potential barrier of width an. The formula for the current-voltage characteristic for the case when the current is limited by the probability of an electron passing through a nanocrystal can be written based on formula (2) in the following form:

$I \propto K^* \sim \exp[-4V^*]$; $I \sim I_0\exp[-\gamma^*(k^2\text{-}2.7Va_n^2m/m_0)^{1/2}]$ (3)

Here γ* can have a value of 4 or be slightly more due to a decrease in the probability of electron passage due to the chaotic deviation of its wave vector from the electric field line. The parameter γ* depends on the degree of electron mobility - the "heavier" the electron, the smaller γ*.

With a strong influence of size quantization (confinement), resonant properties appear in the form of sharp current peaks on the current-voltage characteristic. The degree of these manifestations is determined by the type of semiconductor and the dimensions a_n - for different cases it can be estimated by the parameter $C \sim (m/m_0)\text{-}1a_n^{-2}$ [2]. In table Figure 1 shows the values of parameters C and Ẽkn calculated for the maximum of the distribution curve a_n.

In Fig. Figures 2, b, c show fragments of the current-voltage characteristics in the observation zones of the resonant peaks. The numbers on top of the peak curves indicate the sizes an, calculated from the resonance condition $k^2 \sim 2.7Va_n^2m/m_0$. These values correlate satisfactorily with the actual measured sizes for NC-InSb (comparison of the Eki and aki values in Table 1) taking into account the actions of the 1st and 2nd order resonant modes. For NC-PbS, satisfactory agreement is observed only at relatively low energy (voltage) values, less than 2 V, and higher, 2nd and 3rd order modes. This suggests that the model of quantum conduction through an extended potential barrier may be more accurately suited for cases of high size quantization parameters, such as the narrow-gap NC-InSb semiconductor.

Estimates of conductivity G~dI/dV by differentiation of formula (3) give values approximately an order of magnitude lower than measured (Fig. 2 b, c). In the quantum thread model, taking into account the single-electron nature of the current, $G \sim K^{-1}q^2/h \sim 4\cdot10\text{-}5K^{-1}$ S, where: q is the electron charge, K is the number of quantum steps [4]. The ratio a_n/a^0 can be taken as the number of quantum steps in a nanocrystal. In our case, $a_n/a^0 \sim 10$. Then it should be: $G \sim (1^{-4})\cdot10^{-6}$ S. As the graphs in Fig. show. 2b, the values of $G \sim (1 – 2)\cdot10^{-6}$ S are in good agreement with the calculated ones. We used this circumstance to define conductivity as quantum.

Bloch oscillations in nanocrystals

In recent years, there has been increased interest in theoretical studies of a quantum mechanical phenomenon in crystals – Bloch oscillations, in connection with studies of low-dimensional semiconductor structures [5]. The predicted practical application of the phenomenon is the generation and recording of terahertz radiation modulated by supershort pulses. The physical essence of the phenomenon is that, under the influence of an external constant field in a crystal, an electron in the space of the band diagram E(k) makes a jump along the kx axis near the origin of coordinates in the scheme of reduced repeating Brillouin zones, oscillating on a limited segment of the axis along the field. The electron oscillates on a segment of the x axis along the field Fx with an amplitude ax~Eg(2qFx)$^{-1}$ and a frequency ν~qFxax/h. The inverse dependence on the field strength Fx (energy) is due to the relationship between energy and de Broglie wavelength for the electron: Λ* ~ h(2mE)-$^{1/2}$. The vibration intervals ax range from the nanocrystal size an to its lattice constant a0. Assuming that the field in a nanocrystal is uniform and equal to the ratio of the voltage drop V to the size an, we can obtain the formula: a_x/a_n~Eg(2qV)$^{-1}$, and estimate, in particular, the intervals of permissible variations of V for average values of a_n.

The oscillations under consideration occur as a result of the resonant vibrational motion of an electron at a linear distance ax with reflections of the de Broglie wave from crystallographic planes, as a result of which small current peaks appear on the current-voltage characteristic with a value proportional to the oscillation frequency ν. The number of these peaks, N, must be equal to the ratio a_n/a_0. The volt distance ΔV_i between adjacent peaks should change according to the formula: ΔV_i~$Eg(2q)^{-1}(an\text{-}ia^0)/a^0$, *where i ~ 0, 1, 2,…*$(a^n/a^{0\text{-}1})$ – the order of the reflected electron waves.

Experimentally, the current-voltage characteristics were measured for all studied variants in quantities, for each of them, of 80-90 nanocrystals in the range of external voltage up to 4 V and current up to 150 nA, but before the appearance of a large resonance peak (Fig. 3). The proportion of samples with features such as Bloch oscillations ranged from 60 to 90%, depending on their type. At the same time, the higher the dimensional quantization parameter C, the greater it is. The measured minimum values of ΔV_i and numbers N (Table 1) were in good agreement with the calculated ones, which we used as one of the proofs of the validity of the physical model used.

