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TRENDS OF THE RUSSIAN MILITARY-INDUSTRIAL COMPLEX IN THE GROWING CONFRONTATION WITH THE COLLECTIVE WEST

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抽象的。 作者研究了全球军火市场的转型以及军工综合体品牌产品种类的增长，这些产品正变得更加创新和高质量，同时考虑到通过数字化转型和数字化转型解决的日益增长的威胁和任务。 在“知识经济”中使用人工智能和大数据系统。

关键词：军工联合体、全球军火市场、俄罗斯、美国、中国、印度、人工智能、大数据、网络空间、NBICS、工业4.0。

Abstract. *The authors examine the transformation of the global arms market and the growth of assortment in the branded line of military-industrial complex products, which is becoming more innovative and high-quality, taking into account growing threats and tasks being solved through digital transformation and the use of AI and Big Data systems in the “knowledge economy.”*

Keywords: *military-industrial complex, global arms market, Russia, USA, China, India, AI, Big Data, cyberspace, NBICS, Industry 4.0.*

After the death of Iranian President Ebrahim Raisi in a plane crash and the emerging escalation of violence and growing tension in the countries of the Middle East, the issues of ensuring states’ own sovereignty are becoming increasingly relevant. That is why the transformation of Russia from an importer of weapons and military equipment into an exporter was initially undoubtedly associated with a long-term increase in military spending, which, based on the Soviet experience

of the defense industry, gave amazing results in the field of materials science and hypersound, multiple launch rocket systems and drones for various purposes and applications. Some countries that claim to be regional and even world leaders began by purchasing military products from their traditional partners. For example, for several decades of the 20th and even 21st centuries, China and India were the largest consumers of Russian weapons. Having created their own diversified military production, they began to actively supply to other countries, creating competition for the "three leaders" in the markets of third countries (including Africa, Latin America and the Middle East) [1]. A similar picture can be observed in relation to a number of other countries. South Korea, Saudi Arabia and the United Arab Emirates are still the largest importers of arms and military equipment, but are gradually creating their own large and technologically advanced defense companies.[1] [2]

Is the global arms market becoming more and more "commoditized"? Commoditization refers to an economic situation characterized by almost no meaningful differentiation between competing goods, and where instead they are sold almost exclusively on the basis of price. In our case, commoditization is understood as the process of transforming a product from an elite one into a public one, and the Second Chinese Leapfrog, which has been going on since February, is making the world more transparent and China-centric. Commodity products are characterized by standardized, common technology or attributes rather than unique branding or capabilities, resulting primarily in price competition.[2] [3]

In this regard, Southeast Asia may be a good example of such potential commercialization. If arms sales to the region truly become a commodity business, it could result in Southeast Asian countries gaining increased access to advanced military equipment and technology. And with the security situation in the region escalating, such as in the South China Sea, where the prospect of conflict grows by the day, a freer flow of all types of advanced weapons to local militaries could seriously undermine regional stability. [4]

The Southeast Asian arms market is unique for a number of reasons. Firstly, it is relatively small and, according to the Stockholm International Peace Research Institute (SIPRI), in total it amounts to only 2-3 billion dollars a year (for comparison, South Korea annually spends almost the same amount on imported weapons as the entire South -East Asia combined). [5]

However, it is a fast-growing market, and it is one of the most truly open and competitive markets when it comes to selling weapons (compared to China or India, which traditionally bought weapons mainly from the Soviet Union and

[1] The Military Balance 2020-2021. –L.: International Institute of Strategic Studies,2021. –434 p.

[2] Leonovich, A.N. World military production in the context of economic globalization: monograph / A.N. Leonovich. —Moscow, 2021. — 236 p.

Russia, or from Japan, South Korea or Taiwan , which are more or less dependent markets of the US defense industry). These factors are especially important given the "buyer's market" for arms that has existed since the end of the Cold War. [6]

As military procurement budgets shrink, traditional leading arms manufacturers in North America and Europe are increasingly moving abroad in search of new markets to compensate for declining domestic demand. European defense firms such as BAESystems, Saab and Thales now generate up to three-quarters of their revenue from overseas sales. It is believed that the Russian arms industry receives up to 90 percent of its revenue from exports. At the same time, other arms-producing states are becoming competitive arms exporters. The Israeli defense industry typically exports more than 75 percent of its output, while countries such as Brazil, China, Poland and South Korea have become aggressive arms producers. [7]

Not only has arms exports become critical to the survival of most arms manufacturers, but the global arms market is saturated with highly motivated sellers. Consequently, supplier reticence has given way to a willingness to sell virtually every type of conventional weapons system available in Southeast Asia. No potential sale is too small to pass up, and sellers are willing to cut a deal when it comes to price.

This can be clearly seen in the structure of arms supplies to Southeast Asia over recent decades. The region is home to some of the world's most advanced weapons systems, from a wide variety of suppliers. Russia sold Su-30 fighter jets to Indonesia, Malaysia and Vietnam. [3] [8]

Indonesia has received 16 T-50 trainer and light combat aircraft from South Korea and is collaborating with Korea on the KFX Next Generation Combat Aircraft Project, in addition, Indonesia is acquiring 24 ex-USAF F-16 fighter jets from the United States. Singapore has acquired 20 F-15 fighter jets in recent years and, as a partner in the international JointStrikeFighter program, may also acquire up to 100 F-35 fighter jets. The Philippines has ordered 12 FA-50 fighters from Korea (and may purchase 24 more), while Thailand has purchased 12 Gripen fighters from Sweden. [9]

Meanwhile, regional navies have acquired or are currently acquiring submarines from France, Germany, South Korea, Russia and Sweden. Malaysia purchased warships from France, Germany and the United Kingdom, while the Netherlands sold corvettes to Indonesia and Vietnam. Russia has exported frigates to Vietnam, while China and South Korea are supplying warships to the Thai Navy. [10]

Southeast Asian ground forces are even more eclectic when it comes to weapons acquisitions. The Malaysian Army has tanks from Poland, armored vehicles

[3] Agibalova, L.S. Positioning of Russia on the global arms market [Text] / L.S. Agibalova // Innovation processes in the scientific environment. – M., 2022. – P. 11-13.

from the UK, South Korea and Turkey, multiple rocket launchers (MLRS) from Brazil, howitzers from South Africa, anti-tank weapons from Pakistan, Russia, France, Spain and the US and surface-to-air missiles "(SAM) from Russia, China, Pakistan and Great Britain. The Indonesian TNI is equipped with tanks from Germany, armored vehicles from France and South Korea, anti-tank weapons from Russia, Sweden and the USA, air defense systems from China, France and Sweden and MLRS from Brazil. The Thai army is armed with Chinese and Ukrainian tanks, American armored personnel carriers, French and Israeli howitzers, as well as French, Italian, Russian and American helicopters.[4] [11]

Consequently, no single arms supplying country dominates the overall Southeast Asian arms market. In fact, according to SIPRI, no arms exporter has accounted for more than 10% of this total market in the last decade, the only exception being Russia, which accounts for a whopping 44% of the market, but this is mainly due to the recent increase in arms shipments to just one country, namely to Vietnam. [12]

Based on these patterns of recent arms transfers, it can be concluded that the Southeast Asian arms market is becoming increasingly commoditized. The fact that most individual Southeast Asian militaries possess a diverse range of weapons systems acquired from a relatively wide range of supplier states suggests that the capabilities of competing weapons systems are judged to be relatively equal, and that therefore price is a major factor. determining the process of acquiring weapons. Commoditization could certainly help new suppliers such as Brazil, Poland and South Korea penetrate the Southeast Asian arms market. This may also explain how Russia was able to find expanded opportunities to export weapons to the region, especially its fighter jets (e.g., Indonesia and Malaysia). [13]

However, even with relatively equal opportunities, price alone does not always have the greatest impact on gun acquisition. A variety of other motives can and do influence gun purchasing decisions, including reliability, after-sales support (parts and upgrades), technology transfer and offsets (such as licensed manufacturing agreements), and even bribery. The factors of political instability and geoeconomic volatility of markets in their post-Covid recovery are also strong.

The tasks of modern Russia, which has received a universal economist-statist in the leadership of the Ministry of Defense of our Motherland, allow us to talk about their professional solution due to the convergence of many innovations and NBICS technologies into Industry 4.0, which can be more precisely and targetedly applied in the digital transformation of fixed assets of the defense industry and implemented for each type of troops in accordance with the level of tasks and their specifics on the battlefield and in virtual space.

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DOI 10.34660/INF.2024.99.58.182

虚拟现实和增强现实技术在高等教育中的应用前景
PROSPECTS FOR THE IMPLEMENTATION OF VIRTUAL AND AUGMENTED REALITY TECHNOLOGIES IN HIGHER EDUCATION

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注解。 该研究的目的是分析虚拟和增强现实技术在俄罗斯高等教育机构中的实施情况。 揭示了“虚拟和增强现实技术”概念的解释内容，确定了它们在高等教育系统中的优点和缺点。 对高等教育机构的组成和结构进行了分析，确定了需要最积极实施虚拟和增强现实技术的方向和专业。 结论是，虚拟和增强现实技术在高等教育机构中的引入和发展过程取决于教育过程的真正转变，因为虚拟和增强现实技术的使用最广泛地体现在以实践为导向的专业和来自 国家对教育数字化领域投入了大量资金支持。

关键词：虚拟现实技术、增强现实技术、高等教育机构、学术方向、政府项目、学习过程。

Annotation. *The purpose of the study is to analyzeimplementation of virtual and augmented reality technologies in Russian higher education institutions. The content of the interpretation of the concept of “virtual and augmented reality technologies” is revealed, their advantages and disadvantages in the higher education system are determined. An analysis of the composition and structure of higher educational institutions was carried out, directions and specialties were identified that require the most active implementation of virtual and augmented reality technologies. It is concluded that the processes of introduction and development of virtual and augmented reality technologies in higher education institutions depend on the real transformation of educational processes, since the use of virtual and augmented reality technologies is most widely represented by*

practice-oriented specialties and from the allocated volumes of state financial support in the field of digitalization of education.

Keywords: *virtual reality technologies, augmented reality technologies,higher educational institutions, academic directions, government programs,learning processes.*

The higher education system acts as the most promising direction for the introduction of virtual and augmented reality technologies. The choice of methods for implementing virtual and augmented reality technologies is carried out based on the specifics of a particular academic area of training and the specialty of students.

M.E. Weindorf-Sysoeva and V.V. Pchelyakov, noted that in the current conditions in the educational and scientific processes of many countries of the world community there is an active use of digital and information technologies, which are effectively introduced into the education system, as they contribute to the creation of new innovative technological approaches to learning [2]. S.V. Tolmacheva and L.A. Tolmachev pointed out the fact that virtual and additional reality technologies are aimed at organizing such educational processes in which students are able to apply various knowledge without leaving the classroom [18].

P.M. Vidyaykin and D.A. Taurova, noted that educational processes organized on the basis of the use of virtual and additional reality technologies provide students in architectural and construction disciplines with ample opportunities in the field of virtual computer modeling of design processes affecting architectural, design, technological, economic and other information, while students, medical Universities, using these technologies in their educational processes, are able to study the anatomy of the human body, implement surgical intervention in virtual space, avoiding the risk of causing irreparable damage at the final stages of training in the specialty [3].

K.S. Intinson, pointed out the fact that virtual and additional reality technologies are capable of presenting complex structured materials in game forms on specially designed simulators, which significantly facilitates and accelerates the process of mastering educational materials, especially when it comes to the areas of navigation, aircraft navigation and driving ground vehicles [4]. Consequently, the education system begins to apply actively the principle of “technologization” in learning processes. N.Yu. Korneeva and N.V. Uvarin reveal the interpretation of the content of the concept “virtual reality” from the standpoint of simulations of real situations, which are produced using computer programs and through the senses lead subjects to reproduce sensations and perceptions of the surrounding reality [7].

The founder of virtual reality (VR) technology, Morton Heilig, by combining in one device the processes of movement, processes generating odors, sounds and

air currents, processes of visual perception, for the first time immersed the consciousness of an individual in virtual reality, and thereby created a qualitatively new, innovative breakthrough technology. Myron Krueger was the first to coin this term [17].

The breakthrough to the use of these technologies in practice first occurred in the entertainment industry and precisely at the moment when virtual reality glasses and helmets were created. Since then, these technologies have been constantly modernized and updated taking into account consumer requirements. In modern conditions, virtual reality is created based on VRML (a special coding language). Augmented reality (AR) is a technology that allows gadgets to update system functions and applications. Their creator is Tom Caudell [17].

I.I. Polevodoy, A.G. Ivanitsky, A.S. Mikanovich, S.M. Pastukhov, A.V. Grachulin, V.N. Ryabtsev, O.D. Navrotsky, A.O. Likhomanov, G.V. Vinyarsky, I.S. Gusarov, the processes of introducing virtual and augmented reality technologies in higher educational institutions were studied, and the authors noted that for the first time the Russian education system used them in 2016 in medical universities.

Based on the composition and structure of higher educational institutions, it should be noted that in 266 cities of the Russian Federation at the end of 2023, 1024 higher educational institutions operate on the basis of full-time education, while according to the form of ownership, 853 of them are educational institutions, represented by state higher educational institutions and 171 educational institutions represented by non-governmental higher educational institutions [21]. The dominance of public higher education institutions emphasizes the importance of state support in the field of digitalization of the education system in the context of resolving issues related to the introduction of technology virtual and additional reality in learning processes.

Based on monitoring data from the Higher School of Economics based on the results of 2023, it should be noted that in the Russian Federation higher education4 million people received it [5]. By the end of 2023, over 437 thousand budget places have been created in higher educational institutions of the Russian Federation [5]. According to monitoring data from the Higher School of Economics, 1.9 million Russian students study in budget places, which emphasize the importance of state support in the field of digitalization of the education system [5].

In the current conditions in the Russian Federation, the introduction of virtual and augmented reality technologies into the education system is being implemented within the framework of the following programs: Project “Education” [11]; “Strategy for the development of the information society of the Russian Federation for 2017-2030” [9]; Project “Digital Economy” [13]; Project “Digital School” [12]; Project “Digital University” [14]; Federal project “Digital educational environment” [19].

In Federal project "Digital educational environment" the definition is presented: "Digital learning is an educational activity in which the key factor in the production of educational services is the use of applications, programs and other digital tools, presented in digital form and associated with the processing of large volumes of information" [19].

A.V. Kozlov noted that digitalization is the evolution of digital technologies in a certain period of time, which entails a qualitative change in the structure of educational processes in general and a qualitative change in the types of training in particular [6]. Meanwhile, despite the fact that all program documents of the Russian Federation are aimed at the creation and implementation of technologies in higher education institutions, their use, associated with medicine and navigation, where there are high risks when making an error, resulting in human casualties [10]. The distribution of students in accordance with academic areas of education and specialties [5] is presented in Figure 1.

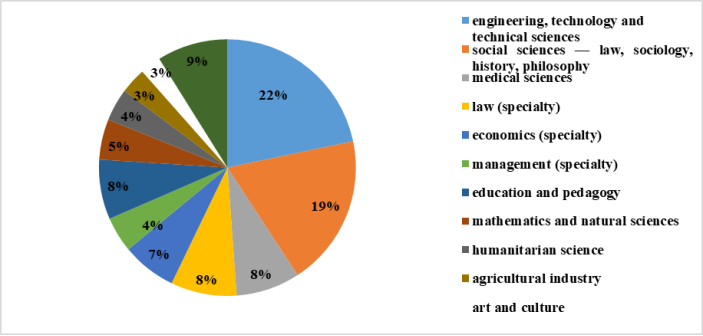

Figure 1. *Grouping students in academic areas of education and specialties (%) [Source: compiled by the authors based on materials from [5]*

It should be noted that in accordance with the academic directions and specialties of university students in engineering, technology and technical sciences (868 thousand students), in medical sciences (322 thousand students), in economics (274 thousand students), in management (179 thousand students), education and pedagogy (301 thousand students), the minimum number of target audiences requiring the introduction of virtual and augmented reality technologies in educational processes is 1,944 thousand students, almost 50% of the total number in higher educational institutions, but taking into account specialties of a narrow focus, it will be much more.

Russian researchers E.A. Kuznetsova, P.M. Vidyaykina, D. A. Taurova, it was found that virtual and augmented reality technologies in teaching students of eco-

nomic specialties represent a global innovative process of transformation of educational programs, causing a revision of approaches and teaching strategies and a number of fundamental changes in the education system [8]. Acquisition students of economic specialties carry out professional skills in the process of performing practical tasks based on solutions to situational problems, in which modeling of real situations is used, and this is the area of virtual technologies and augmented reality technologies (simulation of real communication with clients from the financial services sector, trade sector or skills development management of the workforce, demonstration of a visual theoretical aid, including group or individual forms of immersion of students in lectures), which can be actively used in distance education. It should also be noted that there are opportunities to create special applications for smartphones that help increase the efficiency of students' self-training by studying, repeating and consolidating educational materials (Figure 2).

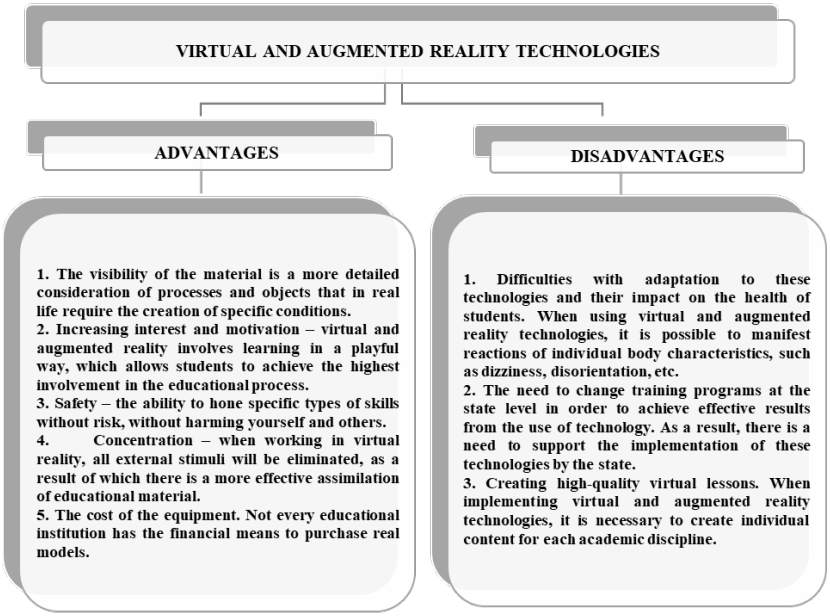

Figure 2. *Advantages and disadvantages of technologies [compiled by the authors]*

The need to introduce virtual and augmented reality technologies into the higher education system is justified by large-scale changes associated with the development of the use of digital computer technologies (BIM technologies) designed to organize information and virtual computer modeling in real design processes

affecting architectural design, technological information in construction sector (models and algorithms for virtual computer simulation). For clarity, let us imagine the dynamics of the volumes of the Russian digital market computer technologies in construction [22] (Figure 3).

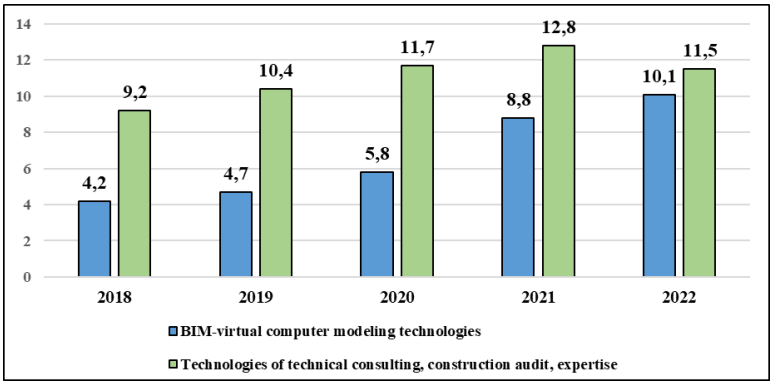

Figure 3. *Dynamics of digital computer technology market volumes in construction (billion rubles) [Source: compiled by the authors based on [15]*

There are steady upward trends in both directions. However, the volumes of BIM technologies for virtual computer modeling by the reporting year 2022 compared to the base year 2018 showed a rapid growth of 140.47%, while the market volumes of conventional digital computer technologies in the period under study increased in general by only 25%, and according to the results 2021/2022 they decreased by 10.15%.

For example, when introducing BIM technologies, graduates of higher educational institutions who have become specialists use virtual and augmented reality technologies, which make it possible to display most effectively architectural, design, technological and other solutions in the design process of construction projects [1].

When exploring the process of introducing virtual and augmented reality in higher educational institutions, it is necessary to present an index of the development of digitalization of the Russian education system. It is included in index of development of digitalization of the social sphere and key sectors of the Russian economy based on the results of 2020/2024 [15], (Figure 4).

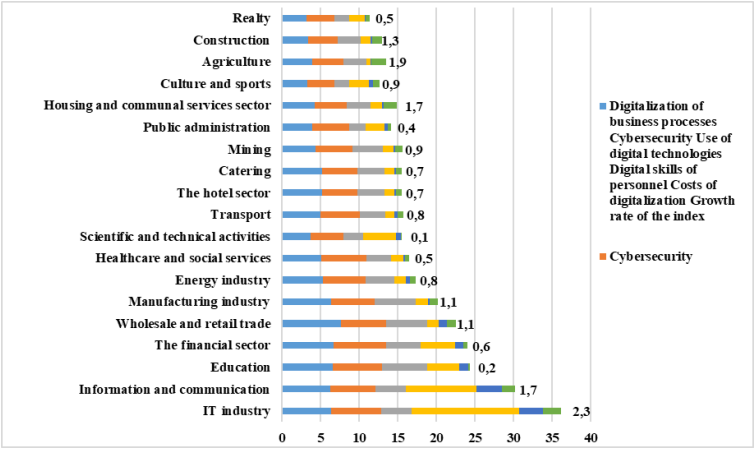

Figure 4. *Index of development of digitalization of the social sphere and key sectors of the Russian economy based on the results of 2020/2024 [Source: compiled by the authors based on materials from [15]*

All indicators of digitalization of the education system record positive rates of index growth. However, the increase in the digitalization index of the education system at the end of 2020/2024, amounted to only 0.2 points. At the same time, the share of digitalization of the education system from the total share of digitalization of key sectors of the economy and social sphere amounted to only 7.27%, of which only 1.8% is due to the development of digital technologies. Meanwhile, most of the educational computer programs are in no way connected with virtual and augmented reality technologies [16].

It is worth noting here the fact that at the plenary meeting of the BRICS summit in 2023, which was attended by representatives from 45 countries of the world community and 75 constituent entities of the Russian Federation, as part of expanding cooperation of the association, the task of ensuring the accessibility of digital platforms was set [20].

Summarizing the results of the study, it should be noted that the processes of introduction and development of virtual and augmented reality technologies in higher education depend on the allocated volumes of state financial support in the field of digitalization of education. In modern conditions, virtual and augmented reality are most widely used by specialties related to medicine and navigation, where there are high risks when making mistakes that lead to human casualties. Nevertheless, in the current conditions, a high degree of effectiveness in teaching students in natural science disciplines has been recorded, as part of the teaching of which virtual and augmented reality are used.

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为上海合作组织成员国一体化联盟的创建和发展形成国家经济政策生产模式的投资结构向量

THE INVESTMENT-STRUCTURAL VECTOR OF SETTING UP A PRODUCTIVE MODEL OF STATE ECONOMIC POLICY FOR THE CREATION AND DEVELOPMENT OF THE INTEGRATION ASSOCIATION OF THE MEMBER COUNTRIES OF THE SHANGHAI COOPERATION ORGANIZATION

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摘要。 作者提出了两种国家经济政策模式，用于创建和发展具有发展中市场的国家的一体化联盟——生产型和再生产型。 生产型模式与创建和发展上合组织成员国一体化联盟的再生产型国家经济政策不同，旨在确保各国在实施以下原则的基础上建立平等互利的新型（新形式）经济关系： 国家一体化经济政策的基本原则。 目前，上海合作组织成员国经济关系的主要趋势是形成投资和结构的向量，以创建国家经济政策的生产模式，以促进上合组织成员国一体化联盟的创建和发展。

关键词：一体化、上海合作组织、国家经济政策、生产模式、投资结构向量的形成、一体化联盟。

Abstract. *The author identified two models of state economic policy for the creation and development of integration associations of countries with developing markets - productive and reproductive. The productive model, in contrast to the reproductive, state economic policy of creating and developing an integration association of SCO member countries, is aimed at ensuring a new type (new format) of equal, mutually beneficial economic relations between countries based on the implementation of the basic principles of state integration economic policy. Currently, the main trend in the economic relations of the member countries of the Shanghai Cooperation Organization is the formation of an investment and structural vector for creating a productive model of state economic policy for the creation and development of integration associations of the SCO member countries.*

Keywords: *integration, Shanghai Cooperation Organization, state economic policy, productive model, formation of an investment-structural vector, integration associations.*

Currently, regional economic interstate integration (REMI), being a natural and one of the most dynamically developing economic phenomena in the international economy.