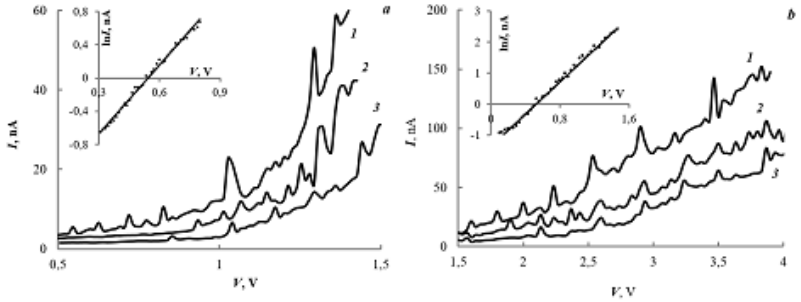


Figure 3. *Current-voltage characteristics with peaks of Bloch oscillations for different samples (1, 2, 3):*
a *– NC-InSb;* ***b*** *– NC-PbS.*

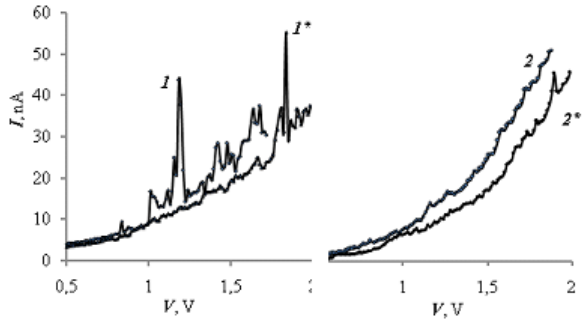
On electron entanglement in nanocrystals

In recent years, there has been increased interest in one of the phenomena predicted by the theory - quantum entanglement. In this case, experimental studies are carried out on photons, which are given entanglement properties in one way or another [6]. The Nobel Prize in Physics was awarded in 2022 for experiments with entangled photons. Thanks to these and subsequent experiments, quantum entanglement has become a physical reality, helping in computer science to overcome such limitations in the processing and transmission of information as ultra-fast computing, cryptography, and teleportation.

In this consideration, the quantum mechanical particle is an electron, information about the state of which is carried by the photons emitted by it. The phenomenon of entanglement is inherent in the states of an electron, transmitted in the properties of the photons emitted by it. In the crystal structure of a quantum-sized nanocrystal, an electron moves resonantly, exhibiting the properties of a quantum oscillator and emitting parameterized microwave radiation. Moreover, its movement must be spatially (structurally, geometrically) complex and, therefore, confusing. At certain parts of this movement, the electron can experience inhibition, emitting a photon with certain specific properties of an electromagnetic wave. In this regard, the phenomena of photonic entanglement are easiest to study on quantum-sized nanocrystals. The physical essence of the phenomenon, in our opinion, in this case is that an electron in a nanocrystal, oscillating resonantly in time and space, creates single-photon (more precisely, photon) radiation with strictly fixed parameters (frequency, polarization, coherence, phase relationships and perhaps something else). Such radiation most likely interacts only with an electron in the same state as the one that emitted it, that is, with exactly the same nanocrystal. In this case, the state of uncertainty will be expressed in the statistical difference be-

tween the technologically specified properties of the nanocrystal and the quantum mechanical uncertainty of the states of the electron in it. If it is possible to find two absolutely identical nanocrystals, then only statistically using a large sample size. In this case, the interaction of two identical samples should appear, located at a certain distance from each other and devoid of any interaction of an obvious nature - electromagnetic-wave.

We carried out such an experiment on two identical NANOEDUCATOR scanning probe microscopes. First, the current-voltage characteristics of each sample were measured when switched on separately, and then when switched on simultaneously. On each of the samples, 25-30 points (nanocrystals) were selected in the same zone, the current-voltage characteristics were measured and statistical analysis was carried out. In Fig. Figure 4 shows typical current-voltage characteristics of NC-InSb samples without interaction (curves 1 and 2) and with their interaction with supposed radiation (curves 1* and 2*). The current-voltage characteristics with the manifestation of resonance (characteristic resonance peaks) are significantly relatively shifted (Fig. 4a). The current-voltage characteristics without them did not change qualitatively (Fig. 4,b). We explain the observed phenomenon by the fact that in the range of nanocrystals of the same batch there will always be absolutely identical ones in shape and size, emitting absolutely identical photons at the same time, which is equivalent to the phenomenon of entanglement.



a ***b***

Figure 4. *Typical current-voltage characteristics of QP-InSb samples without interaction (1 and 2) and with interaction with supposed radiation (1* and 2*).* ***a*** *– current-voltage characteristic with characteristic resonant peaks;* ***b*** *– without them.*