REMI is a multidimensional phenomenon of expanding the common economic space, primarily of countries with emerging markets, pooling their resources and harmonizing their national markets through the creation and development of economic integration structures in various interstate forms[1].

It is advisable to distinguish two models of state economic policy for the creation and development of integration associations of countries with developing markets - productive and reproductive.

The productive model as a promising model of state economic policy for the creation and development of the integration association of the SCO countries must be characterized taking into account:

- firstly, the totality of current conditions and emerging future trends in the development of the international economy in the “new reality” and new formats of integration associations of countries with emerging markets;
- secondly, providing the most favorable foundations for economic growth and innovative development of the SCO countries based on using the competitive advantages of having a large economic space and obtaining long-term integration effects of regional economic integration based on institutional mechanisms and forms of interaction;
- thirdly, the creation and use of synergistic effects from the addition of the resource potentials of the participating countries in all areas of the economic space;
- fourthly, a modern axiological approach to the content of the state economic policy of creating and developing an integration association of the SCO family countries, which forms a new format of regional integration associations (“Shanghai Spirit”).

In contrast to the productive one, the reproductive model of the formation and implementation of state economic policy for the creation and development of integration associations by countries with developing markets involves the repetition and multiplication of the features of previously known practices of the integration economic policy of developed countries that have experience in creating integration associations [2].

If the reproductive model is adopted as the basis for building economic public policy, countries with developing markets can follow the path of uncritical reproduction (reproduction) of methods and methods of pursuing economic integration policies, for example, by EU countries that have actually accumulated significant experience in essentially linear movement of economies along “integration ladder” by B. Balassa.

The study of the elements of the reproductive model of state economic policy for the creation and development of integration associations of countries in the international economy, as a theoretical model, has, at the same time, positive results, since it allows researchers and practitioners:

– firstly, the opportunity to learn lessons from the ineffective results of integration practices in order to form and implement state economic policies of countries with emerging markets seeking effective integration cooperation;
– secondly, to rethink the geopolitical-economic and geostrategic aspects of the role of each country with a developing market in the system of world economic relations and build its own state economic policy for the creation and development of integration associations in its national interests[3].

It can be concluded that scientific and practical understanding of a number of elements of the reproductive model of state economic policy for the creation and development of integration associations of countries with developing markets provides the opportunity to avoid dead-end solutions to the problems of the integration movement and determine effective directions for building a productive model of state economic policy for creation and development integration education of the SCO member countries, taking into account the specifics and needs of each country. In this case, the cost of "trial and error" will decrease, as the cost of political, economic and transaction costs when implementing a productive model of state economic policy for the creation and development of an integration association of SCO member countries. At the same time, countries with emerging markets will have an advantage in time to create effective administrative, economic and institutional mechanisms for integration ("from above" and "from below"), as well as to select effective forms of interaction and institutional mechanisms emerging in national-state economies and at the interstate level, reducing and/or leveling out many types of costs and risks associated with the internal and external conditions of the functioning of the modern international economy.

A productive model of state economic policy for the creation and development of an integration association of SCO member countries is aimed at ensuring a new type (new format) of equal, mutually beneficial economic relations between countries based on the implementation of all groups of basic principles of state integration economic policy. This presupposes a rejection of its focus on recreating a linear (linear-stage) integration model and an "accounting" understanding of the integration good outside its value component – the "Shanghai Spirit".

The productive model under consideration can be characterized as innovative, based on the meaning of the definition of "innovation". Indeed, in this aspect, innovation as an innovation emphasizes a new order of relations between countries

and forms of interaction, in which coercion, the desire for unilateral economic gain at the expense of another participant in the integration structure, ignoring legitimate economic national interests recognized by other participants, as well as the use of so-called " rules", which can be arbitrarily changed in favor of a politically, militarily and economically stronger participant at his own discretion.

Currently, the main trend in economic relations between the member countries of the Shanghai Cooperation Organization (SCO) is the formation of an investment and structural vector for creating a productive model of state economic policy for the creation and development of integration associations of the SCO member countries. The importance of this vector increases many times due to the fact that the development of the SCO countries should be based on internal regional cross-investment, since the aggressive sanctions policy of the collective West, led by the United States, is actually aimed at suspending foreign investment from Western companies in the economies of the SCO countries [4].

In the medium term (until 2030), this vector should determine fundamental changes in existing trade and economic practices, when the role of China as a supplier of finished products, and other SCO member countries, in particular Russia, as suppliers of resources, is more clearly expressed. In accordance with the provisions of the current "SCO Economic Development Strategy for the period until 2025" and the "SCO Economic Development Strategy for the period until 2030", which was signed by the SCO member countries (except India) in July 2023 at a meeting of the Council of Heads of State - members of the SCO in the SCO member countries, significant structural changes must occur in favor of building an innovative economy and overcoming its resource orientation [5].

One of the central provisions of these strategies has a pronounced investment character, as the basis for the formation of a productive model of economic integration policy of the SCO member countries. The investment vector of this model is aimed at the implementation of fifteen sectoral programs with an emphasis on the development of energy, including green energy, infrastructure and logistics corridors, all types of transport, innovative technologies and artificial intelligence, microelectronics, smart agriculture and agro-innovations.

These sectoral programs are "woven" into the national economic development programs of the SCO member countries. The practical implementation of these programs should ensure a synergistic effect in the development of the integrated development of the SCO member countries. The investment-structural vector of the model under consideration is aimed, inter alia, at increasing direct relationships between business structures of all forms of ownership and creating joint ventures for investing in high-tech sectors, as well as introducing innovative technologies, creating additional jobs due to energy cooperation, and developing transport communications, shared pipeline systems, formation of close trade, investment and

research ties (integration "from below"). Particular attention is paid to innovative medical and educational services, energy efficiency, e-commerce, and ensuring intellectual property rights, which is the subject of discussion at the level of the Special Working Group on Promoting Investments of SCO Member States.

Chinese researchers rightly justify the need to build an innovative structure of the integration economic space of the SCO family countries based on the implementation of innovations in the high-tech energy sector and the search for breakthroughs in multilateral energy cooperation based on investment models [6]. Moreover, these models should initially, in our opinion, be based on a regenerative economy, which reflects reproductive relations without causing irreparable damage to the biosociosystem [7].

The leaders in shaping the investment-structural vector of creating a productive model of economic integration policy of the SCO member countries are China and Russia, which constantly coordinate this activity, including within the framework of the intergovernmental Russian-Chinese commission on investment cooperation. According to its data, 21 significant and promising projects are currently being implemented, the total volume of declared investments is 60.83 billion US dollars [8].

A special role in the formation of the investment and structural vector of the formation of a productive model of economic integration policy of the SCO member countries is played by the institutions of cross-border and cross-border cooperation, the development of which is aimed at strengthening direct relationships between enterprises of the regions located along the borders of the SCO family countries.

In this regard, the experience of China and its neighboring countries of the SCO family is noteworthy, which since 1992 have established special operating regimes for resident enterprises within the framework of cross-border cooperation.

Currently, the China-SCO pilot zone (Qingdao, China), which was created at the proposal of Chairman Xi Jinping and is a demonstration zone of cooperation between China and the SCO, is quite actively developing. Its expansion should be aimed not only at trade and logistics cooperation, but also at the implementation of investment projects with the participation of all countries of the SCO family, including through the launch in 2022 of the "Comprehensive Service Platform" for business entities.

The Expert Advisory Council for the development of the China-SCO Pilot Zone and the Russian-Chinese permanent working group on interregional and cross-border cooperation and special economic zones, in cooperation with the Ministry of Economic Development of the Russian Federation, is a "think tank" on a comprehensive approach to the formation of investment and structural vector of a productive model of integration policy between China and Russia.

In the context of a strict sanctions regime and the regular introduction of new packages of sanctions, including secondary sanctions, Chinese researchers emphasize that "Western sanctions open up important opportunities for cooperation" [10]. These opportunities, first, open up new horizons for investment cooperation between China and Russia and contribute to the formation of the investment and structural vector of a productive model of the SCO integration policy. During the May 2024 visit of President V.V. Putin noted the need to "accelerate the development and approve in 2024 a new edition of the Russian-Chinese Investment Cooperation Plan, to fully facilitate its practical implementation in order to improve the results of bilateral cooperation in the field of investment" [11].

Despite China and Russia's significant leadership in shaping the investment and structural vector of the productive model of economic integration policy within the Shanghai Cooperation Organization (SCO) after the SCO Summit (New Delhi, July 2023), other member countries of the SCO are becoming more active in this direction - including India, Iran, Pakistan, and the Central Asian republics (Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan). A notable feature is the emergence and implementation of joint investment projects, including in the field of logistics, specifically investments by SCO member countries in launching the North-South International Transport Corridor, for the development of which a project office of VTB Bank has been established from the Russian side.

Investment cooperation in this area ensured the creation and modernization of the transport infrastructure of Russia, Kazakhstan, Iran, China and India, which made it possible to open new railway routes through Iran: Russia (Chekhov) - India (Nava Sheva port), China (Jingan) - Iran (Julfa).

Thus, the investment-structural vector serves as the basis for the formation of a productive model of state economic policy for the creation and development of integration associations of member countries of the Shanghai Cooperation Organization.

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关于评估公司人力资本的问题：数字创新和经济效率
ON THE ISSUE OF ASSESSING COMPANY'S HUMAN CAPITAL: DIGITAL INNOVATIONS AND ECONOMIC EFFICIENCY

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抽象的。 本文讨论了当前数字创新积极发展中人力资本评估的问题。 考虑到人工智能技术和WEB 3.0的影响，扩展传统人力资本评估方法的必要性得到证实。通过对评估人力资本效率（定性、定量、经济等）的现有方法、方法和指标的分析，发现了它们的局限性，特别是它们对技术影响的简化表示以及对人力资本动态的考虑不足 发展。 提出了一个概念评估模型，该模型不仅考虑人力资本的基础水平，还考虑人工智能和WEB 3.0实施的效率、部署成本、投资回报率和其他影响因素。 描述了根据特定组织的任务和挑战转变概念评估模型的前景，从而能够精确评估公司的人力资本及其动态。 拟议的评估可以更准确、更全面地评估数字创新对组织人力资本效率的影响。 研究得出的结论是，所开发的方法扩展了对传统人力资本评估方法的理解，可以作为在数字化转型背景下创建有效的人力资本管理系统的基础。

关键词：人力资本、评估、数字创新、人工智能、WEB 3.0、效率、投资回报率、动机、企业文化、管理质量。

Abstract. *This article addresses the current issue of assessing human capital amidst the active development of digital innovations. The necessity of expanding traditional approaches to human capital assessment is substantiated, considering the influence of artificial intelligence technologies and WEB 3.0. Through an analysis of existing methodologies, approaches, and metrics for assessing the efficiency of human capital (qualitative, quantitative, economic, etc.), their limitations are identified, particularly their simplified representation of technology's impact and insufficient consideration of the dynamics of human capital development. A conceptual assessment model is proposed, which considers not only the basic level of human capital but also the efficiency of artificial intelligence and WEB 3.0 implementation, the costs of their deployment, ROI, and additional influencing factors. The prospects for transforming the conceptual assessment model depending on the specific organization's tasks and challenges are described, enabling precise evaluation of the company's human capital*

and its dynamics. The proposed assessment allows for a more accurate and comprehensive evaluation of the impact of digital innovations on the efficiency of an organization's human capital. The study concludes that the developed approach expands the understanding of traditional human capital assessment methods and can serve as a foundation for creating an effective human capital management system in the context of digital transformation.

Keywords: *human capital, assessment, digital innovations, artificial intelligence, WEB 3.0, efficiency, ROI, motivation, corporate culture, quality of management.*

In the context of the rapid pace of the scientific and technological process and the digitalization of the economy, issues of assessing human capital are acquiring fundamental importance associated with the formation of approaches to determining economic efficiency and clarifying the influence of modern technologies on the nature and quality of functioning of human capital. Being a fundamental category of functioning of any enterprise that forms value, human capital sets the space for the growth and development of a commercial structure, carries with it innovative, reproductive, social, economic, and creative and other functions aimed at increasing organizational efficiency. Any enterprise is interested in investing in improving the efficiency of its own activities, which also affects investments in the development of human capital and improving the practice of its activities.

The relevance of the topic of research into the assessment of a company's human capital from the perspective of the influence of digital innovation and economic efficiency is associated not only with the systemic importance of human capital as a strategic resource of the organization, but also with the rapid penetration of modern technologies into business (artificial intelligence, WEB 3.0, advanced production systems), which become a factor in increasing the efficiency of human resources. Such conditions create a contradiction in which, on the one hand, there is a positive influence of modern technologies on the efficiency of human resources and the effects acquired by business, on the other hand, it is difficult to assess the effectiveness of human capital and measures strictly aimed at its development. The result of this contradiction is the problem of justifying management decisions at the enterprise, which would be distinguished by the return on investment in the development of human resources. In our opinion, the development of a conceptual methodology for calculating the effectiveness of strategic human resource management, in which the focus will be on economic efficiency and clarifying the impact of innovation on human capital, has the potential to resolve the identified problem and contradiction.

The purpose of the study is to characterize and justify a way to assess a company's human capital through digital innovation and economic efficiency.

Before considering directly the method of assessing the human capital of a company, it is important to emphasize that the strategic importance of investments in human capital is associated with increasing financial and economic efficiency, creating additional effects from the functioning of the enterprise that arise as a result of accumulating efforts and improving the carriers of key functions, i.e. .e. of people.

We agree with the opinion of V.B. Salakhova, who considers investments in human capital as the foundation for the formation of economic growth and development, which is based on the concepts of the quality of implementation of professional functions, tasks, and creativity; a person, according to the author, is endowed with the most important creative function, and therefore needs its maximum disclosure, which is achieved by increasing such a metric as human potential in the organization [9].

Human potential is one of the basic categories that reflects the maximum efficiency of the entire set of human resources; potential is a reflection of the maximum achieved efficiency of human resources and is revealed, as a rule, at the level of an individual employee or group, division, component of the organization in the context of the functions performed. However, high human potential does not mean its full implementation (maximum impact) within the walls of the enterprise, and therefore modern organizations are faced with the need to influence the effectiveness of human capital, and not the expansion of potential (since expansion does not necessarily lead to real changes). In addition, increasing the efficiency of human capital, one way or another, inevitably leads to an increase in its potential, and therefore, when developing assessment methods, it seems advisable to focus on assessments of human capital, not potential.

According to M.N. Arnaut, human capital should be considered as a management category, which allows for its goal setting, planning, implementation, control, and assessments at each stage of strategic management. The author summarizes the system of principles of human capital management, the key of which is economic efficiency; achieving economic efficiency means compliance of the management practice of an enterprise with a given commercial function, i.e. efficient use of resources to make a profit - the excess of income over expenses [1].

As I.G. emphasizes Kuznetsov, the essential side of human capital as a scientific category is associated with systemic contradictions and complexities that come from the evolution of definitions reflecting human capital. According to the author, it is more expedient for each organization to develop its own universal metrics for assessing human capital, which forms the basis for increasing efficiency, taking into account the specific features and objectives of business practice [7]. Taking into account the proposed recommendation, we note that, as a rule, when assessing human capital (resources), they are guided by economic indicators

related to return on investment, profit generation, ability to work, output, etc. Such assessments, as a rule, make it possible to evaluate the results of human capital activities , rather than its cost or contribution to efficiency, which limits their resulting application. In addition, the question of assessing the impact of innovation on the efficiency of human capital remains open, which is the area of scientific interest of the author of this study.

A striking example of such assessments related to the performance of human capital or conducting assessments of activities are those proposed by E.V. Zenkina and O.Y. Myasnikova indicators for assessing the effectiveness of human capital management activities, which are aimed for the most part not at assessing human capital and its changes, but rather at the results of purposefully organized work on the development of human resources (reflect mainly the effectiveness of the funds involved) [5]. And although in some cases such an assessment is indeed effective, in practice it is more expedient to conduct a multidimensional assessment of human capital, including determining the impact of various stimulating conditions on its effectiveness. In this case, speed and financial and economic metrics become the basic metrics of human resource performance.

The assessment of human capital becomes even more problematic when considering the content and features of the implementation of the creative function; according to A.O. Gruzdinsky, I.V. Guskova and N.E. Serebrovskaya, measuring the creativity of human capital can be carried out through the results of its creative work, the implementation of the creative function in the enterprise with the degree of its impact on the object of application (for example, how much income did the development of a group of employees bring). Using their own methodology for assessing human capital as an example, the authors conclude that the creative function of human capital is quite subjective and diverse, and its assessment remains virtually impossible, both due to objective complexity and due to the lack of data necessary for assessments [3]. Similar problems are highlighted in the work of A.P. Tsypin and A.A. Firsova, who consider modern methods of assessing investments in higher education; the authors emphasize that the intangible and difficult to establish nature of investment results leads to additional difficulties in assessing cost effectiveness. Based on the correlation and regression analysis carried out, the authors establish that investments in higher education shape the growth of the country's gross domestic product [11]. Extrapolating the results of the assessments to the micro level, we note that in a similar way, investments in human capital generate additional income for the organization, which is the result of increasing the efficiency of the functioning of human resources.

Notable in the context of the presented arguments are the views and ideas of D.V. Lanskoy, A.V. Kovtun and I.A. Gordienko, who consider solving the problems of increasing the efficiency of human resources through their strategic man-

agement, implementation of controlling procedures and constant assessment of the effectiveness of personnel development. The authors propose to invest in human capital with a focus on factors for assessing human capital, including profit, costs, receipts (revenue), added value, return on investment, on the basis of which the corresponding indices are calculated, which form the basis for assessing the production function of the enterprise's human resources [8]. In general, these assessments are indeed relevant and promising, since they allow us to assess human capital in the context of basic indicators for assessing economic efficiency. In accordance with these estimates, human capital is considered as a variable category, which nevertheless influences the results of the functioning of the entire commercial structure. Assessing these results and their dynamics allows us to take into account indirectly the contribution of human resources and the implementation of human functions in the functioning of the entire organization.

Quite similar approaches to assessing the economic efficiency of human capital are highlighted by many other authors. For example, S.M. Degles Hani Hani and N.R. Kelchevskaya propose to evaluate human capital through the analysis of projects and their impact on human resources. In fact, the authors' assessment comes down to a study of benefit and its impact on human capital and business performance outcomes [6]. L.S. Kerber and A.I. Tikhonov propose to evaluate primarily the effectiveness of human resource development activities, in particular, to evaluate the return on investment in organizing and conducting such activities, which allows indirect monitoring of the effectiveness of investments in human capital [4]. N.V. Balashov and V.S. Kharkin propose a similar approach based on assessing the return on investment in personnel, associated both with the assessment of the profitability of activities and return on investment, and the contribution (change, dynamics) of profitability indicators of the entire enterprise based on the results of investments in human resources [2]. However, a significant drawback of the described assessment methods is the focus on evaluating ongoing activities, while there is no opportunity to determine the basic effectiveness value from which the effectiveness of ongoing activities could be assessed.

Noteworthy in the context of the stated judgments is the work of I.V. Skoblyakova and S.M. Efremova, who also propose to take into account factors of the efficiency of using human capital, since, often, influencing such efficiency allows one to achieve greater growth at lower costs than investing in the development of human capital. In fact, the authors consider ways to assess the degree of utilization of human potential, not the maximum values, which reflect the space for improving and developing human resources without significant investments [10].

In accordance with the identified components of the assessment of human capital and its impact on the effectiveness of the organization, we highlight that the management of human capital development is associated with:

Firstly, by determining the basic values of the "maximum" human potential, which reflects the high degree of return and production that occurs in reproductionwonderby human resourses.

Secondly, by assessing the actual values of human potential at the current stage, it allows us to establish space for its maximization without involving significant (relative to other cost items) financial investments.

Thirdly, an assessment of the costs of maximizing the current human potential and its expansion through the development of human resources, which is also associated with the development of personnel strategies and the formation of the personnel service's own place in the organization's system.

Fourthly, the assessment of variables affecting the effectiveness of investments in human resources, a clear example of which is the course of the period of investment activity (adaptation, employee adaptation, functioning).

Fifthly, assessing the impact of innovation on the activities and results of human capital, with their impact on basic performance metrics.

Note that human capital can be at one of four stages of the "investment" period, depending on which the effectiveness of the influence of the human function on the organization's results is formed. These stages are clearly illustrated in Fig. 1:

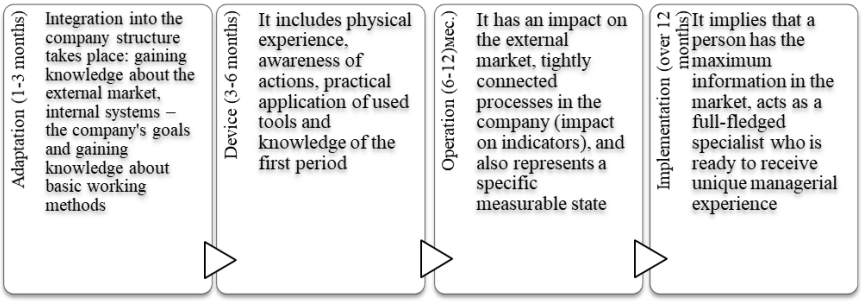

Figure 1. *Stages of investment in human capital (compiled by the author).*

Referring to Fig. 1, we note that the first three stages are of an "investment" nature, which corresponds to the principles of short-term investment. It is assumed that during the first three stages of personnel adaptation, the latter will provide full payback and form a minimum economic efficiency, according to which investment income exceeds expenses. At the same time, organizations today have more and more opportunities to accelerate the onset of payback, which is associated with the influence of human capital assessment factors and the emerging tools for influencing efficiency, for example, digital technologies.

From the point of view of different levels of human capital, a system of its assessment can be distinguished:

1) individual human capital, reflecting the personal value of one conditional human resource;

2) corporate human capital, which is a characteristic of the total value of the organization's human resources (intangible assets);

3) territorial human capital, reflecting a similar assessment at the level of a certain territory;

4) national human capital, reflecting the general economic country assessment.

This method of assessment does indeed take place, however, when it comes to a specific organization, it is advisable to focus on the first two assessments, since they are characteristic of the micro level. In addition, the degree of automation of the economy is important, which also has a significant impact on the automation of the activities of specific enterprises. Modern technologies, such as artificial intelligence and WEB 3.0, determine the possibility of creating alternative scenarios for influencing the effectiveness of human capital and assessments. In addition, such technologies are revolutionary in nature and cannot bypass business entities in terms of the achieved effects and changes.

Returning to the mentioned stages of human capital investment, reflecting the stages of employee adaptation in the organization, we note that for each stage, its own evaluation metrics, grouped by us in Table 1, acquire relevance:

Table 1.

Metrics for assessing the stages of investment in human capital (compiled by the author).

Stage	A set of metrics and calculation formula
Adaptation (1-3 months)	Completion plan (average time for which an employee will master his own duties), days.
	Level of satisfaction (degree of employee satisfaction with the adaptation experience), %
	Share of successful completions of training (share of employees who successfully completed training in the total share of those who entered), %
	Execution of the plan (volumes ahead of the plan), coefficient.
	Personnel costs (hiring, training and maintenance costs), rub.
Devices (3-6 months)	Quality of communication with employee (satisfaction with communication), %
	Error rate (number of errors made by a new employee), units.
	Self-regulation ability (proportion of independently solved functions), %
	Labor productivity, coefficient

Functioning (6-12 months)	Talent management (percentage of employees remaining from those initially hired),%
	Quality level (proportion of absence of errors, learning ability, meeting deadlines), %
	Economic effect (calculation of additional profit and cost reduction), coefficient.
	Internal promotions (how many employees received promotions within the company, which indicates opportunities for career growth), coefficient.

Referring to Table 1, we note that the assessment of the presented metrics is carried out in the context of the duration of a specific period and assumes the possibility of making additional assessments in accordance with the areas of interest and the needs of the organization.