Table 1

General characteristics of nanocrystals

NC	E_g, eV	m/m_0	a_0, nm	$a_{низм}$, nm	a_m, nm	p_n %	$\tilde{E}_{kn}$, eV			C	$a_{k=1}$ nm	$a_{k=2}$ nm	N	ΔV_i V
							$\tilde{E}_{k=1}$	$\tilde{E}_{k=2}$	exp					
CdSe	1.74	0.13	0.430	2.0-3.5	3.0	15	0.30	1.20	0.26	1.2	2.0-3.0	2.5-6.0	4-8	0.8
PbS	0.41	0.080	0.593	2.5-4.0	3.0	25	0.51	2.05	0.57	1.4	2.0-4.0	2.5-8.0	4-7	0.2
HgSe	0.07	0.045	0.585	3.5-5.5	4.0	50	0.49	1.94	0.60	1.5	2.0-5.5	3.0-8.0	6-9	0.06
InSb	0.17	0.013	0.649	4.5-7.5	5.5	70	0.89	3.56	0.83	2.5	2.5 -8.0	5.5-8.0	6-11	0.08

Thus, the analysis carried out indicates the possibility of controlled production of binary semiconductor nanocrystals, the crystalline perfection of which can be judged by their stoichiometric composition, polygonal shape, properties of quantum conductivity and Bloch oscillations. The phenomena of size quantization, manifested by resonant current peaks in the current-voltage characteristic, are caused by the de Broglie wave resonance process of electron motion in a nanocrystal as a deep, extended potential well.

References

1. N.D. Zhukov, M.V. Gavrikov / Electron transport in single colloidal quantum dots in an interelectrode nanogap // Technical Physics Letters, 48 (3), 61-65 (2022).

2. N. D. Zhukov, M. V. Gavrikov, S. N. Shtykov / Dimensional Modeling of the Synthesis and Conductivity of Colloidal Quantum Dots // Semiconductors, 56 (4), 269–274 (2022).

3. V.P. Dragunov, I.G. Unknown, V.A. Gridchin, Fundamentals of nanoelectronics (Logos, M., 2006), p. 495.

4. N.T. Bagraev, A.D. Buravlev, L.E. Klyachkin, A.M. Malyarenko, V. Gehlhoff, V.K. Ivanov, I.A. Shelykh // Semiconductors, 36(4), 462 (2002).

5. S. Singh, M. Battiato. Effect of Strong Electric Fields on Material Responses: The Bloch Oscillation Resonance in High Field Conductivities Materials 2020, 13(5), 1070. https://doi.org/ 10.3390/ma13051070

6. A. Ivashkin, D. Abdurashitov, A. Baranov, F. Guber, S. Morozov, S. Musin, A. Strizhak, I.Tkachev.Testing entanglement of annihilation photons. Scientific Reports. 13, 7559 (2023). https: //doi.org/10.1038/s41598-023-34767-8.

DOI 10.34660/INF.2023.77.36.301

别拉绍夫脉冲变压器
BELASHOV PULSE TRANSFORMER

Belashov Alexey Nikolaevich
Theoretical physicist
ORCID 0000-0002-4821-8004

抽象的。 这篇文章致力于电气工程，特别是脉冲交流变压器的设计和制造的新方法，这给我们的社区带来了困境。 制造紧凑型变电装置，不可挽回地损失部分来之不易的自然能源，或减少来之不易的自然能源损失，但同时增加变电装置的尺寸和使用独立初级的铜消耗量 每个半周期的次级多匝磁路。 此外，新型脉冲变压器还增加了多匝绕组控制系统，提高了变比，降低了多匝绕组的感抗和磁芯发热。

关键词：静态电磁装置，脉冲变压器，独立磁路。

Abstract. *The article is devoted to electrical engineering, in particular to new approaches to the design and manufacture of pulsed alternating current transformers, which poses a dilemma for our community. Manufacture compact transforming devices and irretrievably lose part of the hard-earned energy from nature or reduce irretrievable losses of hard-won energy from nature, but at the same time increase the size of the transforming devices and the amount of copper consumed by using independent primary and secondary multi-turn magnetic circuits for each half-cycle. Moreover, the new type of pulse transformer additionally contains a control system for multi-turn windings, which increases the transformation ratio, reduces the inductive and reactance of multi-turn windings, as well as heating of the magnetic cores.*

Keywords: *static electromagnetic device, pulse transformer, independent magnetic circuits.*

In the eighties of the 19th century, there was a real struggle between supporters of direct and alternating current systems, which reflected the search for ways to overcome the then urgent energy crisis associated with the problem of centralized production of electricity and its transmission over long distances. A lot of time has passed since then. Then and now this problem remains as relevant as before, but at that time the invention of the transformer was one of the strongest arguments in favor of alternating current. In this article we will try to return to the origins of the

invention of the transformer and look at this invention from a different perspective. The great role of the induction coil, which turned into a device later called a transformer, as a means of electrical separation of alternating current circuits was clearly recognized in his works by the Russian inventor P.N. Yablochkov, who later was the first to use a capacitor in an alternating current circuit.

In the early 1980s, it became increasingly clear that the DC power supply system had no prospects at that time. However, time passes and a lot changes. So, instead of incandescent heating lamps, energy-saving LED lamps are now mainly used; many household appliances in cars and buses have appeared that operate on direct current.