In addition, an important part of the assessments is the establishment of indicators that will be relevant when calculating the implementation stage; such indicators will allow assessing the results of investments in human capital, and therefore suggest the previously described basic assessments of human capital and its impact on the organization. We offer the following metrics for assessing the implementation stage, namely:

- the traditional "ROI" indicator – return on investment in personnel, the ratio of the profit received from an employee's work to the costs of training and development;
- indicator of innovation activity - the quantity and quality of new ideas or projects proposed by an employee;
- ability to learn and flexibility - the ability to quickly adapt to new technologies and working methods;
- quality of work - assessment of the standards of work performed by an employee and its impact on the overall quality of products or services;
- average annual number of personnel - may indicate the scale of use of human capital;
- network of contacts – having a wide professional network can open up new opportunities for career growth and increased income for the employee and the company.

Metrics for calculating the listed indicators are established by each organization independently, which is associated with work on the specific functions and characteristics of a particular business entity.

Note that conceptually significant factors influencing the increase in human capital are artificial intelligence factors (or AI - the influence of artificial intelligence on human capital) and WEB 3.0 factors (or the influence of Web 3.0 on human capital). The use of these factors allows us to expand our understanding

of the current state and approaches to assessing an organization's human capital through the prism of digital innovations (the organization's investments in them).

Taking into account the existing stages of investment in human capital, we will form a system of basic notations:

The "D" factor, which can be determined based on productivity or engagement data or other indicators (which are established by the company itself), which will quantify the contribution of each stage to the total human capital. For example, D1 – for (1-3) months; D2 – for (3-6) months; D3 – for (6-12) months; D4 – (1-2) years. Directly the metric of human capital, or Human Capital (HC) - human capital; Human (H) – basic level of human capital. The basic level of human capital "H" can be represented as an index on the average level of education, experience, skill and health of employees. AI is the coefficient of influence of Artificial Intelligence (how much it can automate in percentage or improve quality). WEB 3.0 – Impact coefficient of Web 3.0 (percentage ratio of how decentralized the system is and its profitability).

In accordance with the presented notations, we highlight the following method (indicator) for assessing human capital taking into account digital innovations:

HC = H x (1 + AI) x (1 + WEB 3.0) x (D1 + D2 + D3 + D4).

The base value of H is 100, which can reflect an index based on the average level of education, work experience, skills and health of employees depending on the required results. Taking into account the efficiency values, we highlight the application of this assessment. For example: AI influence coefficient (AI) as a percentage, for example if AI increases productivity by 20%, then the coefficient is 0.20. The influence coefficient of WEB 3.0 is expressed as a percentage, for example, if WEB 3.0 increases efficiency by 15%, then the coefficient is 0.15. Influence coefficient D1 as a percentage, for example, if during period D1 an employee poorly fulfills the norm, then 0.05. Influence coefficient D2 as a percentage, for example, if during period D2 an employee increases efficiency and fulfills the norm = 0.10. Influence coefficient D3 as a percentage, for example, if during period D3 an employee increases efficiency by 2 times and fulfills the norm = 0.20. The period of implementation of the experience for the first year or after 12 months is the degree of effectiveness based on ROI - return on investment = 0.30. Taking into account the presented values, we present the calculation of human capital:

HC = H * ((1+AI) * (1+WEB 3.0) * (D1 + D2 + D3 + D4));

HC = 100 * ((1 + 0.20) * (1 + 0.15) * (0.05 + 0.10 + 0.20 + 0.30));

HC = 100 * (1.20 * 1.15 * 0.65);

HC = 89.7;

Let us provide additional justification for the proposed algorithm. The assessment begins with a baseline level of human capital (H), which is represented as an index reflecting the average level of education, experience, skills and health

of employees. In the example, H = 100. Next, the impact of AI and WEB 3.0 on human capital is taken into account. These technologies are expected to increase efficiency, as reflected by the AI and WEB 3.0 ratios. In the example, AI = 0.20 (20% increase in efficiency) and WEB 3.0 = 0.15 (15% increase). Accounting is introduced for the dynamics of human capital development using coefficients D1-D4, which reflect the contribution of each stage of investment to total human capital. In the example, the values of coefficients D1-D4 reflect the different efficiency of the employee at different stages of work. The ROI (return on investment) ratio is used to determine D4, which represents efficiency after a year of operation. In the example, ROI = 0.30. The final formula HC = H * ((1 + AI) * (1 + WEB 3.0) * (D1 + D2 + D3 + D4)) aggregates all factors to obtain a final human capital score.

In this case, the HC value turned out to be less than the basic level H (100), which indicates the low efficiency of the employee (or the entire human capital) during the year, which means that human potential is not fully disclosed and the presence of unrealized opportunities to strengthen it, without the need for significant investments in human capital. Such a value (below the basic level) potentially means that the enterprise is faced with a system of possible causes: insufficient adaptation, skill shortages, low motivation, management inefficiency, technology problems, which ultimately reduce the level of human potential and the production of human capital efficiency. In general, there are several ways to interpret the results of calculating the indicator:

- HC > H, means that human capital is effectively developing, investments are paying off, employees are motivated and effectively use new technologies;
- HC = H, means that human capital is in a stable state, there is no significant growth or decline;
- HC < H, means that human capital and investments in it are ineffective, measures are needed to optimize and increase returns.

Thus, the proposed approach to assessing human capital expands the understanding of traditional methods, thanks to the inclusion of a system of conceptually significant influences, namely: digital innovations are taken into account (the inclusion of AI and WEB 3.0 coefficients allows assessing the contribution of new technologies to the development of human capital, which is especially important in modern conditions of digital transformation); it is assumed that dynamic assessment will be used, using coefficients that reflect efficiency at different stages of work, which provides a more accurate reflection of the dynamics of human capital development and makes it possible to track the effectiveness of investments at different time intervals; the presence of a basic value, as well as an assessment of the degree of deviation of negative or increasing efficiency, which contributes to the transition from the paradigm of simply increasing investments to the paradigm of optimizing and increasing the efficiency of their use. The prospects for the au-

thor's future research are associated with clarifying the methods and techniques for assessing the component coefficients underlying the author's model for assessing human capital, which will be reflected in future works.

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在移动应用知识产权客体法律保护的背景下保护个人数据主体的权利
PROTECTION OF THE RIGHTS OF PERSONAL DATA SUBJECTS IN THE CONTEXT OF LEGAL PROTECTION OF INTELLECTUAL PROPERTY OBJECTS IN MOBILE APPLICATIONS

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Introduction. Modern achievements in the development of innovative technologies, generated by intellectual work, become the basis for determining new directions in the development of science and technology. As a result of this state, there is a need for effective legal regulation of innovation processes. The legislation of the Russian Federation in the field of protection of the results of intellectual activity (hereinafter – RID) is regulated in accordance with Part four of the Civil Code of the Russian Federation (hereinafter - the Civil Code of the Russian Federation). The objects of the RID include: industrial designs, trademarks, inventions, utility models, databases (hereinafter referred to as databases), software for electronic computers (hereinafter referred to as computers), etc. At the same time, databases and computer programs are used for processing, systematization of personal data (hereinafter referred to as PD), as objects of copyright (and databases are also objects of related rights in terms of their protection from unlawful extraction and reuse of materials included in their content in accordance with clause 4, clause 1 of art. 1304 of the Civil Code of the Russian Federation) have been recognized in the world as objects of intellectual property for quite a long time - more than 50 years.

In today's developing world, a person needs guarantees of non-disclosure of personal information, as well as guarantees of non-interference in the personal space of an employee of third parties and an employer. Personal information and personal interests must be expressed in the inviolability of privacy when processing personal data. These data can be different, starting simply from the first and last name and ending with all passport data. Currently, despite the significant efforts of the Russian legislator, the processes related to the collection, storage and

processing of personal data do not provide an adequate level of confidentiality and legal protection. We have analyzed the methods of protection and the expediency of using artificial intelligence to protect personal data.

Personal data refers to any information related to a specific individual or subject of personal data. These include: full name, date of birth, residential address, phone number, etc.

The legislation of the Russian Federation in the field of protection of the results of intellectual activity (hereinafter – RID) is regulated in accordance with Part four of the Civil Code of the Russian Federation (hereinafter - the Civil Code of the Russian Federation). The objects of the results of intellectual activity include: industrial designs, trademarks, inventions, utility models, databases (hereinafter referred to as databases), software for electronic computers (hereinafter referred to as computers), etc. At the same time, databases and computer programs are used for processing, systematization of personal data (hereinafter referred to as PD), as objects of copyright (and databases are also objects of related rights in terms of their protection from unlawful extraction and reuse of materials included in their content in accordance with clause 4, clause 1, Article 1304 of the Civil Code Russian Federation) have been recognized in the world as objects of intellectual property for quite a long time - more than 50 years. Now personal data is the main identity identifier that requires reliable protection.

Traditional methods of PD protection in mobile applications are rapidly losing relevance due to the fact that they are a target for organized criminal activity. Every year, the growth of hacking methods used by scammers is improving, which makes it possible to bypass PD protection methods. Traditional methods include: data encryption, authentication method, access rights, network protection, software updates, data masking, biometric protection, user activity monitoring.

In recent years, the use of artificial intelligence (hereinafter – AI) in various fields can be considered as one of the new methods of PD protection. However, before implementing individual PD protection methods, additional work needs to be done to develop methodologies in the field of depersonalization of data necessary for AI training.

Russian legislation on the protection of personal data is enshrined in a number of federal laws, including laws on personal data, information technology and public health protection.

At the international level, the recognition of personal data as an object of intellectual property varies. In the EU, GDPR represents a significant evolution in data protection, being applied extraterritorially and recognizing the fundamental right to personal data protection. Countries such as Japan and Kenya have also made strides in integrating personal data protection into the broader context of intellectual property, recognizing the importance of protecting personal information from

unauthorized use and violations. An important difference between GDPR is its extraterritorial principle of operation.

The protection of personal data in the European Union is considered as an integral element of fundamental human and civil rights and freedoms, along with the inviolability of the individual. The right of citizens to personal data protection is guaranteed by the founding treaties of the EU. Thus, according to article 8 (1) of the Charter of Fundamental Rights of the European Union and article 16 (1) of the Treaty on the Functioning of the European Union, it is provided that everyone has the right to protection of personal data concerning him or her. At the same time, this right applies not only to EU citizens, but also to third-country citizens who are legally in the EU, regardless of the length of their stay (we are talking about businessmen, tourists, students, researchers, seasonal workers, employees of international organizations and multinational companies, third-country nationals and individuals stateless persons who have applied for asylum, etc.).

Initially, the EU regulatory framework in this area was based on international instruments - the OECD Framework Principles for the Protection of Privacy and Cross–border Transfer of Personal Data in 1980 and the Council of Europe Convention on the Protection of Individuals with Automated Processing of Personal Data, opened for signature in 1981, within which, for the first time in world legal practice, it was The right of citizens to protect their personal data is highlighted as an object of protection.

In 1995, the countries of the European Union adopted Directive No. 95/46/EC on the protection of the rights of individuals in the processing of personal data (PD). However, the companies mostly ignored her. As a result, on May 25, 2018, this document was replaced by the General Data Protection Regulation (GDPR). An important difference between the GDPR is its extraterritorial principle of operation — the Regulation applies to all companies processing personal data of EU residents and citizens, regardless of the location of such a company.

According to GDPR, personal data is any information related to an identified or identifiable natural person (data subject) by which it is possible to identify him directly or indirectly. Such information includes, among other things, the name, location data, online identifier, or one or more factors characteristic of the physical, physiological, genetic, mental, economic, cultural or social identity of this individual (paragraph 1 of Article 4). The definition is broad and makes it quite clear that even IP addresses can also be personal data.

It is important to note that there are certain types of personal data that fall into the category of special or confidential personal data. This is information that reveals: racial or ethnic origin, political views, religious or philosophical beliefs, and membership in trade unions. In addition, this group includes genetic, biometric data used to identify an individual, health data, information related to sexual life or sexual orientation (art. 9).

The protection of personal data as database content in mobile applications requires innovative approaches and technologies. However, each method has both advantages and disadvantages, as well as workarounds.

The most popular framework is due to the implementation of cross-platform, user-friendly documentation, and an increasing community. More than 700,000 applications are implemented on Flutter.. It allows you to quickly create applications for Android, iOS, Web, Windows and Linux. Therefore, it is the highest priority for hackers.

Using OWASP statistics, we studied the most relevant vulnerabilities of mobile applications in 2024. As you can see in the diagram, the largest number of break-ins by hackers falls on web applications and applications on the android operating system. In total, more than 70%. We will be able to familiarize you in detail with the features of mobile application vulnerabilities if you have any questions. Security threats to mobile applications are constantly evolving, with vulnerabilities ranging from misuse of credentials to inadequate privacy controls and unsafe data storage. Addressing these vulnerabilities requires a comprehensive approach to mobile application security, including best practices and the use of advanced security tools.

The Open Web Application Security Project is an organization that deals with current information security issues

1. Misuse of credentials: This vulnerability is associated with incorrect storage of sensitive data such as passwords, API tokens, etc. For example, if the api token is inserted into the code as a constant and has not been pre-encrypted in any way

2. Insufficient security: By exploiting a vulnerability in the supply chain, an attacker can manipulate the functionality of a mobile application. An attacker can leave vulnerabilities in the code or embed or exploit them in third-party libraries and SDKs. This vulnerability is caused by a lack of proper code security, ineffective review or weak testing

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个人政策是公司政策的初始和基础环节

THE POLICY OF INDIVIDUALS AS THE INITIAL AND BASIC LINK OF THE COMPANY'S POLICY

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注解。 文章以辩证分析为基础，考察了政治学科。 揭示了现代政治认识论的方法论和方法的原因和错误。 个人政策被认为是政策的最初和主要基础。 最后，提出了改进社会政策理论和实践的建议。

关键词：政治、个人政治、政治学危机、政治学前景。

Annotation. *The article, based on dialectical analysis, examines the subjects of politics. The reasons and errors of the methodology and methods of epistemology of modern politics are revealed. The policy of individuals is justified as the initial and main basis of policy. In conclusion, recommendations are offered for improving the theory and practice of social policy.*

Keywords: *politics, politics of individuals, crisis of political science, prospects of political science.*

Introduction. By the 2020s, a paradoxical situation arose in the theory and practice of human development: everyone talks and writes about politics, not knowing what it is. Over the past 10 years, the Russian scientific library elibrary.ru has recorded thousands of publications on the topic of "politics." No fewer works have been written abroad. The most pressing issue has been the problem of actors in politics, which has led to significant disagreements among theorists. At the same time, most have silently chosen to abandon the possibility of solving it, thereby predetermining another crisis in political science [1, 2]. The philosophy of politics has become detached from real reality. Meanwhile, the world is facing critical questions: who, on what basis and with what goals governs societies? How can potential social upheavals be prevented? The answers to these questions are of paramount importance for stabilizing the socioeconomic development of the world today.

Methodology and research methods. In the article empirical, formal-logical, dialectical and systemic methods of epistemology have been used. Social relations

are analyzed in all the diversity of their interrelations and contradictions. Practice is considered the source and criterion of knowledge of the truth of phenomena.

Discussion. The topic of politics is studied generally one-sidedly and superficially. Therefore, practice is often carried out blindly, by trial and error, which leads to negative consequences. The term "politics" acquired a scientific framework in the form of political science in the 20th century. Its questions were intensively developed by foreign political scientists, mainly the United States. The history of political theory can be clearly traced in the "creativity" of the famous American political scientist D. Easton (1917-2014), who announced the main characteristics of the stages of development of political science. In the 50-60s of the XX century. many foreign political scientists, in particular D. Easton, R. Dahl, A. Cobban and others, came to the conclusion that political theory is dead [1, 2]. The main signs of the crisis in political science were:

- complete absence of new political ideas;
- inability to predict social processes;
- transformation of science into a form of textual criticism and historical analysis;
- loss of demand for the results of political science and political scientists themselves.

The XXIV World Congress of Political Science (2016) showed that the time has come to re-evaluate critically the foundations of political science. Rein Taagepera writes that current political science is less scientific than half a century ago; senseless processing of statistical data, the use of numbers, formulas and graphs at any cost have replaced logical modeling; Political science is moving from its complete "non-scientificness" to more and more "pseudo-scientific" [3]. In these conditions, a number of researchers are calling for a radical rethinking of political science. The first and most important thing is to stop deceiving yourself and look boldly at reality and at yourself. At the same time, some political scientists insist on the further development of political science, proposing to rename the last post-behaviouralist period of the theory as "post-normal science" as a tool for examination and making socio-economic decisions. At the same time, developments should be directed not into the depths of science, but into subdisciplines, the creation of lexicons for complex contexts [4].

The onset of a crisis in political science is caused by a number of reasons. The first and main reason for the crisis is the lack of a clear understanding of the essence of politics and, accordingly, the subject of study of political science. To date, there are hundreds of definitions of politics. Most of them are subjective abstractions, very far from reality. The main factors behind the diversity of policy definitions are the ignorance of the real historical genesis of humanity, the predominance of the subjective method and abstraction from practice. In this regard,

many domestic and foreign theorists consider the search for the essence of politics to be an "intellectual trap," a meaningless task. Discrepancies in the understanding of politics have led to a devaluation of the scientific and practical significance of understanding the phenomenon, and, accordingly, to a confusion of the concept with law and management [5].

The second reason is ignoring the conditions and timing of the policy. There is a clear opinion that politics has been formed since the advent of the state. Recent studies have shown that in herd (group) animals, and above all primates, there is no state, but the territory, boundaries, relationships between individuals both within groups and between groups are regulated by acquired rules [6]. All this led to the need to reconsider the attitude towards historical genesis: replacing its sweeping denial with the need for systematic accounting.

The third reason is the abstraction from the political capacity of people and groups. Many works have been written around the world about the practical limitations of political monism and the reality of political pluralism. Russian universities have long been studying courses on the strategic and short-term policies of organizations, and studying the political brands of leaders. However, many theorists continue to consider the state exclusively as the subject of politics [6].

Fourth, the reason is the complete separation of political theory from reality. Political scientists unanimously recognize various violence, endless, widespread, small and large wars, the creation and use of weapons of mass destruction, negative children's and youth movements and other social crises, but they cannot foresee and explain them, and therefore oppose the use of facts.

Thus, political scientists found themselves in an epistemological trap. On the one hand, they are expected to make specific proposals for the development of democracy, and on the other, it was forbidden to deal with issues of property, international relations, and relations between individuals. Under these conditions, they could not foresee the socio-economic crises in the world.

Solving the problems of political theory is possible by considering the real lives of people, and not abstract dogmas. It is extremely important here to start from the following four fundamental realities of human existence. Firstly, all members of societies from the primary unit, clan, tribe to the state are not the same and differ in age, gender, physiological parameters, abilities, labor capabilities, character and consumer demands. Only to ensure security, successful reproduction and development of the race, individuals unite into societies and create various organizations. The modern population of our planet is not a monotonous intelligent mass, but consists of many different socially and economically isolated subjects who are in constant competition to achieve a better quality of life.

The second reality is that humanity lives in conditions of limited goods in life. In other words, all values are insufficient to fully satisfy the various needs of mem-

bers of society. Hence, the cardinal problem of human existence is how to survive and develop in the absence or insufficiency of most of the benefits of life. In practice, it is solved through the production, distribution and redistribution of values.

The third reality is that people live for themselves and their children. With the limited benefits of life, the existence of members and societies occurs in conditions of competition and self-actualization. The struggle for the quality of material and social well-being has come to the fore. The criterion for people's success was the level of socio-economic prestige.

The study of the above-mentioned realities shows that the entire history of societies is an open or covert struggle between subjects for the preservation of life, better distribution, redistribution, alienation and appropriation of life values. It is from the positions that it is possible to reveal the essence and solve cardinal problems of politics.

It is obvious that an isolated individual cannot have politics, since equality, self-actualization, competition, distribution of life's goods, as well as property are generally absent. Politics arises only among associated members of a particular society; where life values are divided into mine, yours, ours, yours and a variety of forms of ownership dominates. From the genesis of human development, it follows that, because of the above-mentioned objective realities, subjects are forming principles for protecting and realizing their interests as opposed to similar interests of others. We define this phenomenon as politics in general, existing in all manifestations regardless of political understanding [7].

All associated subjects of society are involved in politics: citizens, stateless persons, various organizations, regions, states, international unions. Depending on the type of subject, there are five main types of politics: individual, family, collective, state and international, each of which, according to the object, is divided into many types and varieties.

Analysis of the genesis of humanity shows that historically and logically, the initial and final type in the political "tree" is the policy of individuals, reflecting the principles of protecting and realizing the personal interests of individuals. The most significant types of policies, according to human needs, are security policies, sensory policies, economic policies, social policies and spiritual policies.

The principles of protecting and realizing the personal life values of individuals as opposed to the identical interests of others are manifested in the following areas:

- in the family in relation to the wife, children;
- in a team of loved ones and relatives (jealousy towards relatives and acquaintances, friends, boys and girls, distribution of material wealth, the position of women as a means of comfort and sex, etc.);
- in organizations between employees and entrepreneurs;

- in the state in relation to members of state structures;
- in interstate relations.

The objects of policy are all life values, but the main one, which is of paramount importance for all subjects of a market society, is money as a means of realizing the absolute majority of people's needs. Political principles of improving the well-being of family members by infringing on the interests of other members of society, as a rule, lead to negative consequences, and sometimes to the collapse of the property, labor, image and physiological capital of relatives, societies and states.

Factors changing the role of individuals' policies are:

- level of development of private ownership of life's goods;
- creation of primary gross domestic product;
- the prevalence of the elective system of public bodies;
- concentration of the media in private hands;
- development of public bodies.

The true politics of individuals manifests itself, as a rule, during periods of aggravation of contradictions between members of societies, starting with family relations and ending with international ones. This is evidenced by the level of various offenses, the number of divorces, the struggle for inheritance, illegal competition, large and small wars of states and interstate entities.

On the basis of individual policies, family and kinship policies are formed, the essence of which is the principles of protecting and realizing the interests of relatives as opposed to similar interests of other entities. Kinship makes it possible to realize the natural needs of a person to a greater extent. First, it provides direct protection for children and the elderly; secondly, it contributes to the maintenance and development of the younger generation; thirdly, it serves as a medium for the primary realization of sensory needs; fourthly, it acts as a direct sphere of self-actualization of individuals. Through family ties, human capital is transferred between generations, the formation of professional dynasties, the functioning of various organizations, and the development of states over thousands of years of human history.

Individual and related policies are implemented through the policies of organizations and the state. The policy of legal entities is related to the creation, distribution and redistribution of gross domestic product - the main source of livelihood of the population. In a market economy, the policies of legal entities are dictated by affiliated individuals. In this case, the policies of top managers and the mass of employees play a significant role. Public policy is designed to ensure the protection and implementation of the common interests of individuals, groups of citizens and the state itself within the country and abroad. Under the dominance of private property, the role of public policy is determined by the interests of the

socio-economic elite. International politics expresses the interests of affiliates of multinational and transnational corporations. A 1% increase in I. Musk's stock price means an increase in his wealth by billions of dollars.

Having objective prerequisites, politics itself is a subjective process. Reflecting the interests of some subjects as opposed to others, it is put into practice through such elements as thoughts, words and deeds, secrecy and publicity, and comes down to the achievement of one or another power (economic, sensory, spiritual, etc.). The principles of relationships between people are formed first as informal ones, which then may or may not accept a formal shell. The policy outcomes can be three main options.

1. The policy of one subject receives legal completion through reaching an agreement with other subjects.
2. Politics takes on forceful expression when relationships are realized through violence.
3. Political principles do not acquire social embodiment.

At all levels of the political "tree," politics appears in two forms: shadow and public. The relationship between official and informal politics in reality is based on the principles of subordinate complementation, mutual coexistence and antagonistic contradictions. This is evidenced by numerous facts from world and domestic practice. The scale and role of shadow politics is clearly demonstrated by the modern system of US relations policy. It is clear to the whole world that US policy is shaped not by the US President, but by the economic elite, subjects of the military-industrial complex and the families of senior officials. Shadow politics is, as a rule, a negative manifestation of legal pluralism. Its implementation is ensured with the help of shadow legal and forceful methods, using various specialists, including highly qualified professionals. The sanctions policy organized by the United States clearly showed the true meaning of the political interests of the American elite, which consists in the distribution, redistribution, alienation and appropriation of the values of world actors.

These are, in general, the essence and main provisions of the policy of individuals. They are fully confirmed by the modern practice of life in all kinds of societies, from a simple union of two individuals and a family to the world community. It was the interests of exceptional individuals that determined and determine the nature and principles of the most important political relations of their society (V.V. Putin, Xi Jinping, the Rothschilds, Rockefellers, B. Gates, I. Musk, etc.) determined and determine the nature and principles of the most important political relations of their society.

Unfortunately, some scientists believe that political science deals with the patterns of impersonal subjects of the political process - institutions, and the behavior of individuals is the sphere of psychology, and therefore individual politics is not

recognized by them and is rejected as untenable. This understanding of the social role of individuals only deepens the disconnect between politics and reality, leading to a lack of responsibility and significant damage. For example, the head of a structure makes a decision that leads to social damage. Fines are generally imposed on the organization rather than the person responsible. Examples of this are the Russian practice of fining mainly organizations, rather than officials, and dismissing employees due to lack of confidence, and not due to violation of official instructions. On the contrary, foreign leaders act more wisely, trying to take into account the political role and significance of individuals. Russian decision-makers and billionaires were deeply shocked when they were included in the sanctions lists with all the ensuing consequences.

Various societies from the family, the courtyard collective to organizations, states and international unions serve as a social form of masking the politics of individuals.

All types of individual politics exist in subordination and dependence. The complexity of political relations lies in the fact that one individual can act as a political subject of a formal and civil family, informal groups, corporations, social institutions, and various authorities of both domestic and foreign countries. These features give rise to numerous contradictions, as a result of which some political attitudes acquire a shadow character.

Conclusion. The traditional understanding of politics exclusively as the activity of the state inherently presupposes the emergence and deepening of a crisis in political theory, and accordingly makes unnecessary a huge army of trained politicians and the ineffective use of labor and budgetary resources. The main role in the political system of society is played by the politics of individuals, the study of which should be the focus of political science. Otherwise, a naive attitude towards people, idealization of their life principles, and denial of socially dangerous political inclinations leads to very negative consequences [9]. To overcome the crisis of political theory, it is advisable to:

- unite groups of political scientists into one independent scientific organization;
- organize a study of the policies of individuals in society;
- supplement legal acts with provisions on individuals as a subject of politics;
- adjust the educational programs of universities for the study of politics and the law of subjects of society while reducing the number of students in political sciences.

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数字化转型世界中的传统印刷媒体：俄罗斯年轻一代信息消费者如何想象报纸的未来

TRADITIONAL PRINT MEDIA IN A WORLD OF DIGITAL TRANSFORMATION: HOW THE YOUNG GENERATION OF RUSSIAN INFORMATION CONSUMERS IMAGINE THE FUTURE OF NEWSPAPERS

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抽象的。 本文致力于研究现代印刷媒体在年轻“数字”读者的信息消费范围中的地位。 这项工作基于对圣彼得堡大学新闻系一年级学生进行的社会学研究，以及他们对报纸和杂志作为未来信息来源的问题和前景的看法。

关键词：印刷媒体、报纸、杂志、印刷品生产、“古腾堡时代”、信息消费。

Abstract*. The article is devoted to study of the place of modern print media in the spectrum of information consumption of a young “digital” reader. The work is based on a sociological study conducted among first-year journalism students at St. Petersburg universities, their vision of the problems and prospects of newspapers and magazines as sources of information in the future.*

Keywords**:** *print media, newspapers, magazines, print production, “Gutenberg era,” information consumption.*

Discussion

The modern information space is characterized by the expansion of both media channels and media content, which is determined by “the development of ... technology and the substantial overlap of content on different media channels” [Ilmukhin, 2015]. [Ilmukhin, 2015]. Information retrieval “is becoming increasingly multimedia, meaning that consumers rarely use only one or a limited number of media channels, constantly expanding their media consumption” [Shamray, 2022].

Traditional media today are changing under the influence of modern technological innovations and the active use of new technical means by the audience. This process is particularly reflected in the further development of the print media, especially newspapers, the first means of mass information of society in the histo-

ry of mankind. Print media still occupy a prominent place in shaping the overall information flow that is bombarding the modern individual who is interested in the world around him today, in a period of global digitalization of all aspects of life, expanding his presence in infospace through new technical and communicative means. However, the title of A. Miroshnichenko's book "When Newspapers Die", published in 2011. However, the title of A. Miroshnichenko's book "When Do Newspapers Die" published in 2011 [Miroshnichenko, 2011], is now called by some media experts a forecast that has come true [Gurova&Lomykina, 2021].

On the one hand, the editorial boards of newspapers and magazines are now becoming a kind of "hubs" for content production. The result of their activities is increasingly becoming information Internet platforms with widely developed reader and advertising services. On the other hand, the traditions of the editorial process make it possible to achieve a high-quality presentation of information on a variety of topics, which consequently generates the trust of readers and advertisers, thus creating a clear advantage over numerous Internet sources, often simply impersonal.At the same time, the media form of such platforms can be called "hypertextual", "which indicates the primacy of text as the original carrier of information and communication connection". [Shamray, 2022]. It is no coincidence that studies have shown that the process of "virtualization" of traditional media, which was predicted to be explosive at the turn of the millennium, "has taken a long time and lasted about 10 years" [Kachkaeva, 2010]. [Kachkaeva, 2010].

Examples of Internet platforms that emerged on the basis of editorial boards of printed media include portals for federal newspapers and magazines, as well as many regional ones. For example, the editors of the newspaper St. Petersburg Diary have in recent years created not only a business supplement to the regular print edition, but also a popular information portal, its own video production, and a production center for creating socially significant projects.

But even with such a deversified vector of development, many editorial offices continue their output of print media, improving their design and printing execution, exploring new niches and ways of distribution. The media management of newspapers and magazines takes into account the presence of other traditional forms of information and new media in the consumption of journalistic content by modern audiences.

And, obviously, the youth sector of this audience is the most distant from reading traditional print media.

The media environment of today's youth is characterized by a free choice of media channels, actors of information (bloggers, friends, "LOMs," etc.), the presence of feedback from sources and conductors of information (subscriptions, ratings, comments, the possibility of direct communication). Forms of televisual and multimodal representation of information (web-streams and other forms of

direct communication with the presenter) are becoming increasingly important. Thus, new forms of media intensify the information message, giving it a whole set of functions in a single message: informative, communicative, opinion-forming, entertaining [Kiuru & Krivonosov, 2018].

We can talk about the creation of a holistic social media environment, in which "the social nature of modern man no longer exists outside the processes of mediatized communication, and man becomes 'media man'"[Vartanova, 2020].At the same time, mediatization leads not only to the generalization of information consumption, but also, in a certain sense, becomes the source of a new division of society. Mediatized worlds," which "are distinguished by a set of obligatory intersubjective knowledge, certain social practices and cultural compactifications... For example, although it is impossible to study the mediatization of culture or society in general, we can study mediatized worlds of the stock exchange, school, households, etc." [Hepp, 2020]. [Hepp, 2020]. We can also talk about the mediatized worlds of the social media sphere itself - journalism, blogging, etc.

One of the problematic topics of the mediatization of social space is the relationship between the new media and the traditional political information sphere, the servicing of which was and still is an important task of the print media. First of all, the traditional media form a professional image of a journalist, a trained and socialized specialist whose credibility does not depend on subjective preferences and network "hype. The opinion of a professional journalist is ideally based on "reflecting and broadcasting the essential meanings, main factors and causes, problems and prospects of development of society, which are based on universal human values" [Svitich, 2013]. [Svitich, 2013].

This mission of the print media journalist, of course, limits the direct-communicative possibilities of presenting information, separating the author from the reader. Nevertheless, the semantic load of printed information material creates around a political event a concentration of positive (affirmative) or negative (critical) messages. The printed physical form also carries a rather meaningful sense of preservation, sustainability and value of the information captured not in a virtual form.

The modern political activity of young people is mainly concentrated around online information and communication resources in the form of media activism. At the same time, physical information carriers most often function in forms that have shown their effectiveness in influencing the mass consciousness in commercial and political advertising. These are essentially advertising products - clothing with political memes and slogans, graffiti and posters, badges, flags, leaflets, etc.

However, at the level of media activist leadership, printed and, in general, traditional forms of media, including newspaper, magazine and book products, retain their significance as "authoritative" and "rule-setting" means of informa-

tion. For example, books like The Media Activist's Cookbook, excerpts from it and from programmatic Western authors like J. Sharpe and J. Soros do not lose their political and informational significance. Leaflets and brochures distributed during political actions are often the very first information resource that promotes, among other things, online "tactical" political media: online magazines, blogs, video blogs, streamers, etc.

At the same time, recent sociological research shows that political activism is not a broad social phenomenon and more often than not expresses the positions of small radical groups, including youth. Forms of medaactivism"...as a rule, do not appeal to a broad mass audience, but are formed in the interests of particular social groups or individuals who are disadvantaged by the mass media. They are characterized by a desire for opposition, dissent, opposition and resistance. More often than not, they express the point of view of the social and political minority" [Raspopova, 2020]. [Raspopova, 2020].

In one way or another, questions about the future of such a traditional form of media as the newspaper are directly related to the role they play in the lives of today's youth, including in the lives of young people who have chosen journalism and related activities as their future specialty and profession. In many ways, it will depend on them how successfully the new technical and communicative media will converge with traditional media in order to preserve the social function of the modern media.

Practice

The author's excursion by first-year students of journalism at St. Petersburg universities () to the largest printing facility in the Northwest region of Russia showed students' interest in the form of a traditional printed newspaper, a certain personal experience of using them, and, in a sense, a nostalgic attitude toward the newspaper as a form of news reporting.

To conduct the research, students were asked to write an essay that included answers to the following questions:

1. The place of the newspaper in my life.
2. Where do I get newspapers to read or never get them.
3. What kind of newspapers I read, what kind of information I find in them.
4. Why I read newspapers or don't read them
5. How I see the newspaper in the near future, in what form they will remain or why they will disappear
6. Five reasons why newspapers are sure to disappear in the near future.
7. Five reasons why newspapers will exist for a long time to come.

The study involved 100 students, among whom questionnaires were administered to participants in the study.

The results of the three questionnaires were as follows.

1. What topics in the media are you interested in? (number of positive answers):

- culture - 79; - art - 75; - social life - 57; - travel - 54; science - 42; politics - 42; - economics - 27; - celebrities - 20; - other - 17; - sports - 16; business - 14; - shows - 14.

We can see that today's freshmen are more interested in cultural information, while entertainment information showed a surprising lag. Socio-political information is located in the middle. These three blocks clearly stand out and show that issues of education and self-education are the most relevant for first-year students.

2. What channels of information do you use (sum of scores on a five-point scale):

- Internet - 426; - books - 383; - social networks - 341; - messengers - 321; - magazines - 197; - television - 192; - newspapers - 171; - radio - 167.

There is also a sharp distinction between online and traditional media, with no one type of traditional media, not even television, standing out.

As a result of the analysis of the 100 free-form essays received, the following conclusions can be made:

Less than 15% believe that newspapers matter in their lives (or have influenced their lives in some way in the past).

The remaining 85% believe that the newspaper does not exist for them as a channel for receiving information. But they almost always mention that the newspaper was important to their parents and that it is still important to their grandparents today.

Most respondents have fond memories of reading children's magazines and using newspapers for games and various crafts. Undoubtedly, newspapers have played a role in the development of reading habits and interest in the surrounding life. Almost all respondents believe that the future of newspapers as an information channel is the transfer of content to electronic format and distribution on the Internet. The main reasons for the imminent disappearance of newspapers are called their ineffectiveness in the presentation of information and inconvenience of use. But at the same time, more than half of the respondents believe that newspapers will never disappear, but will acquire other forms of existence.

The future of newspapers as media through the eyes of today's student youth were analyzed according to negative (A) and positive (B) indicators.

A. Reasons why newspapers will cease to exist in the near future (placed in descending order of frequency of mention):

1.Lack of immediacy of information (70%)

2.The cost of the newspaper (57%)

3.Uncomfortable to use (45%)

4.harm the environment (42%)
5.Not profitable for advertisers (34%)
6.Lack of feedback (23%)
7.Existence of editorial restrictions and censorship (20%)
8.Poor print quality (17%)
9.An aging generation of readers (14%)
10.Low availability (8%)
11.Voluminous articles (5%)
12.Volume Limitation (2%).

Б. Reasons why newspapers will last a long time (placed in descending order of frequency of mention):

1.Low cost (32%)
2.Aesthetic and cultural value (28%)
3.Tactile perception (25%)
4.absence of "information garbage" (24%)
5.Traditions of consumption (23%)
6.Confidence in the content (22%)
7.Local news (20%)
8.Clear business model (14%)
9.Independence from electricity and Wi-Fi (9%)
10.Periodicity (7%)
11.Availability for advertising (5%)
12.Recyclability, repairs, crafts, scrapbooking (4%)
13.Possibility of collecting (3%)
14.Fashion as a vintage item (2%)

An analysis of student papers allows us to create the following supposed image of the newspaper of the future, as seen by today's students - future journalists:

1. The newspaper will look more like a magazine in terms of presentation, quality of printing, illustrations, and journalistic materials.
2. Circulation: according to the number of people who want to buy it (print-on-demand). It may be printed directly at the point of sale.
3. Will be an artifact of artistic value.
4. It will be a collector's item.

It is revealing that in their reports, students hardly touched upon the political and ideological function of the newspaper, which has been the main one since its emergence as a mass medium. The only "politicized" topic was the environmental one, with students noting both the negative aspect of print media - the need for a paper medium - and the positive aspect - the reuse of paper. They also pointed to the reduction of negative environmental damage through the individualization of print media production.

If we talk about the social significance of the newspaper, we can say that aspects of professionalism, trust and in general the general cultural aura of the print media are the most important factors for journalism students in the issue of maintaining the newspaper as a significant source of mass information. Also noteworthy is the multimodal nature of the significance of the newspaper: the positive aspect of the tactile perception of print media, the desirability of combining visual and textual information.

Conclusion

In conclusion, we can state that the young generation of future journalists, unlike some radical theorists, does not problematize the disappearance or preservation of traditional print media, recognizing both their shortcomings and advantages, which allows us to be optimistic about how the modern media sphere, including new technical and communicative means, virtualizing and communicating, preserves the professional qualities developed during the long development of traditional media.

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预防儿童成瘾行为的现代科学方法
MODERN SCIENTIFIC APPROACHES TO THE PREVENTION OF ADDICTIVE BEHAVIOR OF CHILDREN

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抽象的。 该文章揭示了预防儿童成瘾行为的主要现代科学方法。 应在社会学、心理教育学和社会教育学背景下考虑预防。 预防计划有一定的类型。 在实践活动中，要注重对成瘾行为的一级预防，其核心是孩子的个性以及为孩子创造良好的微环境。

关键词：成瘾行为，儿童，预防。

Abstract. *The article reveals the main modern scientific approaches to the prevention of addictive behavior in children. Prevention should be considered in a sociological, psychological-pedagogical and socio-pedagogical context. There is a certain typology of prevention programs. In practical activities, it is necessary to place emphasis on the primary prevention of addictive behavior, the center of which is the child's personality and the creation of a favorable microenvironment for him.*

Keywords: *addictive behavior, children, prevention.*

The increase in various types of addictive behavior in children is an urgent and urgent problem. Pedagogical science must provide answers to the question of how to prevent its many harmful consequences. Problems of preventing children's addictions are considered in their studies by L.A. Gizyatova, L.N. Gladkova, O.V. Gribanova, R.D. Dyshechev, A.V. Zaporozhets, O.S. Matyukhina, I.A. Olevskaya, E.N. Pristupa, L.K. Fortova, E.V. Shalomova and many others. At the same time, individual trends and directions in the field of prevention of addictive behavior have not been sufficiently studied.

The purpose of the article is to characterize modern scientific approaches to the prevention of addictive behavior in children from the perspective of an integrative approach.

Let us turn to the analysis of scientific approaches formed in pedagogy to the essence and content of the prevention of addictive behavior in children. We will

consider prevention as a special type of social and pedagogical activity, which is at the intersection of different branches of knowledge. Modern preventive medicine, which has the main goal of creating a healthy lifestyle, actualizes a complex, systemic view of a child's health, including physiological, mental, spiritual and social aspects. And therefore, activities to prevent addictive behavior consist in predicting negative trends in personality formation at all mentioned levels, early detection, study, assessment of the initial signs of deviant behavior; this can be a separate event or a whole series of events that have a single goal and are aimed at preventing and overcoming negative phenomena. Prevention can be considered as a special type of activity that integrates knowledge not only in the field of medicine, pedagogy, psychology, sociology, but also information technology [2, p. 41–42].

In general, the term "prevention" is defined as a set of preventive measures aimed at maintaining and strengthening the normal state and order. Prevention, as defined by the World Health Organization, is action aimed at reducing the likelihood of a disease or disorder, interrupting or slowing the progression of a disease, and reducing disability. In a broader context, this is a multifaceted activity that prevents the spread of psychoactive substances in society. Such prevention covers a fairly wide range of activities [1].

Prevention in the sociological sense is an activity aimed at strengthening and maintaining the stable functioning of the social system, which is carried out by identifying, eliminating or neutralizing the causes and conditions that cause various deviations. Consequently, the prevention of addictive behavior is a special case of general preventive activities of society and represents activities aimed at weakening the negative impact of addictive behavior on society as a social system, which is carried out by identifying, eliminating or neutralizing the causes and conditions for the occurrence of addictions [3].

Social prevention is understood as a complex of economic, political, legal, medical, psychological and pedagogical measures aimed at preventing, limiting, and localizing negative phenomena in the social environment. Social prevention as a direction of socio-pedagogical activity is aimed at preventing social problems or life crises of clients, individual groups or preventing complications of existing problems and consists of a set of economic, political, legal, medical and psychological-pedagogical measures aimed at preventing, limiting and localizing negative phenomena in the social environment. In a broader sense, socio-pedagogical prevention is a system of social education measures aimed at creating an optimal social situation for the development of children and adolescents, which contributes to the manifestation of various forms of activity. Also, socio-pedagogical prevention is understood as scientifically based and timely actions aimed at influencing the consciousness, feelings and will of students in order to develop immunity

to the negative influences of the environment and prevent antisocial behavior of minors; prevention of possible physical, psychological or sociocultural conflicts among individuals at risk; preservation, maintenance and protection of the normal standard of living and health of people; assisting them in achieving their goals and unlocking their internal potential [2].

As we see, specialists fill socio-pedagogical prevention with deep meaning, not limiting themselves only to the need to prevent problems, thus embodying one of the main principles of socio-pedagogical activity - the principle of humanism - in its everyday manifestation.

Separately, we can distinguish psychological and pedagogical prevention as a system of preventive measures, which aims to prevent and overcome unwanted mental and somatic disorders, as well as eliminate external causes, factors and conditions that cause certain deficiencies in the development of children. This type of preventive activity is used in the context of trends in the humanization of education and upbringing, and, based on this, experts believe that the educational psychological service should be primarily engaged in preventive activities [4].

Preventive activities involve preventing problems that have not yet arisen, overcoming problems immediately before they arise, and intervening in the range of existing problems in order to prevent new ones. When implementing this approach, it is necessary to promote the growth of the individual's capabilities, his self-actualization, complex spiritual and psychophysical development, and not be based on the selection of treatment or rehabilitation programs [2].

Taking into account all of the above, we propose to define the prevention of addictive behavior of children in a socio-pedagogical environment as a pedagogically appropriate system of actions that contribute to enhancing the action of favorable environmental factors that stimulate the development of children, the formation of prosocial forms of their behavior, aimed at preventing and limiting social, psychological and biological causes of all types of addictive behavior.

Today there are many classifications of prevention based on various criteria. Thus, they distinguish the type of prevention by type, by target group, the type of prevention by the content of the activity, the level of prevention by the level of effort [3].

Types of prevention are traditionally divided into primary, secondary, and tertiary. Based on the content of the activity, the following types of prevention are determined:

- non-specific (general social) - it involves activities that do not directly relate to the problem of addictive behavior, but influence it indirectly (for example, through organizing children's leisure time), it is aimed at optimizing living conditions, creating an alternative to negative manifestations, etc.;

- specific – it involves activities directly aimed at preventing various manifestations of addictive behavior [2; 4].
- Depending on the object of activity, prevention is divided into levels:
- personal – aimed at improving the condition of an individual, developing personality traits that contribute to a healthy lifestyle, self-realization in socially valuable activities;
- family – involves influence on the family as a social group and the most important institution of socialization;
- social – aimed at changing social norms and public opinion about addictive behavior [6].

The typology of prevention programs can also be built depending on their scale, targeting and subjectivity (who implements them). Thus, there are universal programs designed to cover the maximum number of children or aimed at a specific group of the population as a whole (for example, all school students); indicative (selective), that is, selective programs that address children at risk; modification programs according to indications), which are addressed to those who already have experience of addictive behavior [7]

From the point of view of the focus of influence, prevention is divided into two large groups: person-centered (influence on personality characteristics) and environment-centered (influence on parents, teachers, peers, communities).

Depending on the level of the object of prevention, in addition to the level of activity of people who are specialists in prevention and the individual at whom the preventive work is aimed, processes and phenomena of an economic, social, medical, and political nature are also distinguished. As objects of prevention, they need improvement and methodological assistance. Also, preventive intervention can be permanent, systematic and periodic [3].

Moreover, each strategy from all those discussed above can be combined with others.

As we see, the target groups for the prevention of addictive behavior include a healthy, law-abiding population without signs of using psychoactive substances; and individuals at risk; and individuals with addictive behavior.

Let's return to the types of prevention. The World Health Organization traditionally distinguishes such main types of prevention as primary, secondary, tertiary [5].

Primary prevention is a set of social, educational and medical-psychological measures aimed at preventing addiction to psychoactive substances. It provides for social activities of a non-specific nature, the contingent of which is the general population of children and adolescents; this type of prevention is the most widespread [2].

Primary prevention is divided into radical and early. Radical prevention involves changing the socio-cultural living conditions of the population (promotion

of a healthy lifestyle, sports, health education, etc.) and measures that prohibit and control the consumption and distribution of alcohol, narcotic and other psychoactive toxic substances. Early prevention includes both identifying individuals who abuse without addiction and preventing the development of addiction. In addition, this includes information about what needs to be done if a child or student begins to use addictive substances.

Psychological impact within the framework of primary prevention is implemented through the development of personal resources, the formation of a functional family, medical impact - by identifying biological risk factors and their correction at the medical level. Primary prevention is also called "social prevention" because it affects, first of all, a set of social conditions that contribute to the preservation and development of health, preventing the adverse effects of social and natural environmental factors.

Secondary prevention is a set of social, educational and medical-psychological measures aimed at preventing the formation of addictions and complications. The secondary prevention population includes individuals with addictive behavior or members of a risk group. Its goal is to stop addictive behavior and replace it with adaptive forms of behavior. Objectives of secondary prevention: increasing the potential of personal-environmental resources, mastering the skills of practical use of various behavioral strategies in a stressful situation. These tasks can be implemented as follows: by teaching effective skills and abilities to overcome stress that has a social orientation, providing social support. Also, in some cases, secondary prevention is aimed at slowing down the development of the disease; in narcology, it includes early diagnosis of addiction and its timely treatment [8].

Tertiary prevention is a set of social, educational and medical-psychological measures, the purpose of which is to prevent breakdowns and relapses, that is, to create conditions for mobilizing the spiritual forces of the individual, creating a desire to solve one's problem oneself. The target population for this activity are individuals with established addictive behavior. The goal of tertiary prevention is to prevent the transition of established addiction to the next, more severe stage, mainly through rehabilitation measures. It covers very severe cases, in particular those associated with repeated relapses and unsuccessful treatment [2].

Without questioning the conclusions of the World Health Organization, we note that this organization looks at the problem of prevention, first of all, from a medical point of view. On this basis, we allow ourselves to assume that a pedagogical classification according to this model will not meet the modern needs of pedagogical science, because it detracts from the importance of primary prevention, which, in our opinion, is of exceptional importance for overcoming the problem of addictive behavior in children and its possibilities insufficiently identified.

We propose to meaningfully improve the distribution of prevention by type, focusing on primary prevention, because in modern socio-pedagogical research

it is primary prevention that becomes the subject of scientific research. Thus, primary prevention should cover all children, but its goal is not to prevent addiction to psychoactive substances, but to promote the harmonization of the socialization process, the formation of the child's moral and psychological stability, and the acquisition of a variety of life skills that are not related to problems with the use of psychoactive substances. That is, the main task of primary prevention is to do everything possible so that the child does not have any reasons or reasons to take this or that substance or become involved in other addictions. Of course, such prevention is designed primarily for children of primary school age. As logically follows from the above, secondary prevention should already address problems of addictive behavior. We divide this type of preventive activity into two areas. The first direction covers all children, partly it is designed for primary school age, and to a greater extent - for younger teenagers. We are talking, first of all, about informing about the causes and types of addictive behavior and developing the skills to resist the offer of addictions from the environment, which is carried out in an interactive training form, using game activities. The second direction of secondary prevention consists mainly of individual work with representatives of the risk group for addictive behavior. And finally, tertiary prevention is individual and group assistance to people with addictive behavior to overcome it and prevent relapse in people who have already overcome addiction. We do not strictly tie the last two types of prevention to a specific age period. An analysis of the literature and our own experience have shown that this is mainly adolescence, but there are cases of persistent addictive behavior and rehabilitation from addiction in earlier age periods.