Moreover, when using AC transformers in a circuit, in addition to active resistance, reactance of multi-turn windings and heating of the magnetic circuit arises, which reduces the transformation ratio and the transformer has to be cooled, and the heat generated by the transformer is very difficult to use for useful purposes, so powerful AC transformers have to be cooled and expensive ones must be used cooling systems.

The purpose of the invention is to increase the transformation ratio by eliminating reactance from multi-turn windings and heating the magnetic cores.

This goal is achieved by the fact that the pulse AC transformer consists of independent magnetic circuits with primary and secondary multi-turn windings for each pulse pulse period, where the switching of the primary and secondary multi-turn windings is controlled from the electronic circuit.

AC pulse transformer, fig. 1, consists of input terminal 1 and input terminal 2. The primary winding 3 of the transformer 4 and the primary winding 5 of the transformer 6 are located on separate magnetic cores. The primary winding 3 of the transformer 4 is electrically connected to the capacitor 7, the cathode of the thyristor 8 and the control electrode 9, which through an additional resistance 10 interacts with the anode of the thyristor 8, the isolation capacitor 11, the cathode of the rectifying diode 12 and the input terminal 1.

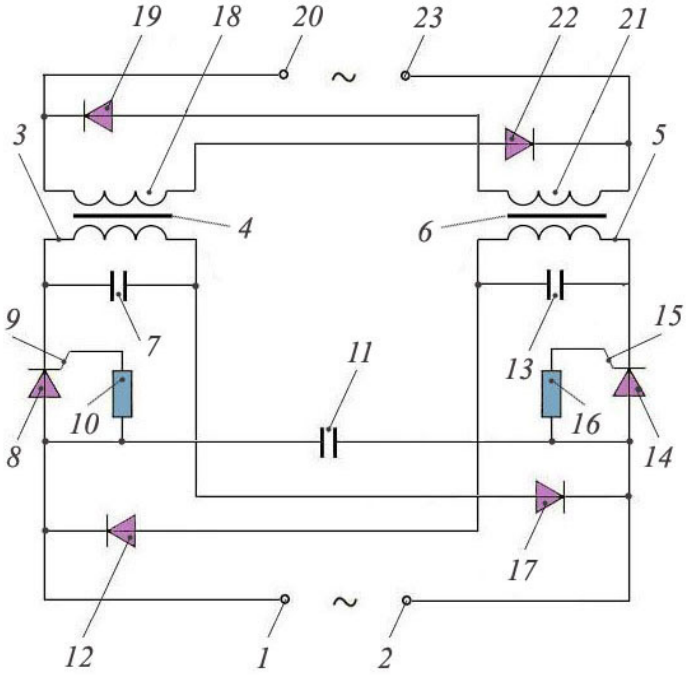


Figure 1.

The primary winding 5 of the transformer 6 is electrically connected to the capacitor 13, the cathode of the thyristor 14 and the control electrode 15, which through an additional resistance 16 interacts with the anode of the thyristor 14, the separating capacitor 11, the cathode of the rectifier diode 17 and the input terminal 2. The secondary winding 18 of the transformer 4 is electrically connected with the cathode of the rectifying diode 19, the output terminal 20 and the anode of the rectifying diode 22. The secondary winding 21 of the transformer 6 is electrically connected to the cathode of the diode 22, the output terminal 23 and the anode of the rectifying diode 19.

The only negative consequence of this invention is that it is necessary to increase the volume of copper consumed and increase the size of the pulse transformer, but in this case we get rid of Foucault currents and reactance of multi-turn windings and large heating of the magnetic core. Moreover, it must be especially emphasized that copper wires are a great asset of our country, and the heat released when the transformer is cooled disappears into the atmosphere without a trace.

Foucault currents arise under the influence of an alternating electromagnetic field and, by their physical nature, are no different from induction currents arising in linear wires. They are vortex, that is, closed in rings. The electrical resistance of a massive conductor is small, so Foucault currents, discovered by the French physicist Foucault and Jean Bernard Leon, can reach very high strengths.

Our community is currently faced with a dilemma:

- to leave everything as before and move towards compactness of inverting or transforming devices and irreversibly lose some of the energy hard-earned from nature;

- or to reduce irreversible losses of hard-earned energy from nature, but at the same time increase the size of inverting and transforming devices and the amount of copper consumed, which does not disappear without a trace and is a great asset to our community.

This technical solution is fully confirmed by the laws of physics. If we talk about the efficiency of a given pulse transformer, it can be calculated according to the proven laws of physics where it is necessary to calculate the ratio of useful work or power to expended.

$$\eta = \frac{A_{\text{пол}}}{A_{\text{затр}}} \qquad \eta = \frac{P_{\text{пол}}}{P_{\text{затр}}}$$

The pulse transformer works as follows.