Thus, the analysis of approaches to social and pedagogical prevention of addictive behavior in children allowed us to draw the following conclusions. In our opinion, the most important thing is that modern prevention programs should operate within the framework of a person-centered approach, which best meets the objectives of positive prevention of addictive behavior. The goal of this prevention is the formation of an individual who is able to independently and responsibly build his life, manage his actions, and believe in his strengths and capabilities.

Prospects for further study of the topic lie in the development of interactive forms and methods for preventing addictive behavior in children.

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纳米技术在体育运动中的应用回顾
REVIEW OF NANOTECHNOLOGIES THAT HAVE FOUND APPLICATION IN SPORTS

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注解。 文章总结了有关在体育运动中使用纳米技术创造高强度和有效的数据，在确保性能、库存和装备、舒适的装备以及为运动员的健康创造更好的条件（恢复、免受伤害、预诊断）方面 -病理状况）。 由于缺乏对纳米产品对环境和人体影响的了解，文章表达了支持需要为纳米产品市场创建统一认证和标准化体系的想法。

关键词：纳米技术、运动、装备、库存、性能、康复。

Annotation. *The article summarizes data regarding the use of nanotechnology in sports to create high-strength and effective, in terms of ensuring performance, inventory and equipment, comfortable equipment and creating better conditions*

for the health of athletes (recovery, protection from injuries, diagnosis of pre-pathological conditions). The article expresses an opinion regarding support for the idea of the need to create a unified certification and standardization system for the market of nanoproducts, due to the lack of knowledge of their impact on the environment and the human body.

Keywords: *nanotechnology, sports, equipment, inventory, performance, rehabilitation.*

Introduction

The most popular explanation of what nanotechnology (NT) is that it is a method of combinatorial operations with various materials, the size of one of which will not exceed 100 nanometers. The choice of just such a limiting dimensional value is determined by the fact that materials with these parameters can, when exposed to gravitational and other forces, exhibit new physical, chemical or biological properties

The most complete definition of NT can be found in the materials of the US National Nanotechnology Initiative, according to which technologies carried out byat the atomic, molecular or macromolecular levels with a subnanometer scale along one or more coordinates to provide a fundamental understanding of the phenomena and properties of materials at such sizes and for the manufacture and use of structures, devices and systems that have new properties and functions due to their small sizes [1, 6].

The term “nanotechnology” was coined by Tokyo University professor Norio Taniguchi in 1974 in the context of processing materials by adding or removing an atom or molecule. And already in 1981, this term was more widely popularized by J. Drexler, an employee of the Sandia National Laboratory (a laboratory of the US Department of Energy, dealing primarily with issues of the nuclear weapons complex and related innovative conversion technologies), who used the concept of “nanotechnology” to generalize the processes of creating materials, structures and devices with grains, layers and elements in the subnanometer range, as well as methods for their measurement [3, 4].

Currently, nanotechnology is widely used in the fields of electronics, healthcare, mechanical engineering, biology, ecology, nutrition, as well as in sports.

The materials used in writing this review article were obtained based on the method of analyzing information sources in electronic resource format, taking into account the usefulness of the information provided in them and the status of the sources.

The purpose of this work (collecting data and writing an article) was seen by the authors as studying and summarizing current publications concerning the use of nanotechnology in the sports industry. In appearance, the article is a descriptive

review containing information about a specific subject of research, which is nanotechnology that has found application in sports. Addressing the article to a wide audience, the authors followed the path of simplifying its structure and content.

Main content of the article

The application of nanotechnology is now recognized as a new stage in the development of the sports industry, providing the implementation of innovative solutions to improve equipment, training and recovery of athletes.

In our opinion, the emergence of nanotechnology in sports is due to several key factors:

A). The need for further growth in sports results is to increase the effectiveness of training and overcome physical limitations.

b). The development of science and technology, which allows the use of nanotechnology in various fields, including sports.

V). Commercial Interest – The sports industry is a huge market, and companies see nanotechnology as an opportunity to create innovative products and gain a competitive advantage.

G). Increasing the safety of athletes, as nanotechnology helps create safer equipment and gear, reducing the risk of injury.

Overall, the emergence of nanotechnology in sports is the result of a combination of scientific progress, commercial interest and the desire to achieve better athletic performance [10].Sports activity is highly dependent on even minor changes affecting sports equipment, which can provide an increase in performance. It is nanotechnologies, being the embodiment of innovative ideas in the field of materials science, that have a very significant impact on competitiveness in sports [12].

The list of sports equipment, the quality characteristics and durability of which are increased due to the use of nanotechnologies in their production, includes baseball bats, tennis and badminton rackets, arrows for archery and the bows themselves, hockey sticks, racing bicycles, golf balls[10].Silicon nanoparticles, nanoclay fullerenes, etc. are used to produce new types of functional materials called polymer nanocomposites. Their use in the manufacture of skis allows them to provide a given rigidity, precision turns and a high degree of control over the trajectory of movement in alpine skiing disciplines (slalom, downhill) and freestyle (ski acrobatics, moguls, ski cross). In addition, the use of nanotubes in the materials from which racing skis, ski poles, snowboards, sleds (for bobsleigh, luge and skeleton) are made allows them to be made more durable and lighter. The ban on fluorinated ski lubricants further actualizes the development and use of those that include nanoparticles, which can provide an optimal combination of physical and chemical properties of various materials that reduce friction and increase wear resistance. This is achieved by enclosing material particles in nanoshells that firmly adhere to each other and to the surface of the skis, which leads to a manifold increase in the water-repellent sliding properties of ski lubricants[9].

Incorporating carbon nanotubes (**ICNs)** as the most commonly used material in sports equipment (they are 100 times stronger and 6 times lighter than steel and still have the stiffness of diamond) combined with graphite oxide in the composite material content for canoe and match hulls yachts, increases the slip of boats in the first case, and in the second, makes them much stronger and in both cases lighter.

In speed skating, short track speed skating and figure skating, applying super-hard ceramics to the blades of skates keeps them super sharp for a long time.

A number of experts consider the use of nanotechnology for processing rifle barrels in shooting sports and biathlon to be a very promising direction: an increase in the static stability of a bullet can be achieved by increasing its rotation speed.

Lighter and more wear-resistant nanocomposite materials are widely used by automakers participating in Formula 1 racing, where the speed of a racing car largely depends on the weight of the body and the quality of the tires. In addition, the use of nanoparticles of zirconium dioxide (ZrO2), zinc oxide (ZnO); Copper oxide (CuO) and other chemical compounds in lubricants provide internal combustion engines installed in these vehicles with reduced wear and friction[9].There is also information that additives to motor oils of racing cars containing nanocarbons have pronounced repair and restoration properties. A certain increase in nanocarbon content in fuel (gasoline) leads to an increase in its actane number [8].

Studies of the effect of adding nano-sized diamond-containing powders to rubber mixtures used for the production of tire rubber and rubber products show that this additive leads to increased tear resistance, wear resistance, and reduced crack growth[15].Nano-based paints and varnishes are used in motorsports to reduce aerodynamic drag, which leads to increased vehicle speed.

More than 20 years ago, development began on the widespread use of composite materials in aircraft structures, including those used in aviation (airplane, glider, hang gliding) sports. Nowadays, molecular composites containing carbon nanotubes and hollow nanofibers (these are already third-generation materials) make it possible to reduce the total weight of aircraft structures by 60–80%, and, consequently, increase the flight properties of manufactured devices [5].

Nanotechnology is now being used in the creation of materials used for the manufacture of safety and rescue ropes for mountaineering and rigging cords for sports sailing yachts, as well as for the manufacture of impact-resistant and lightweight protective helmets, elbow pads, breastplates and other protective equipment that hockey players are equipped with. Bicycle helmets, motorcycle helmets, and helmets for luge athletes are also made using nanocomposite materials. Nanomaterials are also widely used in the production of sports uniforms. Sportswear should be light, soft, and hygienic, quickly change its configuration and thus not restrict movement. The development of nanotechnology is leading to an increas-

ingly widespread use of so-called “smart materials” - materials that respond to environmental changes and change their properties depending on conditions. Among the things artificially created from “smart materials”, first, we should include sportswear. Sportswear made from “smart fabric” reacts to temperature changes, has the properties of climate membranes that allow air to pass through when it’s hot and thicken when it’s cold, in addition, it can “kill” bacteria, decompose dirt and sweat, and repel external water[13].

It is silver and copper nanoparticles woven into the fabrics of sportswear that have antibacterial properties, eliminating unpleasant odors and preventing the growth of bacteria. Nano-coatings increase the water-repellent and windproof properties of fabrics, maintaining the athlete’s comfort in all weather conditions.

Carbon nanotubes integrated into athletic shoe materials make them incredibly durable and lightweight. This allows athletes to demonstrate greater speed, strength and endurance, achieving better results.

Global companies producing sportswear today have been able to achieve that an athlete’s uniform can weigh only 150 - 200 grams, and the weight of sneakers has decreased to 180 grams [eleven].

For example, consider the “speed” equipment of a speed skater. Boots in this sport are made of very light and durable carbon fiber (carbon fiber). The overalls are ultrasonically welded from multi-nanocomponent fabrics - elastane-nylon and polyurethane. On the inner thigh of the overalls, there are inserts that reduce friction between the legs to a minimum. For the forearm, a special cut and fit is provided to ensure the appearance of wrinkles in this area when running, which are necessary to impart turbulence to the oncoming air flow, reducing aerodynamic drag. The “back” of these overalls performs a frame function due to its manufacture from polyurethane. This design of the overalls ensures the achievement of higher speeds.

One of the most interesting projects in the nanotextile system, which can find application in the same mountaineering, is the development of electric fabric - a chameleon. The electrical fibers in it are woven with cotton in such a way that the fabric can accumulate thermal energy and convert it into electrical energy, which can be used, for example, to recharge communication equipment and players. Depending on a person’s movements, this material can change its color and even shape, transforming from a tight-fitting T-shirt into a loose shirt [14].

Nanotechnology can also be used to intelligentize sports equipment by embedding nanosensors into it to monitor the physiological parameters of an athlete or nanochips to monitor the condition of sports equipment. For example, a group of scientists from Donghua University in Shanghai has developed a new type of smart fiber. Thanks to it, you can sew “smart” clothes, which will have high-tech components built into them: displays, sensors, chips, wireless transmitters [7].

The list of industries where these products can be used, of course, should also include the field of sports, since fitness trackers that read and transmit information can be built into these "smart" clothes. The smart fiber research team is puzzled by how to make new textiles durable and resistant to environmental factors.

Nanotechnological disruption will be able to change the field of diagnostics and health monitoring of athletes through the creation of implantable nanochip biosensors that will be able to monitor physical activity, the level of certain substances in their blood and tissues (oxygen, glucose, lactate, etc.) in real time, as well as temperature body, heart rate, breathing rate and other parameters.

In many ways, this will be based on the creation of prototype sensors capable of capturing only strictly defined biological microobjects.

The growing demand for complex, high-tech medicine, including sports medicine, and for high-quality diagnostic equipment is a very important factor in the development of the carbon nanomaterials market. The latter can find application in biological scaffolds for accelerated regeneration of tissues damaged because of sports injuries, due to their high potential for biological compatibility. They can provide increased efficiency in so-called "personalized medicine" associated with the production of new types of drugs and the creation of more robust diagnostic systems [2].

Another area of application of nanotechnology can be and is pharmacology, focused on the use of molecular drugs whose structure includes active substances. Development is already underway to create nanotransport capsules capable of releasing their contents in the right place and at the right time. In sports traumatology, this will ensure the delivery of drugs precisely to the site of injury and will speed up the healing process, reduce side effects and reduce the dose of drugs. In addition, we are now talking about creating nanobots that interfere with naturally occurring biochemical processes to achieve higher athletic results (normalization of ATP, lactate, glucose, etc.)[9].

The area of application of artificial nanomaterials is the production of food products, including sports nutrition. Today, you can expect to see hundreds of sports nutritional supplements, sports nutrition ingredients, and packaging materials produced using nanoparticles and nanomaterials on the market. However, it should be pointed out here that the use of nano-containing food products classified as sports nutrition must be approached somewhat carefully for the following reason.

The high chemical and catalytic activity of nanoparticles, their ability to penetrate biological barriers and accumulate in the body determines the presence of toxic properties in many nanomaterials, which must be taken into account when ensuring food safety. Particular attention from the standpoint of the risks involved attracts the composition of such products to amorphous silicon dioxide, titanium

dioxide, colloidal metallic silver with a particle size of less than 100 mm and multi-walled carbon nanotubes [3].

Conclusion

The high pace of development of the nanoproducts market is causing widespread discussion among specialists about the lack of a unified system of standardization and certification of goods of this level of production. The impact of nanotechnological developments on the environment and the human body remains unexplored. This is very important because Nanoindustry products are recognized as an integral part of the global economy of the future, including the sports industry. The experience of developed countries is proof of this. Nanomaterials and nanotechnologies have a wide range of applications and, among other things, can have a significant impact on progress in the sports field. Today, the need to replace imports under sanctions should stimulate the search for reserves to expand the production of the domestic industry and ensure its entry into markets of various levels, including sports-oriented. In addition, the introduction of nanotechnology in the sports field raises a number of ethical and social issues. One of the main ones is the problem of assessing them from the standpoint of "technological doping" and creating equal conditions for all athletes. It is necessary to ensure the development of clear rules and regulations so that the use of nanotechnology does not turn into a pursuit of the latest developments and does not violate the principles of fair play.

Nanotechnology is a powerful tool that has the potential to revolutionize sports by improving athlete performance, making training safer and speeding recovery from injury. Further research and development in the field of nanotechnology promises even more innovations and breakthroughs that will change the way we think about sports and its capabilities.

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学前机构培养特殊教育需要儿童的教学条件分析
ANALYSIS OF THE PEDAGOGICAL CONDITIONS FOR THE UPBRINGING OF CHILDREN WITH SPECIAL EDUCATIONAL NEEDS IN A PRESCHOOL ORGANIZATION

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注解。 本文分析了影响有特殊教育需要的儿童的教育和培训质量的教学条件。 该研究涵盖了各种因素，包括方法、组织方面以及心理和教学支持，这些因素有助于此类儿童在教育环境中的有效融入和发展。 这项工作的结果是确定了确保创造有利的教育环境的关键条件，以促进最大程度地发挥潜力并让有特殊需要的儿童适应教育过程。

关键词：全纳教育、有特殊教育需要的儿童、儿童的惩教和教学支持。

Annotation. *This article presents an analysis of pedagogical conditions that influence the quality of education and training of children with special educational needs. The study covers various factors, including methodological approaches, organizational aspects and psychological and pedagogical support, which contribute to the effective integration and development of such children in the educational environment. As a result of the work, key conditions were identified that ensure the creation of a favorable educational environment that promotes maximum disclosure of potential and adaptation of children with special needs to the educational process.*

Keywords: *inclusive education, children with special educational needs, correctional and pedagogical support for children.*

To solve pressing problems of preserving the health, development and education of children with special educational needs, an effective method is to organize

continuous comprehensive support for the child throughout the educational environment. In Kazakhstan, groups are opened in kindergartens where children, despite their physical, intellectual, social, emotional, linguistic and other characteristics, have the opportunity to be included in the process of upbringing and learning on an equal basis with other children. This direction is implemented through psychological and pedagogical support for pupils in an inclusive educational environment, a person-oriented approach, variability and flexibility of curricula, programs, methods of education and training and other special conditions to ensure equal access to preschool education for all children.

According to the PMPC in Kazakhstan, in the 2022-2023 academic year, of the total number of children with special needs, the number of young children (from 0 to 3 years old) amounted to 7,719 people, or 4.1%; preschool age (from 3 to 5 years) – 47,726 people, or 25.4%.

According to the NEBD, 20.9%, or 11,597 pupils of the total number of children with special needs of early and preschool age are included in the inclusive process of education and training [1].

Available statistics show that the detection of children with SEN from birth to 3 years remains the lowest as a percentage of the total number of children with SEN. This fact requires improving the quality and regularity of screening by primary health care organizations (PHCO) for the early detection of health problems in children in the first years of life, as well as strengthening the interaction between PMPK and PHCO.

In addition, the education of children with special needs in general education and training programs is hampered by the lack of regulations on the inclusion of children with special needs in general groups, as well as the lack of special skills among educators for individual work with the child. An analysis of the activities of preschool educational organizations showed that not all preschool organizations develop individual developmental programs for children with special education needs.

Based on the experience of the regions, there is local positive experience in providing correctional and pedagogical support to children with special education needs. In some preschool organizations, this support is provided through the activities of correctional and inclusive education rooms (hereinafter referred to as CIER), which provide early comprehensive correction for unorganized children with special needs of early and preschool age.

This work is carried out at the request of the parents and on the basis of the conclusion of the PMPK. Often, the reason for the lack of education and correctional pedagogical support for children with special education needs is the remoteness of such children from the district KPK and regional Resource Centers, according to specialists from education departments. In this case, the way out of the situation

is the functioning of CIER on the basis of educational organizations at the place of residence. Unfortunately, the experience of CIER activities is available only in a few kindergartens across the country. Only some of them have Early Help Services and consultation centers for parents. Currently, normative legal regulation of correctional and pedagogical support for children with special education needs is required, which will create a high-quality system to support the implementation of various educational opportunities for children.

In 2022, the share of preschool organizations that created conditions for inclusive education was only 55.4%, but it has a disproportionate distribution across regions [2].

This is explained by the fact that there are no uniform requirements; each region interprets the concept of "conditions for inclusive education" in its own way. In this regard, it is necessary to develop, test and approve indicators for assessing conditions for inclusive education for the purpose of further implementation in practice. In addition, in light of all these problems, the issue of creating optimal conditions for the transition of a child with special education needs from a preschool organization to school, taking into account his individual capabilities and needs, remains relevant. According to the Law of the Republic of Kazakhstan "On Education", a child with special education needs can enter 1st grade from 6 to 10 years old [3]. However, there is no regulatory document granting the right to children with special education needs to be in a preschool organization before entering school. In practice, all children, without exception, are released from kindergarten upon reaching 6 years of age. This issue today requires serious study in order to make management decisions and improve the relevant regulatory documents.

The educational process in preschool organizations of the country is organized in accordance with the State Compulsory Standard of Preschool Education and Training (hereinafter referred to as the State Educational Standard), the general education curriculum for preschool education and training, as well as standard curricula for preschool education and training.

An analysis of the factors influencing the quality of upbringing and education of children with special needs allows us to conclude that the leading factor in the development of inclusive education is the high level of readiness of the teaching staff to work with such children.

In order to identify the preparedness of teachers to work in conditions of inclusion, a survey was conducted among employees of the State Public Institution nursery-kindergarten No. 79 "Shabyt" of the city of Astana. The developed questionnaires included questions that made it possible to study the level of education and qualifications, specifics and work experience, as well as features of understanding and personal teachers' attitudes towards inclusive education.

A total of 12 teachers took part in the survey, of which 66.7% were aged from 35 to 63 years, 16.7% each in the age categories from 21 to 25 years and from 25

to 35 years. The staff of a preschool organization consists of specialists of middle, pre-retirement and retirement age.

75% of the teachers who participated in the survey have higher education, a bachelor's degree, a quarter of the respondents indicated secondary specialized education (25%), there are no postgraduate education specialists (master's, doctor of philosophy, candidate of sciences). The presence of such levels of education does not contradict international experience. For example, the most common requirement for preschool teachers in OECD countries is a bachelor's degree or equivalent. This norm applies to 18 out of 25 countries. At the same time, in France and Portugal, teachers are required to have a master's degree or its equivalent. In Poland, a master's degree or its equivalent is not a strict requirement; however, the majority of preschool teachers begin their careers with this level of education [4].

A study conducted using a questionnaire showed that 41.7% of teachers work with children with special educational needs, 25% of respondents have heard about inclusive education, 33.3% have limited ideas about inclusion. 55% of teachers showed a valued attitude towards children with special needs and towards inclusive education, in particular.

When answering the question about the purpose of inclusive education, respondents noted the following: 41.7% "it is important to help children with special educational needs to believe in themselves, this is possible in conditions of inclusion", 25% "this is important, a child with special needs receives social experience, realizes their educational needs, children have a humane, tolerant attitude towards the limitations of other people," 33.3% "this is important, a child with special needs receives social experience and realizes his educational needs." Understanding of the need to include such children in preschool education and a generally positive attitude towards inclusion was demonstrated by 100% of respondents. This is confirmed by the nature of their answers, which indicates that teachers understand the value of obtaining diverse social experience for children with normal and developmental disabilities, and the social significance of inclusive education

In their teaching activities, 25% of teachers encountered children with disorders associated with behavioral disorders and communication disorders, 25% of respondents with mental development problems, mental retardation, 25% of teachers with speech dysfunction, 16.7% of teachers with hearing impairment, 8.3% of teachers with children with combined, complex developmental disorders.

At the same time, according to the results of the survey, only 8.3% of teachers have a diploma of graduation from a professional organization in their specialty, 17% have completed advanced training courses, 18% have completed an educational seminar, a training seminar, 15.5% have completed advanced training

courses, while a large number Some teachers (41.2%) have not undergone training or advanced training to work with children with disabilities.

However, only 23% of teachers showed a willingness to work with children with disabilities in physical and (or) mental development and organize their joint education with normally developing children, taking into account their constant improvement of their qualifications in the field of inclusive education. To the question: "Are you ready to work with children with various disabilities?" 77% of respondents indicated that they were not ready because they lacked special knowledge about the developmental characteristics of children with disabilities.

Thus, a survey of teachers from nursery-kindergarten No. 79 "Shabyt" made it possible to identify the characteristics of teachers' readiness to work in conditions of inclusive education and to note the insufficient development of competence in working with children with special needs among teachers of preschool organizations.

Despite the fact, that many teachers fully or partially indicated that inclusive education should be one of the forms of joint education of children with special needs with normal children, not all of them are motivated to implement the ideas of inclusion in their teaching practice.

One of the main reasons is the lack/inadequacy of the necessary knowledge about the developmental characteristics of children with special education needs, their special educational needs and ways to meet these needs using special conditions of correctional pedagogical influence.

Unfortunately, not all Kazakh preschool organizations have specialists for the successful implementation of inclusive practices and effective assistance to children with special educational needs [5].

Work should be carried out in the following areas:

- network interaction with kindergartens that have defectologists, psychologists and speech therapists on their staff in the form of consultations for teachers and methodological support in writing adapted programs, consultations for parents;

- training of teachers in advanced training courses on working with children in conditions of inclusion.

In addition, we conducted a survey of children's parents,brought up in nursery-kindergarten No. 79 "Shabyt". 170 respondents took part in the survey, of which 162 were parents of pupils without special educational needs and 8 parents of pupils with special educational needs.

To the first question "How do you understand what "inclusive education" is? we received the following responses:

- "The process of development of general education, which implies access to education for all, in terms of adaptation to the different needs of all children, which ensures access to education for children with special needs."

- “Education for special children.”
- “Education with all categories of people.”
- “When children with special needs study together with normal children.”
- “This is education for special children or for children with speech or developmental delays,” etc.

From the majority of respondents’ answers (63%), it was revealed that among the parent community there is no common understanding of the conceptual apparatus and content of inclusive education, knowledge about various types of physical and mental disabilities of children, conditions of upbringing and education in inclusive conditions. At the same time, 37% of respondents indicated answers that characterize their complete lack of understanding about inclusive education, namely: “I don’t know”, “I find it difficult to answer”, “no way”, “all the children of the world”, “complete education”, “I don’t have information” “, “I don’t understand”.

The greatest difficulty for parents was determining their personal attitude towards the joint upbringing and education of children with special educational needs.

Only 27% of parents of children believe that such children should grow and develop together with healthy children. The majority of parents has a negative attitude towards shared upbringing and education and indicates that they need to be raised separately from other children (57%). They believe that a necessary condition for more successful work of a preschool organization should be the absence of children with special educational needs in groups. 16% of respondents found it difficult to answer the question: “How do you think the problem of adaptation of children with special education needs to life in society can be solved?”

The reason for these statements should be attributed to the lack of awareness of the respondents, parental competence in matters of inclusive education, and the presence of existing negative psychological attitudes towards children with special educational needs, which make it difficult to accept inclusion in education.

And the question “Are you ready to recognize children with special needs as equal members of society?”, unfortunately, 60.5% of parents partially agree, 25.9% find it difficult to answer, 8.6% completely disagree, and 5% of respondents do not agree at all recognize them as equal members of society.

According to 24.7% of parents, interaction between healthy children and children with special needs may be acceptable during joint games in the yard or on the street. 21% of respondents indicate that children can communicate after classes in clubs and sections; 14.8% of respondents indicate casual communication on the street as a way of interaction. Only a small percentage of survey participants recognize joint upbringing in the same kindergarten group and close friendship (Diagram 1).

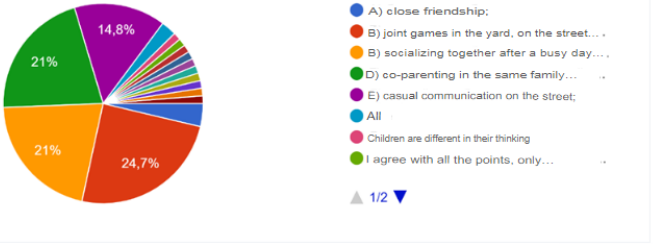

Diagram 1. *What are the ways for healthy children and children with special needs to interact? do you think it is acceptable?*

Despite different points of view about the possibility of interaction between healthy children and children with special needs, 45.7% of parents give a positive answer about the introduction of inclusive education in preschool organizations, 17.3% do not agree with inclusion in preschool organizations and 37% find it difficult to answer this question .

For the successful implementation of inclusive education in a preschool organization, certain conditions are required. Thus, according to 37% of parents, it is necessary to organize additional training for teachers to work with children with special needs, develop special educational programs for supporting the child (21%), increase the number of teachers working in preschool organizations (21.1%), reduce the number of students in groups (8.6%), to prepare public opinion for the integration of children with special needs (12.3%).

In the course of joint upbringing and education, healthy children of a preschool organization, according to 35.8% of parents, children will become kinder, 17.3% will learn to help others, 11.1% will learn to be tolerant, 9.9% will gain experience in showing empathy , compassion. On the contrary, 12.3% of respondents believe that they do not see a positive positive impact. This can lead to a decrease in children's interest in cognitive cycle activities, academic performance and pace of development, as well as the emergence of conflicts in the children's team.

However, according to the opinion of 29.6% of parents, a child with SEN from childhood, as a result of joint upbringing and education, will feel more complete, participating in the life of the children's team, on an equal basis with other children. According to 17.3% of parents surveyed, children with SEN will have more opportunities to demonstrate their abilities in various activities and communication, and 16% of respondents indicated that a child with SEN will learn to interact with other people from childhood. These circumstances prove that the majority of parents see positive aspects in the joint development, education and upbringing of children, regardless of their differences (Diagram 2).

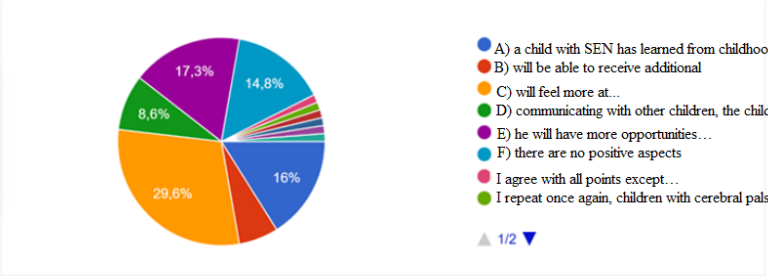

Diagram 2. *What benefits can a child with special needs and his parents expect in the case of joint development, education and training in groups?*

As part of awareness-raising support, it is important for 35.8% of parents of children to study the experience of introducing inclusive education in the world. 64.2% of parents were interested in the experience of introducing inclusive education in Kazakhstan and the impact of this process on children with typical development.

It is important to pay attention to the statement of 5% of parents about the constant violation of children's rights in a preschool organization, 37% - about existing cases of violation of children's rights. At the same time, 58% of parents believe that children's rights are not violated.

Based on the results of the parent survey, it can be stated that

- there are parents who have a negative attitude towards the joint upbringing and education of children with special educational needs and without special educational needs;

- there is a lack of awareness of parents on issues of inclusive education, the presence of negative psychological attitudes towards children with special educational needs, making it difficult to accept inclusion in education;

Therefore, based on the data obtained, we can conclude that the described situation highlights the need for active work in preschool organizations in the field of training teachers to work in conditions of inclusion and increasing parental competence in the field of inclusive education.

Thus, for the successful implementation of inclusion in preschool education organizations, it is necessary to create the following mandatory conditions:

- differentiation and individualization of learning processes;

- preparation of all participants in the general educational process to interact with students with developmental disabilities;

- special training and timely consultation of teachers and parents;

- psychological, medical and pedagogical support for children with special education needs.

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大学生长期压力和适应障碍的迹象
SIGNS OF LONG-TERM STRESS AND ADAPTATION DISORDERS AMONG UNIVERSITY STUDENTS

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注解。 该文章描述了导致适应性障碍发生的长期压力的迹象、适应性障碍的临床类型、其闭塞和预后。 人们普遍考虑了预防这些病理状况发展的组织和心理可能性。 它们会导致学习成绩下降和社交活动中断。

关键词：适应障碍、应激源、临床类型、预后、大学生。

Annotation. *The article describes signs of prolonged stress causing to development of adaptive disorders, clinical types of adaptive disorders, their occlusion and prognosis. Organizational and psychological possibilities of preventing the development of these pathological conditions were generally considered. They lead to a decline in academic performance and disruption of social activity.*

Keywords: *adaptation disorders, stressors, clinical types, prognosis, university students.*

Prolonged stress in higher education students can manifest itself through a variety of physical, emotional and behavioral symptoms. Physical signs are characterized by persistent fatigue and exhaustion, insomnia or sleep disturbances, increased sensitivity to pain, headaches, migraines, digestive problems, increased heart rate or heart pain, muscle tension, back or neck pain. Emotional signs include increased anxiety or restlessness, feelings of helplessness or despair, irritability and short temper, low mood, depression, feelings of tension and unbearability, loss of interest in school or other extracurricular activities. Behavioral signs may include avoidance of social situations or interactions with others, increased consumption of nicotine, alcohol, energy drinks or other stimulants, loss of appetite or reluctance to take care of oneself, constant feelings of tension and anxiety, and decreased effectiveness in school and completing tasks. These signs can vary greatly among different students and depend on individual characteristics [1].

Prolonged stress in higher education students can have many causes related to their academic and personal lives. Of these, several of the most significant can be

identified. Study load: Intensive studying, multiple assignments and exams, lack of time and constant feeling of pressure can cause stress among students. Fear of Failure: Students often experience a fear of failure or a failing grade, which can lead to increased stress levels. Adjustment problems: The transition from school to university can be stressful due to the new social environment, new demands and expectations. Financial problems: Lack of funds for study, living and other expenses can cause stress and anxiety among students. Personal problems: Family, relationship, psychological difficulties or health problems can also have a negative impact on the mental state of students. Lack of support: Lack of support from others, both physical and emotional, can make the situation even more difficult for students. Stress from social expectations: expectations of success, pressure from society or parents can create additional negative emotions in students [7].

Stressful situations that affect students for a long time lead to maladjustment. Adaptation disorders are a common problem among university students. They can manifest themselves in various forms and have various social consequences. One of the most common consequences of adjustment disorders is decreased academic performance. Students who have difficulty adapting to a new environment often have difficulty mastering course material, which can lead to poor grades and unsatisfactory learning outcomes. Another consequence of adaptation disorders is social isolation. Students who have difficulty adjusting may feel rejected or unaccepted in the learning environment. They may avoid socializing with other students or become the target of bullying or negative attitudes from their peers [2].

Let us consider external causes (stressors) that can lead to the development of adaptation disorders [4].

The first reason is a break with usual life, family and friends. Many students leave their hometown or even the country to pursue higher education. This means that they find themselves in a new environment, where there is no usual support and understanding of loved ones.

The second factor influencing the development of adaptation disorders in students is the high demands of the curriculum. They must get used to new educational approaches, faster pace of study and more information. Students may feel stressed due to lack of time or feelings of inadequacy, which can lead to low self-esteem and neurotic conditions. In students studying under the modular system, adaptation disorders are less pronounced, since intermediate control in different disciplines is evenly distributed throughout the academic year, and does not occur at the end of the semester and session.

The third factor leading to adaptation disorders is social interactions. Universities offer many opportunities (an abundance of opportunities) for communication and participation in various events. However, some students may have difficulty making too many new contacts and adapting to this social environment. This can

cause feelings of isolation and not belonging, which negatively affects their emotional well-being.

Finally, the fourth factor to mention is expectations and peer pressure. Students, especially freshmen, may have high expectations imposed on them by family, parents, teachers and friends. This can create a feeling of constant uncertainty, fear of failure, or disappointing others. This kind of pressure can lead to anxiety and decreased motivation to succeed.

Thus, adaptation disorders in higher education students can be caused by various external reasons, ranging from lack of support from loved ones to an unusual level of demands and social isolation. It is important to recognize these factors and provide support and assistance to students as they adapt to new environments to ensure their academic success and physical and mental well-being[6].

The prevalence of adjustment disorders in the population varies depending on many factors, such as age, occupation and gender. Depending on the population studied, the frequency of detection of adaptation disorders ranges from 1 to 28%. Thus, among patients with neurotic disorders, the prevalence of this disease reaches 28%, in people who have made a parasuicidal attempt - 26%.Among students, adaptation disorders are detected in 14–21% of cases [4].

Problems of adaptation in adolescence, and especially among students, have traditionally been of interest to psychiatrists and psychologists. On the one hand, this is due to the fact that the period of training coincides with one of the crisis periods in the life of an individual, during which the formation of personality is completed. On the other hand, the educational process places increased demands on the mechanisms of mental adaptation of students. Their increased vulnerability leads to maladjustment, which can manifest itself in psychological difficulties and social conflicts, accompanied by the development of various forms of addictions, the emergence of deviant and suicidal behavior [3].

In the clinical field of adjustment disorder, there are various types and subtypes, including affective and behavioral variants. However, the clinical and dynamic aspects of these disorders have not been studied enough. Diagnostic criteria indicate the possible duration of adaptation disorders (from 6 months to 2 years), but the phenomenological boundaries of these conditions are uncertain and may vary.

The clinical diversity of adaptation disorders is enshrined in the International Classification of Diseases (ICD-10), which is the only official diagnostic standard in Russia [5]. According to the predominant symptoms, asthenic, vegetative, dyssomnic, anxious, phobic, obsessive and mixed states are distinguished. These disorders fit into the affective (mainly with mood disorders) clinical picture.

The clinical and dynamic aspects of adaptation disorders have not yet been sufficiently studied. It is believed that the term “course” cannot always be applied

to this different and diverse nosographic category [4]. According to the ICD-10 diagnostic criteria [5], the duration of adaptation disorders can vary from several months to two years. However, the maximum duration criterion of two years is arbitrary. Phenomenologically, adaptation disorders as a nosological category remain diverse and uncertain. Its boundaries are blurred and cover a wide range of conditions, ranging from short-term stress reactions to long-term psychogenic disorders. In this regard, the works of N.A. are of particular interest. Schiffner et al. [8], which describe different types of adaptation disorders. A favorable course is characterized by spontaneous or therapeutic regression of psychopathological symptoms and subsequent recovery. With a protracted type of course, two options are distinguished: long-term maladaptive reactions (from 6 months to 2 years) and repeated clinical reactions that occur after a relative improvement in the condition. With an unfavorable type of course, there is an increase in psychopathological symptoms and the development of other mental disorders, such as dysthymia, endogenous or reactive depressive episodes, nosophobic disorders with a hypochondriacal personality orientation [7].

P.V. Voloshin et al. propose another classification of the types of adaptation disorders: progressive, recurrent and regressive. The progressive type is characterized by a progressive deterioration of clinical symptoms and its transformation into other forms of disorders (depressive episodes, anxiety and mixed disorders, personality disorders), according to ICD-10 [5]. The clinical picture of this type varies in the content and intensity of symptoms. The recurrent type of course is characterized by wave-like changes in clinical symptoms. Remissions, characterized by an almost complete absence of signs of adaptation disorders, can have different durations, and relapses of the "cliché" type can have different durations. Clinical symptoms, including affective and behavioral disorders, which form the content of the relapse, never exceed the intensity of the primary manifestations of adaptation disorders. However, some signs of maladaptive behavior may persist even during remission. Frequent relapses are considered as "a risk factor for the transition from a recurrent type of adaptation disorder to a progressive one, with the subsequent formation of other disorders". The regressive type of course is characterized by a pronounced decrease in the main clinical symptoms (affective and anxiety manifestations) and a simultaneous improvement in interpersonal, professional and social functioning [8].

It is important to remember that prolonged stress in students can have serious consequences for their mental and physical health. In this regard, it is necessary to pay attention to signs indicating prolonged stress and, if necessary, seek help from a psychologist or other specialists to solve the problem of stress and adaptation in the university environment.

To solve this problem, it is necessary to provide students with support and assistance within the educational institution. Many universities offer orientation

programs for new students to help them navigate their new environment and learn to overcome adjustment difficulties.

In general, prolonged stress and adjustment disorders are important problems that require attention and solutions. Supporting students during the period of adaptation to the educational process helps them successfully adapt to a new learning environment and achieve better results both in their studies and in their personal lives.

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音乐教师合唱团指挥活动专业能力形成的教学条件
（俄罗斯与中国的比较教育学方面）

PEDAGOGICAL CONDITIONS FOR THE FORMATION OF PROFESSIONAL COMPETENCIES OF THE CHOIRMASTER ACTIVITY OF A MUSIC TEACHER (IN THE ASPECT OF COMPARATIVE PEDAGOGY OF RUSSIA AND CHINA)

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注解。本文致力于从俄罗斯和中国的比较教育学角度思考音乐教师合唱团指挥活动专业能力形成的教学条件。作者重点关注的焦点在于：情感-意志、动机-价值、认知、交际、调节-活动、评价-反思等组成部分，以及将其落实到中国大学实践中的机制，将有助于未来音乐教师的形成，准备好在课堂上计划学生的声乐和合唱工作；采用有效的方法学习适合不同年龄段儿童的声乐和合唱作品；通过掌握指挥控制合唱团的技术来塑造合唱声音。本文的教学条件要求学生发展合唱研究、声乐和合唱表演的历史和理论领域的基础知识；应用，以及组织教学过程的个人和小组形式；将“合唱大师工作坊”和“文化教育实践”学科引入中国大学课程。

关键词:合唱团指挥的专业能力,合唱研究,合唱团工作的理论与实践,指挥,合唱演唱,声乐和合唱工作方法,合唱团指挥工作坊,情感意志,动机价值,认知,交际,调节活动,评价-反思组件模型。

Annotation. *This article examines the pedagogical conditions for developing the professional competencies of a music teacher's choral conducting activities in the context of comparative pedagogy in Russia and China. The author focuses on the emotional-volitional, motivational-value, cognitive, communicative, regulatory-activity, and evaluative-reflective components of the model, the implementation mechanisms of which in the practice of Chinese universities would contribute to the development of future music teachers' readiness to plan vocal-choral work for students in the classroom; apply effective methods of learning vocal-choral works appropriate for different age categories of children; model choral sound by mastering conducting techniques for managing a choir. The pedagogical conditions in the article are positioned as the need to develop students' fundamental knowledge in the field of choral conducting, history, and theory of vocal-choral performance; to apply, along with frontal, individual and small group forms of organizing the pedagogical process; to introduce the*

disciplines "Choral Conducting Practicum" and "Cultural and Educational Practice" into the curricula of Chinese universities.

Keywords: *choirmaster professional competencies, choral studies, theory and practice of working with a choir, conducting, choral singing, methods of vocal and choral work, choirmaster workshop, emotional-volitional, motivational-value, cognitive, communicative, regulatory-activity, evaluative-reflexive components of the model.*

Relevance. Today, with particular clarity, the pedagogical community faces the issue of further improving the professional training of future music teachers, who must possess not only fundamental theoretical knowledge, but also combine it with practical skills and competence-based skills. In the field of choirmaster activity, professional competencies are manifested in the ability to plan students' vocal and choral work in the lesson, in mastery of techniques and methods for learning vocal and choral works that are adequate for various age categories of children, criteria for selecting a song repertoire, modeling choral sound, and conducting techniques for managing a choir. The above competencies are formed in musical and performing activities during students' mastery of the academic disciplines "Choral singing", "Conducting", "Chorusmaster's workshop" and in the course" Methods of music education." Meanwhile, the formal separation of musical performance and methodological training of a teacher-choir master leads to difficulties in organizing vocal and choral work that students encounter during teaching practice. This problem is being considered by educators in both China and Russia, but there is currently no such research in the aspect of comparative pedagogy.

In this regard, the scientific novelty of this study lays in the fact that it:

– a retrospective of the formation of the category "professional competencies of choirmaster activity as a music teacher" in music pedagogical education in the Russian Federation and China;

– in the aspect of comparative pedagogy, unified and characteristic approaches to the formation of professional competencies of choirmaster activity as a music teacher in the conditions of music pedagogical education in the Russian Federation and China are substantiated;

– a model has been developed and tested for adapting Russia's experience in developing professional competencies in the choirmaster activity of music teachers in the practice of Chinese universities, combining emotional-volitional, motivational-value, cognitive, communicative, regulatory-activity, and evaluative-reflective components.

Theoretical significance of the study: the study summarizes the conceptual provisions of comparative pedagogy, choral studies, higher education pedagogy in the Russian Federation and the People's Republic of China, which made it possible to consider a retrospective of the formation of the category "profession-

al competencies of choirmaster activity of a music teacher" in music pedagogical education in the Russian Federation and China; to compare, in the aspect of comparative pedagogy of the Russian Federation and the People's Republic of China, unified and characteristic approaches to the formation of professional competencies of the choirmaster activity of a music teacher in the conditions of music pedagogical education of the Russian Federation and the People's Republic of China; a model has been developed for the formation of professional competencies of choirmaster activity for Chinese music teachers studying at universities in the Russian Federation.

Practical significance of the study is that its results contribute to optimizing the process of music pedagogical education in China.

Research methods:

– study of psychological, pedagogical and special choir literature by Russian [1-4] and Chinese authors [5-8];

— a pedagogical experiment involving ascertaining, formative and testing stages, as well as the use of empirical methods of observation, testing, and statistical processing of the results obtained.

The use of these methods made it possible to state:

1. The general approaches of Russia and China in understanding the essence of choirmaster competencies correlate with the characteristic features of the educational models of these countries. These in Russian education are the fundamentality of knowledge in the field of choral studies, history, theory and methods of working with a choir; a combination of frontal, small-group and individual work with students. In China, the leading method is reflection, as an analysis of a music teacher's own experience in the field of choirmaster activity, and an exclusively group form of teaching manual techniques for managing a choir within the framework of the curriculum discipline "Choral Singing and Conducting" prevails.

2. Studying the experience of Russia allows us to assert that the training of Chinese students in Russian pedagogical universities contributes to the formation of professional choirmaster competencies, uniformly understood by our countries and contributes to the formation of readiness to expand the repertoire of general music education and the Chinese concert stage through the inclusion of Russian works little-known for China in the work practice composers past and present.

3. Adaptation and extrapolation Russian experience in the formation of choirmaster competencies of future music teachers in Chinese universities is possible subject to a number of pedagogical conditions:

– the need for students to develop fundamental knowledge in the field of choral studies, history and theory of vocal and choral performance;

– the use of variable organizational forms of the pedagogical process: frontal, small-group and individual work for future music teachers to master the practice of choral singing, methods of working with a children's choir and manual techniques of a choirmaster;

– enriching the repertoire of work programs in the discipline “Choral Singing and Conducting” by including, along with arrangements of Chinese folk songs and works by Chinese composers, vocal and choral works by Russian authors (concert and chamber);

– updating in work programs that provide methodological support for the discipline “Choral Singing and Conducting” of choirmaster competencies as the abilities of future music teachers to detailing a specific creative task in vocal and choral activity; vision of the dynamics of the rehearsal process; prospects for working on the vocal and choral repertoire; identifying rehearsal stages (stages) in mastering vocal-choral material along with maintaining the task of forming the choirmaster’s reflection, as the ability to understand the success and difficulties of developing vocal-choral skills in children;

– introducing the disciplines “Chorus Master’s Workshop” and “Cultural and Educational Practice” into the curricula of Chinese universities in order to enhance the activity approach in the formation of choirmaster’s competencies of the future music teacher.

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中国艺术中意象之美的分析
AN ANALYSIS OF THE BEAUTY OF IMAGERY IN CHINESE ART

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摘要：当今的中国艺术以其独特的意象之美吸引着世界的目光。本文旨在深入探究中国传统艺术的审美品质，挖掘其意象之美背后的文化底蕴和历史谱系，以及其在全球艺术交流中的价值。中国传统艺术，如书画、诗曲、戏曲等，意象之美源远流长，承载着深厚的历史底蕴和民族精神。在现代社会，随着信息技术的发展，我们可以通过在线平台获得丰富的艺术资源，这有利于我们的研究，也带来了新的挑战。本文将充分利用这些数字资源，进行系统的文献梳理和实证分析。研究方法采用定性和定量相结合的方法，既注重理论层面的深入分析，又注重经验数据的支持。这些数据的收集和分析将为我们更全面地了解中国艺术中的意象之美提供强有力的证据。

关键词：艺术，中国，意向之美

Abstract. *Today's Chinese art attracts the world's attention with its unique beauty of imagery. The purpose of this paper is to deeply explore the aesthetic qualities of traditional Chinese art, to excavate the cultural heritage and historical lineage behind the beauty of its imagery, as well as its value in global art exchange. Chinese traditional arts, such as calligraphy, painting, poetry, opera, etc., have a long history of beauty of imagery and carry deep historical deposits and national spirit. In modern society, with the development of information technology, we can access to rich art resources through online platforms, which facilitates our research and poses new challenges. In this paper, we will make full use of these digital resources to conduct systematic literature combing and empirical analysis. The research methodology adopts a combination of qualitative and quantitative approaches, focusing on both the in-depth analysis at the theoretical level and the support of empirical data.. The collection and analysis of these data will provide us with strong evidence for a more comprehensive understanding of the beauty of imagery in Chinese art.*

Keywords: *Artistic, China, The beauty of intent.*

Although the literature studies have provided valuable resources for us to understand the beauty of Chinese artistic imagery, there are still certain gaps and challenges, which will be an important entry point for our subsequent research. By organizing the historical lineage and reviewing the existing results, we aim to lay a solid foundation for an in-depth exploration of the aesthetic qualities of Chinese artistic imagery.

Theoretical Analysis

serial number	form	Detailed real data
1	Thesis title	An Analysis of the Beauty of Imagery in Chinese Art
2	Content of analysis	Connotation and characteristics of the beauty of imagery in traditional Chinese art
2.1	essential properties implied or reflected by a notion	-Imagery is a blend of nature, life, and philosophy -Writing God in form and having both form and God in mind -Rich in poetry and musical rhythm
2.2	specificities	-Abstract and figurative combination - Emphasize the mood and vividness - Embody the unity of time and space
3	What to explore	Reasons for the Formation of the Beauty of Imagery in Chinese Art
3.1	historical reasons	-Deeply influenced by the philosophies of Confucianism, Taoism and Buddhism - Long history of artistic tradition and accumulation
3.2	Cultural reasons	-Emphasizing inner cultivation and aesthetic taste - a reflection of the psychological structure of the national culture.
3.3	Social reasons	-Social Changes and the Evolution of Aesthetic Needs: The Common Pursuit of the Beauty of Artistic Imagery by Different Classes.
4	elaboration	The Importance of Imagery in Chinese Art
4.1	aesthetic value	-Enriched and developed the world aesthetic system -Provided a unique aesthetic perspective for artistic creation.
4.2	cultural inheritance	-Carrying the cultural genes of the Chinese nation - Contributing to the inheritance and innovation of traditional culture
4.3	social significance	-Enhance public aesthetic quality and promote social harmony -Enhance national cultural soft power and show the charm of Chinese civilization

Traditional Chinese art imagery is not a mere reproduction, but a skillful fusion of nature, life and philosophy, forming an artistic realm of "writing God in form", pursuing both form and spirit, and displaying poetic and musical rhythms (Data 1). This artistic expression embodies the perfect combination of abstraction and figuration, emphasizing the profoundness of the mood and the vividness of the chiaroscuro, in which the space-time dimension is highly unified (Data 2). Since ancient times, the moral philosophy of Confucianism, the natural concepts of Taoism, and the Zen ideology of Buddhism have together shaped the aesthetic orientation of Chinese artists (Data 3.1). The long tradition of art history and deep cultural deposits also provide a deep soil for the formation of its beauty. At the cultural level, Chinese art emphasizes inner cultivation and aesthetic taste, which is a vivid embodiment of the psychological structure of the national culture (Data 3.2), reflecting the universal pursuit of the beauty of artistic imagery at all levels of society, which has always remained the same no matter how times have changed. The significance of the beauty of Chinese artistic imagery lies not only in its aesthetic value, but also in the fact that it enriches and develops the global art system and provides a unique aesthetic perspective for artistic creation (Data 4.1). Artistic imagery carries the cultural genes of the Chinese nation and becomes a bridge for the intermingling of tradition and modernity, which has an immeasurable role in the inheritance and innovation of traditional culture (Data 4.2). From the social level, improving the public's aesthetic literacy, building a harmonious society, and enhancing the country's cultural soft power are all indispensable contributions to the beauty of Chinese artistic imagery (Data 4.3).