A positive half-cycle 24 of an alternating current voltage of a given frequency and amplitude is supplied to terminal 1, Fig. 2, which is supplied to the anode of the thyristor 8, the cathode of the rectifier diode 12, the capacitor 11 and through the additional resistance 10 to the control electrode 9 of the thyristor 8. Then the positive half-cycle 24 through The thyristor 8 is supplied to the beginning of the primary multi-turn winding 3 of the transformer 4 and the capacitor 7, and from the end of the primary multi-turn winding 3 of the transformer 4, the positive half-cycle 24 is supplied to the capacitor 7 and through the rectifier diode 17 goes to terminal 2. Next, the negative half-cycle 25 of the voltage is supplied to terminal 2 alternating current of a given frequency and amplitude which is supplied to the anode of the thyristor 14, the cathode of the rectifying diode 17, the capacitor 11 and through the additional resistance 16 to the control electrode 15 of the thyristor 14. Then the negative half-cycle 25 through the thyristor 14 goes to the beginning of the primary multi-turn winding 5 of the transformer 6 and the capacitor 13. From the end of the primary multi-turn winding 5 of transformer 6, the negative half-cycle 25 is supplied to capacitor 13 and through the anode of the rectifying diode 12 goes to terminal 1. The beginning of the secondary multi-turn winding 18 of transformer 4 is connected to the output terminal 20 and the cathode of the rectifying diode 19. The end of the secondary winding 18 of transformer 4 through

the rectifier diode 22 is connected to the output terminal 23. The beginning of the secondary multi-turn winding 21 of the transformer 6 is connected to the output terminal 23 and the cathode of the rectifying diode 22. The end of the secondary multi-turn winding 21 of the transformer 6 is connected to the output terminal 20 through the rectifier diode 19. From terminals 20 and 23 AC voltage will be supplied from the secondary multi-turn windings of transformer 4 and transformer 6.

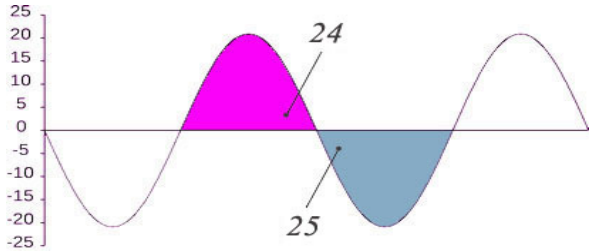


Figure 2.

However, if desired by consumers or manufacturers, depending on the location of the terminals from the secondary windings of transformer 4 and transformer 6, the pulse transformer can generate a pulse voltage shown in Fig. 3

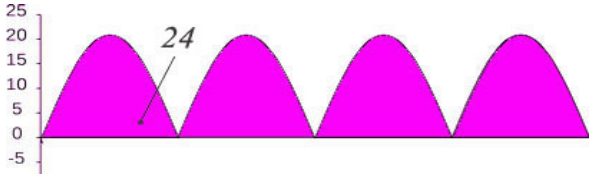


Figure 3.

The invention makes it possible to reduce irretrievable losses of electricity in the resistance of multi-turn windings and heating of magnetic cores and will increase the transformation ratio.

References

1. V.A. Pavlov, Yu.P. Pichugin, I.N. Romanenko, "Pulse transformer" USSR Author's Certificate No. 1078474 KL H01 F for 1984.

2. A.N. Belashov, "Belashov's Transformer", patent of the Russian Federation No. 2000619 KL N 01 A 33/00 for 1993.

3. A.N. Belashov, "Belashov wind engine", patent of the Russian Federation No. 2247860, KL. F 03 D 1/00 for 2005.

4. A.N. Belashov, patent of the Russian Federation "Belashov Screw", No. 2046996 KL. F 03 D 7/00 for 1995.

5. A.N. Belashov, patent of the Russian Federation "Belashov Generator", No. 20258847 KL. F 03 D 7/00 for 1994.

6. A.N. Belashov, "Belashov's wind power plant is self-regulating in height and interlocking in area." International scientific conference "International Scientific Solutions 2022" from 9.02. 2022 – New York, USA.

7. A.N. Belashov, "Discoveries, inventions, new technical developments."
URL: http://www.belashov.info

8. L.A. Sena, book "Units of physical quantities and their dimensions", publishing house "Nauka" Main editorial office of physical and mathematical literature, Moscow 1988.

9. V.I. Grigoriev, G.Ya. Myakishev, "Forces in Nature", Moscow "Science" 1988.

10. O.F. Kabardin, book "Physics, reference materials", publishing house "Prosveshchenie", Moscow, 1988.

11. V.E. Kitaev and L.S. Shlyapintokh, book "Electrical engineering with the fundamentals of industrial electronics", publishing house "Higher School", Moscow, 1973.