Empirical research design

serial number	Content Classification	Detailed information
1	research topic	Analysis of the Beauty of Imagery in Chinese Art
2	Selection of Research Subjects	Containing Chinese artworks (e.g. paintings, sculptures, ceramics, etc.) from different historical periods, regional styles and art schools
3	Determination of research methodology	-Literature review: to summarize the history of Chinese art development and theories of imagery aesthetics -Empirical research: to collect data through fieldwork, artwork viewing, and expert interviews -Comparative analysis: to compare the differences and commonalities in the expression of imagery in different artworks

4	Empirical data collection	-Collect images and textual materials of representative works of various historical periods -Record the background of the creation of the works, information about the artists, art criticism, etc. -Interview artists and scholars to obtain their interpretations and views on the beauty of the imagery of the works.
5	Data analysis tools	-Qualitative analysis: use the theoretical framework of art and aesthetics to summarize and organize the collected data -Quantitative analysis: analyze the data on the frequency of occurrence of imagery elements in the works and the audience's feelings through statistical methods -Cross-analysis: combine the qualitative and quantitative results to explore the deep-rooted rules of the beauty of imagery in Chinese art works

We first sort out the development history of Chinese art through a literature review to dig deeper into the theoretical foundations of the aesthetics of imagery, thus laying a solid theoretical cornerstone for the subsequent empirical research. Next, we adopt a combination of fieldwork and artwork viewing to directly face the artworks and collect first-hand data. In terms of data analysis, we adopted a combination of qualitative and quantitative methods. The qualitative analysis is based on the theoretical framework of art and aesthetics, and the collected data are carefully interpreted and summarized in order to reveal the intrinsic meaning and symbolism of the imagery. Quantitative analysis, on the other hand, quantifies the frequency of occurrence of imagery elements in the works, audience feedback, etc., through statistical means, to reveal their influence in the art market and social acceptance. Through this cross-analysis, we expect to reveal the deeper patterns of the beauty of imagery in Chinese art.

Experimental results and analysis

form	text
Thesis title	An Analysis of the Beauty of Imagery in Chinese Art
Research methodology	empirical research
research target	Specific works of art
research purpose	Demonstrate the characteristics and connotations of the beauty of imagery in Chinese art
Findings	Specific presentation of empirical findings

analysis and interpretation	In-depth analysis and interpretation of research findings
research focus	Specific features of the beauty of imagery in Chinese art
aesthetic inquiry	The Aesthetic Connotation of the Beauty of Imagery

We delve into the detailed dissection of Chinese artworks through empirical research methods, and these specific artworks cover the richness and diversity of traditional Chinese culture, such as calligraphy, painting, sculpture and poetry. The aim of our study is to reveal the unique charm of the beauty of imagery in Chinese art, and to show its intrinsic characteristics and far-reaching aesthetic connotations.The concrete presentation of the empirical findings reveals to us the uniqueness of the beauty of imagery in Chinese art in terms of visual form. For example, we find that the artistic technique of white space in Chinese painting is not only a skillful treatment of spatial layout, but also an aesthetic embodiment of far-reaching imagery. The flow of lines in calligraphy is as rhythmic as music, showing the delicate balance between dynamic and static in the beauty of imagery. In poetry, the symbols and metaphors of imagery make the expression of beauty more subtle and deep. In-depth analysis and interpretation of these findings, we not only explore the aesthetic value of the beauty of imagery, but also try to reveal the cultural and philosophical concepts and historical lineage behind it. For example, how the ancient Chinese theory of yin and yang and the five elements influenced symbolism and allegory in artistic creation, and how Zen thought shaped artists' pursuit of imagery. We find that the beauty of imagery in Chinese art does not exist in isolation, but is deeply rooted in the soil of traditional Chinese culture.

Reach a Verdict

This paper delves into the unique aesthetic value of traditional Chinese artistic imagery. By combing through historical documents, we reveal the far-reaching influence of artistic imagery research in Chinese culture, as well as the rich contributions of domestic and foreign scholars to this field and the areas that have not yet been fully explored. In the theoretical analysis section, we reveal the inner structure and formation mechanism of the beauty of Chinese artistic imagery, emphasizing its central position in artistic expression and cultural inheritance. In the empirical research section, we selected representative art works and demonstrated the vivid display of the beauty of artistic imagery in specific works through rigorous data collection and analysis. These findings not only confirm the aesthetic characteristics of Chinese artistic imagery, but also provide us with new perspectives for understanding artistic creation and aesthetic experience.

Summarizing our study, we find that the beauty of Chinese artistic imagery is not only reflected in the harmony of form and the profoundness of meaning, but also contains deep cultural heritage and philosophical thinking. This aesthetic value cannot be ignored in enhancing the public's appreciation of art, as well as

its role in global cultural exchange. For future research direction, we can further explore the dynamic changes of art imagery in cross-cultural dialogues and how to utilize modern technology to innovate artistic expressions. In the face of the development of art in the context of globalization, we call for more attention to be paid to the protection and inheritance of traditional art, which should maintain its uniqueness while encouraging innovation and integration. Through education and exhibitions and other forms, the younger generation can understand and appreciate the beauty of imagery in Chinese art, making it a bridge between the past and the future.

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中国艺术人才培养的实践与展望
THE PRACTICE AND PROSPECT OF CULTIVATING ART PROFESSIONALS IN CHINA

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摘要：自本世纪初成立以来，经过十多年的快速发展，我国美术教育已成为我国培养高水平、应用型、实践型美术人才的主要渠道。然而，艺术人才的培养也面临一些问题，如学位教学产生的导向徘徊、学科整体实践创新能力薄弱、导师缺乏有效指导等。在此背景下，我国高校通过“新人才计划”和“研究生顶尖人才实验班”等改革举措，实现了人才培养模式的突破，取得了显著成效。实践表明，只有通过系统化、专业化、项目化的培训，艺术人才的培养才能展现出活力和活力。

关键词：艺术人才； 人才培养模式

Abstract. *After more than a decade of rapid development since its inception at the beginning of this century, China's art education has now become the main channel for the cultivation of high-level, applied, and practice-oriented art specialists in China. However, the cultivation of art talents also faces some problems, such as the wandering of orientation generated by academic degree teaching, the weakness of the overall practical and innovative ability of the discipline, and the lack of effective guidance from tutors. In this context, Chinese colleges and universities have realized a breakthrough in talent cultivation mode and achieved remarkable results through reform initiatives, such as the establishment of the "New Talent Program" and "Experimental Class for Graduate Students' Top Talents" and other innovations in talent cultivation mode. Practice has shown that only through systematic, specialized and project-based training can the cultivation of art professionals show vitality and vigor.*

Keywords: *Artistic talents, Talent cultivation model.*

The significance of professional development in the arts

Art majors include environmental art design, graphic design, animation design, jewelry design, Chinese painting, oil painting, stage art design, industrial design, ceramic art design, and architectural design, etc., which play an important role in the process of social development, and are rich in significance and diverse to social development, and the roles of the development of each type of art majors are as follows in Table 1:

Table 1

The Role of Professional Development in Various Arts

art major	Development significance, professional role
environmental art and design	Architectural decoration design, interior and exterior rendering design, landscape design, environmental engineering renovation
graphic design	Advertising, product design, corporate image planning, publishing houses, newspapers and magazines
animation design	Animation production, film and television commercial production, post-production synthesis
Jewelry Design	Product packaging, decorative design, book binding, commercial advertising, corporate image planning, display design
Chinese painting	Teaching, art creation, promotion and counseling in art museums, cultural centers and publishing houses.
pastel	Teaching, art creation and counseling in art galleries, exhibition halls and cultural centers
stage design	Television stations, advertising agencies, audio-visual production organizations, film and television production organizations, film and television advertising companies, etc. engaged in related design, research and management
Industrial Styling	Automobile, aircraft, engineering machinery, furniture, advertising, clothing and other industries
Ceramic Art Design	Ceramic factories, design companies, art creation departments
architectural design	Construction company, decoration company, design company, architectural decoration design

The development of the arts profession has helped to develop people's spiritual world, enhance social cohesion, improve aesthetic cultivation, promote mental health and lead to the awakening of creativity. Art not only meets the material needs, but also nourishes people's spirit, through singing the praises of beauty, praising the good, conveying the truth, so that people live in a beautiful humanistic environment; art can guide people's concepts, correcting the bad trend, through a

more subtle way to criticize the bad ideas, and help to promote the social harmony of the coexistence; art education helps to cultivate people's sensibility, appreciation and creativity, so that people better understand the world, improve the level of aesthetics; art has the ability to loosen up and relax, and to improve mental health, as well as to lead the awakening of creativity. Understanding the world and improving the aesthetic level; art has the effect of relaxing the mind and eliminating fatigue, people can relieve social pressure by participating in art activities, and further maintain psychological balance and mental health. Art is not only an expression of creativity, but also an important driving force for the progress of human civilization. Whether in history or in modern times, art is an indispensable part of human society, and along with the development of society, the importance of art majors has also become more and more obvious. Since the beginning of this century, art education has become the main way to cultivate high-level, applied and practical art specialists through rapid development, and the development of art majors needs to be constantly explored in order to meet the needs of the new historical period.

Cultivation of art professionals

Cultivation of art professionals is a complex systematic project involving several aspects, including specialization and synthesis, teachers and students, curricula and teaching materials, practice and synergy, process and results. First of all, the cultivation of professional talents in art colleges and universities can be formulated through relevant regulations and documents, such as the document "Guiding Opinions on Promoting High-Quality Development of Culture and Art Vocational Education in the New Era"[1] jointly issued by the Ministry of Culture and Tourism of China and the Ministry of Education of China, the Ministry of Education of China on Strengthening and Improving Recruitment and Examination of Artistic Specialties in Colleges and Universities for 2024, and Constructing an Assessment System That More Conforms to the Requirements for Selection and Cultivation of Artistic Talents in the New Era The evaluation system of the "Guiding Opinions on Further Strengthening and Improving the Examination and Enrollment Work of Art Specialties in Ordinary Colleges and Universities" [2], and the "Regulations on the Work of Art Education in Schools" [3] formulated by China's Ministry of Education, etc., which clearly define the content, principles and guiding ideology of the work of art education in schools and are aimed at promoting the all-around development of art professionals.

Cultivation of artistic talents should focus on their professional level and comprehensive quality, including but not limited to the aspects of specialized basic courses, interdisciplinary cross-fertilization development, and cultivation of composite and innovative artistic talents.

First of all, teachers are the pioneers of teaching reform and an important part of talent cultivation. Teachers can guide students to discover their potentials and

interests in the cultivation of art professionals, and through their personalized guidance, they can guide and help students to go to the art field that is suitable for them; teachers can inspire students to love the arts, and help them cultivate their artistic creativity and expression through rich and diverse art experiences and practical opportunities. Teachers can teach students professional knowledge and skills, and provide students with comprehensive art education through teachers' teaching design and new teaching methods; finally, teachers should help students realize their future educational mission and responsibility, and enhance the professional identity of professionals. Therefore, art colleges and universities should pay attention to the construction of the teaching team and improve the professional quality and business ability of teachers.

Secondly, students are also the direct beneficiaries of talent cultivation, and their enthusiasm, initiative and creativity are also indispensable to the cultivation of art professionals. Students should actively participate in classroom learning, master professional knowledge and skills, and constantly expand their horizons by taking the initiative to ask questions, think and explore; students should actively participate in all kinds of practical activities, such as creating their own art, watching art exhibitions and participating in art competitions. Through practical exercises to improve their artistic ability; students should take the initiative to study and research, not only limited to classroom teaching knowledge. Students can read relevant books, visit art exhibitions, pay attention to industry trends, and constantly enrich their artistic knowledge; tutors are also students' mentors and friends, students should maintain good interaction with their tutors. By asking questions, seeking guidance, accepting criticism, and discussing the direction of art creation and development with the tutor to improve their own artistic ability; art creation often requires teamwork, students should have good communication skills and teamwork spirit. Create and communicate with classmates to make progress together.

Finally, art colleges and universities should pay attention to the construction of courses and the preparation of teaching materials to avoid the problem that the knowledge learned by students cannot be applied in practice, and the relevant courses should pay attention to the specialization and strengthening of fundamentals, horizontal expansion, and vertical articulation. Teaching materials should be participated by leading figures in the industry, and be tested and applied for promotion. Art colleges and universities must pay attention to the management of the whole process of talent cultivation, establish a sound working mechanism, improve the working process, and mobilize the enthusiasm, initiative and creativity of all parties.

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中国职业教育高质量发展研究
RESEARCH ON HIGH-QUALITY DEVELOPMENT OF VOCATIONAL EDUCATION IN CHINA

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摘要：我国职业教育走过了一条坎坷跌宕的道路，实现了在国运困难的背景下向强国现代化使命的起步。我国职业教育的发展经历了三个阶段，即初级阶段、改革开放和发展阶段以及培养人才

关键词：中国，职业教育

1.Background and Current Situation of Vocational Education in China

China's vocational education has gone through a rough and tumble course, realizing the start in the background of difficult national fortune to the modernization of the mission of a strong country. The development of vocational education in China has gone through three stages, namely, the initial stage, the reform, opening-up and development, and the development of cultivating talents:

Difficult start-up stage (1949-1978):

In the early days of the founding of New China, vocational education began to explore the cultivation of talents according to the principle of "combining education with production and labor". In order to give more people the opportunity to receive education and learn skills, the half-work-half-study school model was tried in 1958 at the Tianjin State Cotton Factory, and in 1965, the number of vocational secondary schools in China increased to 7,294, with the number of students accounting for 53.2% of the total number of students at the senior high school level.

Reform, opening up and development phase (1978-present):

After China's reform and opening up, vocational education was once again revived as a balance between the needs of the country and the choices of individuals.

In 1996, the Vocational Education Law of the People's Republic of China clarified the status and system composition of vocational education. in 1999, the

Decision of the Central Committee of the Communist Party of China and the State Council on Deepening Educational Reform and Comprehensively Pushing Forward the Quality Education explicitly proposed the development of higher vocational education for the first time. Through the intensive introduction of legal systems and policy initiatives for the reform and innovative development of vocational education, the high-quality development of vocational education has been supported by stable policies.

Cultivating the development stage of reserve talents (current):

China currently has the largest vocational education system in the world, with 11,200 vocational schools and 29.15 million students enrolled. The attractiveness, influence and competitiveness of vocational education have been increasing through the continuous promotion of reform measures such as the modern apprenticeship system, the integration of production and education, and school-enterprise cooperation, and vocational education has effectively cultivated a large number of talents of different types of occupations for China.

2.Policy and regulatory support for vocational education in china

The stable development of the industry cannot be achieved without the support of policies and regulations, and the Chinese government is committed to promoting the high-quality development of modern vocational education, providing strong support for the development of vocational education in China through key policies and regulations:

The Opinions on Promoting the High-Quality Development of Modern Vocational Education issued by the General Office of the Central Committee of the Communist Party of China (CPC) and the General Office of the State Council of China in 2021 aim to promote the high-quality development of modern vocational education, which explicitly emphasizes the importance of vocational education and the fact that vocational education is tasked with the responsibility of cultivating diversified talents, passing on technical skills, and promoting employment and entrepreneurship. Overall requirements, main goals and specific tasks are proposed for vocational education to promote the development of vocational education [1]. The General Office of the Central Committee of the Communist Party of China and the General Office of the State Council of China issued the Opinions on Deepening the Reform of the Construction of a Modern Vocational Education System in 2022, which emphasized the service of students' comprehensive development and economic and social development, based on the enhancement of the key competencies of vocational schools. It aims to build a new mechanism for the high-quality development of vocational education with central-local interaction, regional linkage, and synergy between government, industry, enterprises and schools. The development of vocational education can be promoted by enriching the form of vocational school operation and expanding the forms of

school-enterprise cooperation [2]. The General Office of the Ministry of Education of China issued the Circular of the General Office of the Ministry of Education on Accelerating the Reform Key Tasks for the Construction and Reform of the Modern Vocational Education System in 2023, which emphasizes the importance of the integration of industry and education, school-enterprise cooperation, and the construction of industry-education consortia. Listed companies and industry-leading enterprises are encouraged to organize vocational education and promote the development of industry-education integration-type enterprises. The high-quality development of vocational education can be promoted by optimizing the supply structure of vocational education and improving the system of running schools through the integration of industry and education [3].

The General Office of the CPC Central Committee of the Chinese government, the General Office of the State Council of China and the General Office of the Ministry of Education of China, through the implementation of policies and regulations, have helped to build a modern vocational education system, enhance the construction of a skill-based society, cultivate more high-quality technical and skilled personnel, and provide strong support for the comprehensive construction of a modern socialist country.

3.System building and professional development of vocational education in china

The systematic construction and professional development of vocational education in China is an important issue related to the modernization of the country. China's vocational education system includes secondary vocational, higher vocational specialized and vocational undergraduate programs. China's vocational education is committed to building a modern vocational education system that is vertically coherent and horizontally integrated, and constantly optimizes the type of vocational education positioning and development path by deepening the integration of industry and education, school-enterprise cooperation and other reform measures. Vocational education in China covers a wide range of fields such as modern manufacturing, modern service industry and modern agriculture. This is essentially because China's economic and social development and the cultivation of technical and skilled personnel require high-level vocational schools and specialties. The Chinese government has upgraded the systematic construction and professional development of vocational education in China by means of renowned experts, industry elites and excellent teachers who should be involved in the development of core curricula, high-quality teaching materials, and practical programs, and the introduction of new methods, technologies, techniques, and standards.

China also vigorously promotes the integration of industry and education and school-enterprise cooperation, through which the government, industry, enterprises, and schools should jointly participate to form a systematic environment and

ecology favorable to the development of vocational education. This article takes school-enterprise cooperation in Belarus and China as an example:

On November 21, 2023, the China-Belarus University Union was established in Minsk, the capital of Belarus [4].Representatives of 40 Chinese universities and 41 Belarusian universities signed the Agreement on the Establishment of the China-Belarus University Union.The Chinese Ambassador to Belarus, Xie Qian, said that the number of Chinese students in Belarus has exceeded 7,000, and Belarus has The number of Chinese students in Belarus has exceeded 7,000, and Belarus has become the second largest destination country for Chinese students in Russian-speaking regions; 6 Confucius Institutes and 2 Confucius Classrooms have been set up in Belarus, and a number of Chinese universities and colleges have set up Belarusian research centers; 35 Belarusian primary and middle schools and 11 colleges and universities have set up Chinese language courses, and Chinese has been listed as one of the elective subjects of the Belarusian national unified graduation and promotion exams, which symbolizes that China and Belarus have become the most important countries under the Belt and Road initiative. This marks a milestone development of Sino-Belarusian higher education cooperation under the "One Belt, One Road" initiative.

Conclusions

The development of vocational education in China has gone through a difficult initial stage, a reform and opening-up and development stage, and a stage of cultivating and reserving talents for development, which fully demonstrates that the high-quality development of vocational education needs time to be deduced and gradually improved. The General Office of the Central Committee of the Communist Party of China (CPC), the General Office of the State Council and the General Office of the Ministry of Education of the People's Republic of China have provided strong support for the development of vocational education through the implementation of policies and regulations to build a modern system of vocational education, to enhance the construction of a skill-based society, and to cultivate more high-quality technical and skilled personnel. China improves the institutional environment and ecology of vocational education development through the integration of industry and education and university-enterprise cooperation, and the China-Belarus University Alliance is a practical demonstration of the development of university-enterprise cooperation. This paper concludes that the study of high-quality development of vocational education in China cannot be separated from the time projection, the improvement of policies and systems, and the international cultural exchanges and integration through actual data and real cases, hoping to serve as a reference for the researchers of related education industries.

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欧洲和中国数字图形的异同，各个协会帮助学生学习汉语作为外语
SIMILARITIES AND DIFFERENCES OF GRAPHICS IN EUROPEAN AND CHINESE NUMBERS, VARIOUS ASSOCIATIONS HELPING STUDENTS STUDYING CHINESE AS A FOREIGN LANGUAGE

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抽象的。 选择联想是为了更容易记住汉字。 对中国数字、中国天干与罗马数字以及现代欧洲数字进行了比较。 显示了汉字和欧洲文字的一些相似元素，熟悉这些元素将有助于对外汉语学生的教材记忆。 清楚地表明，一些欧洲数字 1(I)、2(II)、3(III)、IIII、V、6、7、X 和 100 可以假设被视为汉字的书写风格之一 （一、二（乙）、三、四（亖）、五、己、七、十、百。 对于与欧洲数字在命名上没有相似之处的中国数字，我们选择基于汉语基础知识的联想来供学生记忆。

关键词：汉字、中国数字、十天干、欧洲数字、罗马数字。

Abstract. *Associations have been selected to make it easier to memorize Chinese characters. A comparison was made of Chinese numerals, Chinese Heavenly Stems (天干) with Roman numerals and modern European numerals. Some similar elements of Chinese characters and European characters are shown, familiarity with which will facilitate the memorization of educational material by students studying Chinese as a foreign language. It is clearly demonstrated that some European numerals 1(I), 2(II), 3(III), IIII, V, 6, 7, X and 100 can hypothetically be considered as one of the styles of writing Chinese characters* 一（甲），二（乙），三，四（亖），五，己，七，十，百. *For Chinese numbers, which have no similarity in designation with European numbers, associations based on basic knowledge of the Chinese language were selected for students to memorize.*

Keywords: *Chinese characters, Chinese numerals, Chinese Heavenly Stems (十天干), European numerals, Roman numerals.*

Currently, friendship and business cooperation between the People's Republic of China and the Russian Federation is actively developing, therefore, among the general population of Russia, interest in studying the Chinese language and

Chinese culture is constantly growing. Learning the basics of Chinese with the ability to read and understand hieroglyphic text is very important for technology professionals. The personal practice of the author of the article in teaching students the Chinese language shows the frequent presence of a psychological barrier during the initial study of Chinese characters. The literature also notes psychological barriers and difficulties in learning characters for students when learning Chinese [1, 2].

It is convenient to begin overcoming the psychological barrier by familiarizing oneself with numbers, explaining to students that European numbers are also ideographic hieroglyphic signs, but at the same time they do not cause any difficulties in universal use in all European languages. In addition to the basic Chinese numbers, it is necessary to immediately consider the Chinese signs of the Heavenly stems [3], which are used in scientific terminology, but at the same time cause especially great difficulties for students when memorizing. Symbols of Heavenly Stems are used, for example, in the names of the hydrocarbons and their derivatives: 丙 (bǐng) - three 丙烷 (bǐngwán) - propane, 丙醇 (bǐngchún) - propanol, 丙烷羧酸 (bǐngwán suōsuān) - propanecarboxylic acid [3].

Let's start looking at the similarities and differences in the writing of symbols. Graphic explanations are summarized in Table 1, where cells that have similar elements in Chinese and European characters denoting the same number are highlighted in yellow.

Symbols 一 (yī), 甲 (jiǎ), 1, I. In fact, the three characters (一, 1, I) can be considered as font variants of the character 甲. The modern European numeral 1 and the Roman numeral I can be roughly represented as a simplified cursive writing of the sign 甲. The Chinese digit 一 is the same sign as 1 and I, but rotated at an angle of 90º. It is also interesting that 一 (yī) is read similar to the Roman symbol, the letter I. To learn the character 甲 (first), you can also remember that this radical is also part of the word duck 鸭 (yā). According to some ancient myths of the peoples of the world (for example, the Karelian-Finnish Kalevala [4]), the duck was the first bird, from whose egg the modern world was created. It should also be remembered that the first or most popular dish of Beijing cuisine is 北京烤鸭 (Běijīng kǎoyā) - Beijing roast duck [5].