DOI 10.34660/INF.2023.10.90.302

捕食性螨 Neoseiulus californicus（Mesostigmata，Phytoseiidae）子宫培养物微生物组的表征

CHARACTERISATION OF THE MICROBIOME OF THE UTERINE CULTURE OF THE PREDATORY MITE *NEOSEIULUS CALIFORNICUS* (MESOSTIGMATA, PHYTOSEIIDAE)

Meshkov Yuri Ivanovich
PhD in Biology, Researcher
All-Russian Scientific Research Institute of Phytopathology

Andrianov Boris Vitalievich
Doctor of biological sciences, Researcher
Vavilov Institute of General Genetics, Russian Academy of Sciences

抽象的。 我们鉴定了构成加州新狒狒微生物群的细菌种类，加州新狒狒以饲料叶螨二斑叶螨为食饲养。 微生物组基于腐生土壤细菌：嗜麦芽寡养单胞菌、约氏不动杆菌、大肠杆菌和霍马氏肠杆菌，也称为机会性人类病原体。 我们还鉴定出细胞内寄生细菌鲑鱼肾杆菌。 研究结果为加州新鳅养殖技术的改进提供依据。

关键词：植绥科，胞内细菌，16S rRNA 基因。

Abstract. *We identified the bacterial species that make up the microbiome of the Neoseiulus californicus, reared on the forage spider mite Tetranychus urticae. The microbiome is based on saprophytic soil bacterias': Stenotrophomonas maltophilia, Acinetobacter johnsonii, Escherichia coli and Enterobacter hormaechei, also known as opportunistic human pathogens. We also identifesd intracellular parasitic bacteria Renibacterium salmoninarum,. The results obtained provide a basis for improving the farming technology of Neoseiulus californicus.*

Keywords: *Phytoseiidae, intracellular bacteria, 16S rRNA gene.*

Introduction.

Two main methodological approaches are used to characterise the microbiome of predatory mites of the family Phytoseiidae. The most complete coverage of all groups of microorganisms in the microbiome of a species is provided by microscopic examination of mite tissues. Microscopic examination of tissues from adult mites *Phytoseiulus persimilis*, *Typhlodromips swirskii* and *Neoseiulus cucumeris*

reveals the presence of bacteria in cells of the gut and malpighian vessels. Microsporidia are found in cells of the outer skin of the legs and in cells of the idiosoma. [Sumner-Kalkun et al. 2020]. The advantage of broad coverage of microbial groups is combined with the disadvantage of accuracy in identifying individual species. Microscopic examination only allows the identification of the major groups of microorganisms, such as bacteria, yeasts, microsporidia, actinomycetes, but does not allow the identification of specific microbial species of the microbiome. The second approach is based on the analysis of 16S rRNA gene libraries obtained with universal primers. [Hoy, Jeyaprakash 2005; Jeyaprakash, Hoy 2004; Pekas et al. 2017]. The gut microbiome has been studied in detail in *Neoseiulus cucumeris* [Pekas et al. 2017]. The microbiome is mainly represented by the saprophytic bacteria *Staphylococcus kloosii* and *Staphylococcus saprophyticus*. Typical human gut bacteria: *Lactococcus sp*., *Leuconostoc sp*. and *Propionibacterium* are rare in the mites' microbiome. Intracellular bacteria: *Wolbachia*, *Cardinium* and *Spiroplasma* are known in phytoseiid mites [Enigl, Schausberger 2007; Wu, Hoy 2012; Famah, et al. 2014]. The presence of these bacteria is often associated with a shift in the sex ratio towards females and with cytoplasmic incompatibility [Wu, Hoy 2012].

In addition to recurrent bacteria, several pathogenic species are often detected in phytoseiid mite populations, which reduce the reproductive parameters of mite populations or the ability of mites to feed on spider mites. The bacterium *Acaricomes phytoseiuli* sometimes infects biocontrol populations of *Phytoseiulus persimilis*, resulting in shortened mite lifespan, reduced fecundity and reduced feeding activity [Gols et al. 2007].

The presence of the bacterium *Oligosporidium occidentalis* is associated with *Metaseiulus occidentalis* disease, and the phytopathogenic bacterium *Brenneria salicis* is associated with *Neoseiulus cucumeris* disease [Hoy, Jeyaprakash 2008; Pekas et al. 2017]. Based on these data, it can be concluded that it is necessary to control the microbiome of phytoseiid mite populations and implement measures to purify it from potential pathogens.

In this communication, we characterise the Neoseiulus californicus uterine culture microbiome based on metagenomic data of 16S rRNA gene sequences extracted from primary reads of the *Neoseiulus californicus* chologenome.

Materials and methods.

The predatory mites *N. californicus* used in this study were obtained from the collection of the All-Russian Research Institute of Phytopathology. The mite line was obtained from a single fertilised female. The line obtained was bred in mass culture on the spider mite *Tetranychus urticae*. Before setting up the experiment, the predatory mites were transferred to a culture vial without food mites, where they were starved for two days. Adult mites were then collected individually in

lysing solution for isolation of total DNA and determination of the nucleotide sequence of the mite's chologenome. Sequencing was performed on a MinION Nanopore Sequencer 512 channel sequencer (Oxford Nanopore Technologies) using MinKNOW v.5.1.0 software. The AUGUSTUS program was used to search for genes. Identified genes were aligned to the nr database using BLAST software. The resulting *N. californicus* hologenome was deposited in the GenBank database under accession number SRX18492637. To analyse the microbiome of *N. californicus*, all 16S rRNA gene fragments were extracted from the Genome Project using BLAST software and the Centrifuge 16S NCBI database.

Results and discussion.

We compared all the 16S rRNA sequences extracted from the *N. californicus* genome project with the reference sequences in the 16S NCBI database using the BLAST programme. As a result, we obtained a list of bacterial species within the *N. californicus* hologenome and made an estimation of their quantity by the number of reads mapped per genome, or (numReads). The results obtained are summarised in Table 1

Table 1.

Microbiome of the predatory mite N. californicus based on the 16S rRNA gene. The list is sorted by the value of the parameter numReads, which can be considered as a ranking score of the number of bacteria in the microbiome. The first 45 identified bacterial species with the highest representation in the microbiome are presented.

#	Ecological group	Bacteria species of the N. californicus microbiom	Value numReads
1	soil saprophyte	*Stenotrophomonas maltophilia*	36
2	intestinal microflora	*Enterobacter hormaechei*	32
3	soil saprophyte	*Stenotrophomonas maltophilia R551-3*	20
4	intestinal microflora	*Escherichia coli*	12
5	soil saprophyte toxicant	***Clostridium botulinum***	12
6	soil saprophyte	*Acinetobacter johnsonii*	12
7	soil saprophyte	*Acinetobacter johnsonii XBB1*	12
8	opportunistic pathogen	*Acinetobacter baumannii*	8
9	soil saprophyte opportunistic pathogen	*Kocuria rosea*	8
10	pathogenic intracellular bacteria	***Renibacterium salmoninarum***	8
11	aquatic saprophyte	*Synechococcus sp. JA-3-3Ab*	8
12	aquatic saprophyte	*Pelodictyon phaeoclathratiforme BU-1*	8

13	soil saprophyte	*Stenotrophomonas sp. MYb57*	8
14	opportunistic pathogen, , toxicant	*Pseudomonas aeruginosa*	4
15	soil saprophyte	*Pseudomonas putida*	4
16	opportunistic pathogen	*Proteus mirabilis*	4
17	opportunistic pathogen	*Proteus vulgaris*	4
18	fish pathogen	***Aeromonas salmonicida***	4
19	guinea-pig pathogen	***Aeromonas caviae***	4
20	leech symbiont	*Aeromonas veronii*	4
21	skin microflora	*Staphylococcus warneri*	4
22	nematode symbiont	*Moraxella osloensis*	4
23	avian pathogen	***Riemerella anatipestifer***	4
24	vertebrate pathogen	***Salmonella enterica subsp. enterica***	4
25	probiotic intestinal microflora	*Pantoea dispersa*	4
26	skin microflora	*Staphylococcus succinus*	4
27	aquatic saprophyte, fish pathogen	*Pseudomonas plecoglossicida*	4
28	soil saprophyte	*Kocuria palustris*	4
29	soil saprophyte, opportunistic pathogen	*Acinetobacter bereziniae*	4
30	aquatic saprophyte	*Acinetobacter guillouiae*	4
30	intestinal microflora	*Providencia alcalifaciens*	4
32	intracellular pathogen of insects	***Spiroplasma sp. TIUS-1***	4
33	soil saprophyte, human pathogen, toxicant	***Bacillus cereus ATCC 10987***	4
34	soil saprophyte	*Cytophaga hutchinsonii ATCC 33406*	4
35	intracellular pathogen	***Renibacterium salmoninarum ATCC 33209***	4
36	Aquatic and soil saprophyte	*Chlorobium phaeobacteroides DSM 266*	4
37	soil saprophyte and insect pathogens	***Pseudomonas entomophila***	4
38	aquatic saprophyte	*Ammonifex degensii KC4*	4
39	aquatic saprophyte	*Planctopirus limnophila DSM 3776*	4
40	soil saprophyte, toxicant	***Bacillus thuringiensis YBT-1518***	4
41	aquatic saprophyte	*Pseudothermotoga thermarum DSM 5069*	4
42	soil saprophyte	*Sugiyamaella lignohabitans*	4
43	soil saprophyte	*Acetomicrobium mobile DSM 13181*	4

44	aquatic saprophyte	*Aeromonas rivipollensis*	4
45	aquatic saprophyte	*Pseudothermotoga hypogea DSM 11164 = NBRC 106472*	4

The basis of the *N. californicus* microbiome is the soil saprophytic bacterium *Stenotrophomonas maltophilia*. It is a ubiquitous soil aerobic gram-negative motile bacterium, biofilm-forming and opportunistic human pathogen. It is a component of the oral microbiome of terrarium-bred snake species [Hejnar et al. 2007]. It is recorded in the closely related phytoseiid species *Neoseiulus cucumeris*, but as a minority [Pekas et al. 2017]. The second most abundant group of bacteria in the microbiome is the intestinal bacteria: *Enterobacter hormaechei* and *Escherichia coli*. These bacterial species, which prefer an environment with a high concentration of amino acids, reflect the characteristics of *N. californicus*, which feeds on mites with a high protein content. The high diversity and abundance of pathogenic or toxin-producing bacteria should be noted. In Table 1 These species are highlighted in bold and underlined. Of interest is the presence of unusual intracellular pathogenic bacteria, *Renibacterium salmoninarum*, which can infect fish and is transmitted both horizontally between individuals and vertically through eggs (Rozas-Serri, et al. 2020). The presence of a large number of bacterial species known to produce toxins in the *N. californicus* microbiome suggests that the current composition of the *N. californicus* microbiome is not optimal and that it is possible to improve the growth parameters of the mite population by optimising the microbiome, removing pathogenic bacterial species and replacing them with probiotic bacteria.

Funding. This work was financially supported by the Russian Science Foundation within scientific project no. 22-24-00727.

References

1. Akyazi R., Liburd O. E. (2019) Biological Control of the Twospotted Spider Mite (Trombidiformes: Tetranychidae) with the Predatory Mite Neoseiulus californicus (Mesotigmata: Phytoseiidae) in Blackberries. Florida Entomologist, 102, 373-381. https://doi.org/10.1653/024.102.0217

2. Enigl M., Schausberger P. (2007). Incidence of the endosymbionts Wolbachia, Cardinium and Spiroplasma in phytoseiid mites and associated prey // Exp Appl Acarol. V. 42. P. 75–85.

3. Famah S. N., Hanna R., Breeuwer J. A., et al. The endosymbionts Wolbachia and Cardinium and their effects in three populations of the predatory mite Neoseiulus paspalivorus // Exp Appl Acarol. 2014. V. 64. P. 207-21. doi: 10.1007/s10493-014-9820-0

4. Glinushkin A. P., Yakovleva I. N., Meshkov Y. I. (2019) The impact of pesticides used in greenhouses, on the predatory mite Neoseiulus californicus (parasitiformes, phytoseiidae). Rossiiskaia selskokhoziaistvennaia nauka, 3, 32-34. https://doi.org/10.31857/S2500-26272019332-34

5. Gols R., Schutte C., Stouthamer R., et al. PCR-based identification of the pathogenic bacterium, Acaricomes phytoseiuli, in the biological control agent Phytoseiulus persimilis (Acari: Phytoseiidae) // Biol. Control. 2007. V.42. P. 316-325. https://doi.org/10.1016/j.biocontrol.2007.06.001

6. Hejnar P., Bardoň J., Sauer P.; Kolář M. (2007). Stenotrophomonas maltophilia as a part of normal oral bacterial flora in captive snakes and its susceptibility to antibiotics // Veterinary Microbiology. 121 (3–4): 357–362. doi:10.1016/j.vetmic.2006.12.026

7. Hoy M., & Jeyaprakash A. (2005). Microbial diversity in the predatory mite Metaseiulus occidentalis (Acari: Phytoseiidae) and its prey, Tetranychus urticae (Acari: Tetranychidae). Biological Control. 32. 427-441. https://doi.org/10.1016/j.biocontrol.2004.12.012

8. Hoy M. A., Jeyaprakash A. (2008). Symbionts, including pathogens, of the predatory mite Metaseiulus occidentalis: current and future analysis methods // Exp Appl Acarol. V. 46. P. 329-47. doi: 10.1007/s10493-008-9185-3

9. Jeyaprakash A., Hoy M. A. (2004). Multiple displacement amplification in combination with high-fidelity PCR improves detection of bacteria from single females or eggs of Metaseiulus occidentalis (Nesbitt) (Acari: Phytoseiidae). J Invertebr Pathol. 86(3):111-6. doi: 10.1016/j.jip.2004.05.005

10. Ondov B. D., Bergman N. H., and Phillippy A. M. (2011). Interactive metagenomic visualization in a Web browser. BMC Bioinformatics. 12(1):385.

11. Pekas A., Palevsky E., Sumner J.C. et al. (2017). Comparison of bacterial microbiota of the predatory mite Neoseiulus cucumeris (Acari: Phytoseiidae) and its factitious prey Tyrophagus putrescentiae (Acari: Acaridae) // Sci Rep. 7, 2. https://doi.org/10.1038/s41598-017-00046-6

12. Rozas-Serri M., Lobos C., Correa et al., (2020). Atlantic Salmon Pre-smolt Survivors of Renibacterium salmoninarum Infection Show Inhibited Cell-Mediated Adaptive Immune Response and a Higher Risk of Death During the Late Stage of Infection at Lower Water Temperatures // Frontiers in Immunology. 11. 10.3389/fimmu.2020.01378

13. Sumner-Kalkun J. C., Baxter I., Perotti M. A. (2020). Microscopic analysis of the microbiota of three commercial Phytoseiidae species (Acari: Mesostigmata) // Exp Appl Acarol. V. 81. P. 389–408. doi: 10.1007/s10493-020-00520-3

14. Wu K., Hoy M. A. (2012). Cardinium is associated with reproductive incompatibility in the predatory mite Metaseiulus occidentalis (Acari: Phytoseiidae) // J Invertebr Pathol. 110:359–365.

科学出版物

上合组织国家的科学研究：协同和一体化

国际科学大会的材料

2023 年 9 月 30 日。中国北京

编辑A.A.Siliverstova
校正A.I.尼古拉耶夫

2023 年 9 月 30 日。中国北京
USL。沸点：98.7。 订单253.流通500份。

在编辑和出版中心印制
无限出版社