Symbols 二 (èr), 乙 (yǐ), 2, II. The first thing that can be noticed is the actual identity of the symbols 二 and II when they are rotated 90º. If you write the hieroglyph 二 with a brush in the style of grass (草书, cǎoshū), then 二 will easily turn into 2 or Z. It should be noted that in European languages, 2 is sometimes written as Z (*Zwei*, in German, it means "*two*", Fig. 1 on the left). You may also notice that 乙 is actually the symbol 2 flipped 180º.

Symbols 三 (sān), 丙 (bǐng), 3, III. Here, too, we immediately see that 三 is Roman III rotated by 90º. The symbol 3 at first glance seems different from the other symbols, however, if you write the symbol 三 with a brush in the grass style

(草书, cǎoshū), without lifting the brush from the paper, you get a symbol very similar to the 3 on the stand (3). For the symbol 丙 it is very difficult to come up with an analogue among modern European or Roman numerals, but to remember this hieroglyph we remember that we see such a radical in the frequently used word "disease" 病 (bìng), which has a similar reading in a different tone. Already mentioned earlier was a saturated hydrocarbon (alkane) with three carbon atoms in the molecule - propane (C_3H_8) 丙烷 (bǐngwán), a component of a mixture of gases for lighters and household burners, also a useful word for memorizing. 烷 (wán) is a general word for alkanes. Hydrocarbon can also be represented by the word 烷烃 (wántīng).

Symbols 四 (sì), 丁 (dīng), 4, IIII (IV). Here, at first glance, we do not see any similarity, however, 四 is sometimes written in a simplified manner, for example, on the dials of wristwatches (Fig. 1 on the right), where 四 becomes a simplified network (internet or fishing) symbol 罒 (wǎng), which is very similar to IIII, especially when there are horizontal lines at the top and bottom of the symbol, as Roman numerals are sometimes written. Also, to remember the symbol, you can imagine that in the sign 四 on the right side there is a European numeral 4, which looks at its reflection in the mirror on the left. The sign 丁 is not similar to other numbers, it looks more like the Latin letter T and very vaguely resembles the contours of the European number 4. But the symbol 丁 is usually known to students from the textbook "New Practical Course of the Chinese Language" [6] or its version adapted for Russian students [7]. In these textbooks, the last name of one of the main characters is 丁. Also, to remember this character, it is useful to remember the name of the famous Chinese dish 宫保鸡丁 (gōngbǎo jīdīng) - pieces of chicken according to the recipe of the guardian of the heir to the throne. 宫 (gōng) – palace, 保 (bǎo) – guard, 鸡 (jī) – chicken, 丁 (dīng) – slices. The symbol 丁, in addition to meaning "four", also has translations depending on the phrase it is included in: slices, nail, worker. Also worth mentioning here is another substance that is part of lighter gas: butane (C_4H_{10}) - 丁烷 (dīngwán).

Symbols 五 (wǔ), 戊 (wù), 5, V. At first glance, they are completely different signs, however, if you write 五 with a brush and turn it over, the sign becomes quite similar to the Roman numeral V, especially in its version of the traditional writing with two horizontal features above and below. The sign 戊 consists of two radicals: 厂 (chǎng, factory or warehouse) and 戈 (gē, spear). Students will easily remember 戊 if they know the word 工厂 (gōngchǎng, plant) with the character 厂 and 找 (zhǎo, search) with the radical 戈.

Symbols 六 (liù), 己 (jǐ), 6, VI. All these signs are not similar to each other, however, if the symbol 己 extends the hook of the bottom line upward, then you will get a mirror image of the European "6". You can also fantasize about the sign VI: turn the sign V 180º and we get the Greek Λ. Now we turn the sign "I" by 90º,

we get Λ—. If we imagine that the "—" symbol cuts off the upper piece of the "Λ" sign, then we get a sign similar to 六.

Symbols 庚 (gēng), 七 (qī), 7̷ (Russian version crossed out 7), VII. Here, out of four characters, we see an amazing coincidence for two: if you turn over the Russian crossed out 7̷, you get 七. It is also worth mentioning important information for students that the character 庚 can also be translated as "age", "path" and "to compensate for expenses". For example, 贵庚 (guìgēng) is a question about age, 同庚 (tónggēng) is the same age.

Symbols 八 (bā), 辛 (xīn), 8, VIII, 九 (jiǔ), 壬 (rén), 9, IX. European characters and Chinese characters representing the numbers 8 and 9 are not similar. 辛 (xīn) in addition to the meaning 8, also has the translation "tart". The phrase 辛苦(xīnkǔ) "tart and bitter" is often translated as "to work hard" and "tired". The character 壬 (rén), which means 9, is the radical to the character "to be pregnant" 妊 (rèn, rén), a 9-month process that makes a man "responsible" 任 (rèn, rén). It is also useful to remember that 九 (jiǔ) is the radical to the character 丸 (wán), which means medicine in the form of a hard ball, as opposed to the flat tablet of medicine, which is 片 (piàn).

Symbols 十 (shí), 癸 (guǐ), 10, X. Rotating X by 45° gives 十. 癸 (guǐ) is the radical for sunflower 葵 (kuí), or in full 向日葵 (xiàngrìkuí), where 向 (xiàng) means "turn to the side" and 日 (rì) means "Sun".

Another interesting observation is that by writing the numbers 100 vertically with a brush, without lifting the brush from the paper, you can get a symbol very reminiscent of 百 (bǎi). Knowing this analogy, students will no longer confuse 百 (bǎi) - "100" and 白 (bái) - "white".

Table 1.

Comparison of European and Chinese characters denoting numbers.

European numerals	**1**	**2**	**3**	**4**	**5**	**6**	**7̷**	**8**	**9**	**10**	**100**
Heavenly Stems (十天干)	甲	乙	丙	丁	戊	己	庚	辛	壬	癸	
十天干reading	**jiǎ**	**yǐ**	**bǐng**	**dīng**	**wù**	**jǐ**	**gēng**	**xīn**	**rén**	**guǐ**	
Chinese numbers	一	二	三	四	五	六	七	八	九	十	百
Chinese numbers reading	**yī**	**èr**	**sān**	**sì**	**wǔ**	**liù**	**qī**	**bā**	**jiǔ**	**shí**	**bǎi**
Roman numerals	**I**	**II**	**III**	**IIII, IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**C**
transformation of letters when simplifying or writing with a brush											

Figure 1. *On the left is the clock of the cathedral in Kaliningrad. On the right is a wristwatch dial with Chinese symbols for the days of the week.*

Conclusions

We have selected analogies that will help students remember Chinese characters for numbers. As practice shows, this approach to searching for similarities between European and Chinese characters significantly makes it easier for students to overcome the psychological barrier at the initial stage of learning the Chinese language. Indeed, students begin to understand that the European numerals that they are accustomed to using are also hieroglyphs, and the use of hieroglyphs is actually very convenient and not at all scary.

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关于带有连词或连词的复合选言句结构中表语从句的顺序

ABOUT THE ORDER OF PREDICATIVE CLAUSES IN THE STRUCTURE OF A COMPOUND DISJUNCTIVE SENTENCES WITH A CONJUNCTION *OR*

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抽象的。 本文致力于讨论具有联合或的划分结构的结构组织的特殊性。 在复杂的句子系统中，这种结构是现代俄语语法中研究最少的一种。 文章考察了分割句中表语单元的可逆性/灵活性-不可逆性/非灵活性等结构特征； 采用了研究语言材料的定量方法，这使得可以确定带有连词的划分结构或仅在极少数情况下不允许组件的可逆性。

关键词：分割结构、连词or、表语单元、可逆/灵活结构。

Abstract. *The article is devoted to the peculiarities of the structural organization of dividing structures with a conjunction or. In the complex sentence system, this type of construction is one of the least studied in the syntax of the modern Russian language. The article examines such a structural feature as reversibility / flexibility - irreversibility / inflexibility of predicative units in a dividing sentence; a quantitative method of studying linguistic material is carried out, which makes it possible to establish that dividing structures with a conjunction or only in rare cases do not allow reversibility of components.*

Keywords: *dividing construction, conjunction or, predicative unit, reversible / flexible structure.*

In the sphere of the traditional opposition of subordinating and coordinating connections, one of the varieties of the latter is a disjunctive connection, expressed by a certain set of conjunctions (either, whether...or, either, then...that, not that... not that, either...either, or that). The most common means of expressing a dividing connection is the conjunction or, indicating that each of the events described is possible, but only one is real [Pochinyaeva: 186].

A disjunctive link can combine predicative units as part of a complex sentence (1), in the structure of a complex sentence complicated by subordination, when the subordinate clause or set of sentences refers to predicative units connected by

a dividing link (2), as well as homogeneous subordinate clauses as part of a polynomial complex sentence (3).

1. Someone was occasionally shooting at the shooting range. Sometimes, after a weak, abrupt shot, the clink of a broken bottle was heard or the mechanism of a moving target began to make noise (V.P. Kataev. A lonely sail is turning white).

2. If she has a high fever again tomorrow, an ambulance will come, or at least a local doctor will come (V.M. Kudryavtseva. Danilovna).

3. When I pass by peasant forests that I saved from being cut down, or when I hear the noise of my young forest, planted with my hands, I realize that the climate is somewhat in my power *?...?* (A.P. Chekhov. Uncle Ivan).

The conjunction or can connect the components of monosubjective compound sentences - polypredicative constructions, which are messages about several situations characterized by the unity of the subject. In syntactic science, the status of such constructions is determined ambiguously. Some researchers classify them as complex sentences (authors of "Russian Grammar" in 1980), others – as transitional constructions, in some conditions characterized as simple complex sentences, in others – as intermediate between simple and complex sentences (P.A. Lekant) or as complex (V.V. Babaytseva); and others - as simple sentences with homogeneous predicates (N.S. Valgina, S.E. Kryuchkov, L.Yu. Maksimov, etc.). We share the point of view on the status of these structures, according to which these constructions are classified as mono-subjective compound sentences, since grammatically they repeatedly express the meanings of time and mood [Russian Grammar 1980: 462] and establish certain relationships between events (situations) [Kolosova , Cheremisina 1987: 33], and in semantic terms they can be interpreted as messages about several situations - simultaneous or following each other [Russian Grammar 1980: 462]: Sometimes she (Margarita - O.P.) squatted at the bottom shelves or stood at the top and wiped hundreds of dusty roots with a rag (M.A. Bulgakov. The Master and Margarita).

In our study, the main linguistic material (70% of the sample) consists of polysubjective and monosubjective compound sentences. In polynomial complex sentences with a homogeneous disjunctive subordination of subordinate clauses, we trace only the line formed by the conjunction or.

The dividing connection that unites different syntactic units determines their semantic similarity, which manifests itself at the level of structure, grammatical characteristics of the connected components, in their number and order of arrangement.

The unity of the components of structures with a conjunction or is manifested in their interconnectedness, which, as a rule, is contextual in nature. Neither the first nor the second, as well as the nth number of components united by the conjunction or, have any formal indicators of the presence of a grammatical depen-

dence of one component on the other: As soon as he took a nap, a chair fell in the room, either by itself or with a noise old, unusable dishes were breaking in the next room, otherwise (colloquial = or) the children would make noise - at least run away! (I.A. Goncharov. Oblomov); Whether there were keys in this place, or the ice was thinner, or he simply could not hold back the weight of an adult, only Alyosha failed (L.N. Andreev. Alyosha the Fool).

The interaction of grammatically equal predicative units is observed in the identical relation of each member of the series to a certain common component for them - the coordinator of identity (homogeneity) [Kholodov 1977: 78-79]. In the above sentences, the coordinator of homogeneity is expressed implicitly, but can easily be restored from the context: *As soon as he took a nap, /something was sure to happen/: a chair in the room fell, just like that, by itself, or old, unusable dishes broke with a noise in the next room?…? ; /It's difficult to say now/ whether there were keys in this place, or the ice was thinner, or he simply could not contain the weight of an adult ?…?*.

The homogeneity coordinator can be presented explicitly in the form of 1) a determinant, 2) a previous fragment of a text of a generalized nature, 3) part of a polynomial complex sentence, when each of the subsequent parts, connected by the conjunction or, equally reveals the content of this part:

1) *Only occasionally, shaken guns clanked on the grooves, or a horse that did not understand the order for silence snorted or neighed, or an angry boss shouted at his subordinates in a hoarse, restrained voice ?…?* (L.N. Tolstoy. Hadji Murat).

2) *At least something new! If only the French came and ravaged Milan, or the sexton caught fish, or my uncle found gold... My God, what boredom!* (D.S. Merezhkovsky. Christ and Antichrist).

3) *The life of the man of that time was terrible and wrong; It was dangerous for him to go beyond the threshold of the house: just behold, he would be whipped by an animal, a robber would kill him, an evil Tatar would take everything away from him, or the person would disappear without a trace, without any trace (I.A. Goncharov. Oblomov); Surely, after her appearance, some misfortune will happen on the farm*: *a horse will fall ill, or the reaper will break, or - at least - the milk will turn sour* (K.A. Fedin. Cities and Years).

The relationship between predicative units and the homogeneity coordinator can be characterized as a cataphoric relationship with the preceding text, the meaning of which is revealed through the enumeration of situations indicated in components with a disjunctive connection. Accordingly, in constructions with a conjunction or between two or more designated situations, relations of some equivalence and similarity are established. The members of the dividing row "are united by thought...as similar in some way to each other" [Peshkovsky 1956: 442]. This type of relationship can be represented as a proportion: "a : c = b : c = n : c",

where a, b, n are the components of the separation structure, c is the homogeneity coordinator. The same ratio of the content of predicative parts to a certain whole, expressed explicitly or implicitly, which they constitute, indicates the grammatical homogeneity of the components [Oganesova, Skorlupovskaya 1971: 95; Gavrilova 1985: 27-28].

The role of coordinator of homogeneity in the analyzed constructions is also played by the conjunction or, the semantics of which quite definitely contains the meaning of an alternative, therefore the parts formalized by this conjunction acquire the "status" of alternatives and are recognized as homogeneous in relation to each other.

The homogeneity of the components determines the reversible / flexible order of their arrangement in the structure of disjunctive sentences with the conjunction or.

Reversibility occurs if the parts can be swapped without violating the meaning of the statement. This property manifests itself when there is no other dependence between the parts other than a simple connection of messages about something to describe a certain situation. The unity of the communicative task makes the information being connected similar in one way or another.

A significant number of dividing constructions with a conjunction or between predicative units have the property of reversibility, allowing the rearrangement of components in relation to each other without violating the general meaning of the construction. Almost any sentence we examined in the analysis of the constructions of symmetrical and asymmetrical structures is characterized by the possibility of free arrangement of its predicative parts. Wed: ***Either*** *they forgot me,* ***or*** *I did not remember their existence (L.N. Andreev. Alarm). =* ***Either*** *I didn't remember their existence,* ***or*** *they forgot me; Fyodor took his kobza,* ***or*** *they talked for a long time, and Peter's thoughts took a calm direction, and his plans grew stronger again* (V.G. Korolenko. The Blind Musician). = *They talked for a long time,* ***or*** *Fyodor took his kobza, and Peter's thoughts took a calm direction, and his plans grew stronger again; He would come, tipsy after getting paid at the museum,* ***or*** *Fedorov would drag him into his place and they would sit there* (Yu.V. Trifonov. Another Life). = *Fedorov dragged him to his place, they sat there for a long time,* ***or*** *he came, tipsy after getting paid at the museum; The monotonous chatter lulls you to sleep like a lullaby; you drive and feel that you are falling asleep, but from somewhere comes the abrupt, alarming cry of an unsleeping bird, or an indefinite sound is heard, similar to someone's voice, like a surprised "ah-ah!"* (A.P. Chekhov. Steppe). = *The monotonous chatter lulls you to sleep like a lullaby; you are driving and feel that you are falling asleep, but from somewhere an indefinite sound is heard, similar to someone's voice, like a surprised "ah-ah!",* ***or*** *the abrupt, alarming cry of a wide-awake bird is heard.*

However, in the Russian language, not all constructions with a disjunctive connection are characterized by the property of homogeneity. Such proposals are irreversible. Restrictions can be semantic or formal.

Semantic irreversibility is due to the impossibility of reversing components without loss of meaning. This linguistic phenomenon is observed in constructions with a conjunction or in cases where what is said in the second component is presented as necessarily feasible in the event that what is said in the first remains unrealistic, and vice versa, where the conjunction or carries the semantic load of a threat (= "otherwise", "otherwise"). *In sentences of this type, there is a fixed position of the parts: Stop this performance, or I won't go anywhere* (N.M. Sorotokina. Three from the navigation school). ? * I won't go anywhere, or stop the performance; - Stop! - Yuri shouted, - don't come closer!.. **or** *I'll smash your head* (M.Yu. Lermontov. Vadim). ? * I'll smash your head, or don't come closer!

Semantically irreversible are also the components, the content of which is correlated as "private-general": Maybe his wife died, or some other misfortune happened, and I'm laughing (V.P. Astafiev. Tsar Fish). ? * Maybe some tragedy happened, or his wife died.

Formally, irreversible sentences are those in which the preceding context determines a fixed order of components (1), or in the second part there are words connecting the content of the second component with the content of the first (2). However, such proposals are potentially reversible.

1. *Only sometimes, looking intently at her, he will tremble passionately,* ***or*** *she will glance at him in passing and smile, catching a ray of tender submission, silent happiness in his eyes* (I.A. Goncharov. Oblomov). = She will glance at him in passing and will smile, catching a ray of tender submission, silent happiness in his eyes, or he will shudder passionately.

2. *Either this look said absolutely nothing ?…?,* ***or*** *it said too much* (L.N. Tolstoy. War and Peace). = Either this look said too much, or it said absolutely nothing.

Irreversible are the constructions of a binary structure with lexical concretizers of an intercalary-introductory nature in the second part, clarifying the content of the first part: *The sun was not visible,* ***or****, rather, it looked through the hanging darkness as a dim, barely noticeable spot* (N.I. Babenko. This happened in Water lily). ? The sun peeked through the hanging darkness as a dim, barely noticeable spot, **or** rather, it was not visible at all; In that age, mail was very bad, or, better said, they did not exist at all (M.Yu. Lermontov. Vadim). ? *In that age, postal services did not exist at all, or, better to say, they were very bad.

Most (97.15%) of dividing constructions with a conjunction or are characterized by a reversible / flexible order of arrangement of predicative units, and only 2.85% of constructions include irreversible parts. Thus, partitioning structures

with conjunction or only in rare cases do not allow the reversibility of components. Being freer and more autonomous in content, they are characterized by greater flexibility compared to other semantic types of writing.

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慢性实验条件下Anatoxin-a的一般毒性作用
GENERAL TOXIC EFFECT OF ANATOXIN-A UNDER CHRONIC EXPERIMENTAL CONDITIONS

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抽象的。 在亚慢性实验条件下，通过口服注射研究了蓝藻毒素-a对白鼠机体的总毒性作用。在暴露动物的血液中，观察到免疫系统应激反应的表现，例如白细胞减少和淋巴细胞减少。发现脂质-蛋白质代谢紊乱的迹象。在对接受剂量为1.0 μg/kg的ATX-a的动物的内脏器官进行形态学、形态测量学和立体测量学研究的过程中，发现了形态功能紊乱。

关键词：蓝藻，类毒素-a，亚慢性实验，一般毒性作用，阈剂量。

Abstract. *The research of cyanotoxin anatoxin-a total toxic effect on white rats organism by oral injection under subchronic experimental conditions was carried out. In the blood of exposed animals, manifestations of stress reactions in the immune system such as leukopenia and lymphocytopenia were noted. Signs of lipid-protein metabolism disorders were found. In the course of performing morphological, morphometric and stereometric studies of the internal organs of animals receiving a dose of ATX-a 1.0 μg/kg, morphofunctional disorders were revealed.*

Keywords: *cyanobacteria, toxoid-a, subchronic experiment, general toxic effect, threshold dose.*

Introduction. Anatoxin-a (ATX-a), the first cyanotoxin to be chemically and functionally identified in 1972, is a low molecular weight bicyclic alkaloid, sys-

tematically nomenclatured as 2-acetyl-9-azabicyclo-[4.2.1] non-2- en. Molecular weight – 165.237 g/mol, boiling point – 291°C [1]. Empirical formula C10H15NO, CAS 64285-06-09.

ATX-a was first isolated from cyanobacteria (CB) of the species Dolichospermum (Anabaena) flos-aquae; later, its production was established by other species of cyanobacteria of the genus Aphanizomenon, Cylindrospermum, Oscillatoria, Planktothrix and Raphidiopsis [2, 3].

Since ATX-a-producing cyanobacteria are found primarily in freshwater environments, the main exposure of humans to ATX-a occurs through the consumption of drinking water when surface water bodies are used as a source of water supply. Concentrations of ATX-a on the surface of open water bodies can reach 1000 μg/l during the period of their bloom. Other possible routes of entry are of less importance - inhalation of aqueous aerosols containing cyanotoxin while showering, consumption of food products - fish, shellfish, animals, birds, grain crops, use of algae-based food additives contaminated with cyanotoxin [4,5, 6,7,8].

A number of foreign studies have studied the acute toxicity and established the values of the average lethal doses (LD50) of ATX under conditions of various routes of entry into the animal body.

In particular, Stevens D.K., and Krieger R.I., in experiments on male outbred Swiss Webster ND-4 mice with intraperitoneal administration, established an LD50 of 0.21 mg/kg (range 0.20–0.24); under conditions of oral administration, the value LD50 was 13.3 mg/kg (range 12.8–14.1) [9].

Research by Puddick et al. Using female Swiss albino mice, it was found that after oral administration of ATX-a, the LD50 ranged from 8 mg/kg to 25 mg/kg [10].

Experimental studies by Testai E. et al found that the acute toxicity of ATX upon intraperitoneal administration (LD50) is 0.25 mg/kg body weight and causes death in mice within 7–12 minutes [11].

The purpose of the study was to study the general toxic effect of ATX-a on the body of white rats when administered orally under subchronic experimental conditions.

Material and research methods. The doses of ATX-a for the experimental study, selected taking into account the minimum LD50 [9,10,11] and in accordance with MU 2.1.5.720-98 [12], were 0.01, 0.1 and 1.0 μg/kg. The substance was administered intragastrically to laboratory animals in the form of an aqueous solution of a certified reference sample of ATX-a, dissolved in a 1% solution of acetic acid (made in the USA), daily for 90 days.

The general toxic effect of ATX-a was studied on conventional white male rats obtained from the nursery of the Andreevka branch of the Federal State Budgetary Institution “NTSBMT” FMBA in the amount of 40 pieces. The animals were kept

in quarantine for 7 days before the start of the study. All work with animals was carried out in accordance with the principles set out in Guideline R 1.2.3156-13 [13]. Conditions for keeping animals: temperature 20-240 C, humidity 45-65%, feeding with complete feed (recipe PK-120, drinking water - ad libitum.

Animals were stratified by weight and randomized into dose groups. The control and experimental groups consisted of 10 males weighing 174-212 g.

Throughout the experiment, the condition of the animals, water and feed consumption were monitored, the dynamics of changes in body weight were recorded, and the clinical manifestations of the effects of ATX were recorded on days 30, 60 and 90 of the experiment. At the same time, physiological, hematological and biochemical indicators of the state of the animal's body were determined.

At the end of the experiment, the animals were euthanized using CO2, a pathological autopsy, morphofunctional studies of internal organs, and organ samples were taken for the preparation of histological preparations.

Registration of physiological parameters was carried out using an "open field" device Opto-Max v 2.19 (Columbus Instruments, USA) (3 minutes per animal, in arbitrary units) for the following indicators: 1) general activity; 2) length of the traveled path; 3) rest time; 4) indicative reaction; 5) mink reflex [14]. The state of the animals' nervous system was additionally assessed by measuring the summation threshold index (STI) using the LAST-1 device (RAS, Russia) [15].

Blood sampling from animals for biochemical and hematological studies was carried out from the tail on an empty stomach after short-term warming up using a household heating unit.

Blood serum was tested on a ChemWell® 2910 biochemical analyzer (Awareness Technology, USA) using ready-made reagent kits from Hospitex Diagnostics s.r.l. (Italy, Russia). In the blood serum, the activity of alanine aminotransferase, aspartate aminotransferase, alpha-amylase, total lactate dehydrogenase, cholinesterase, alkaline phosphatase, glucose, creatinine, the concentration of total protein, albumin, uric acid, urea, triglycerides, chlorides, and cholesterol were determined.

Hematological studies were performed on an Abacus Vet 5 Junior analyzer (Diatron, Austria) using 14 indicators.

At the end of the experiment, 6 animals from each group were subjected to pathological examination. Morphological, morphometric and stereometric analyzes were carried out on 13 organs: thyroid gland, thymus, heart, lung (part of the left lobe), stomach (fundic part), liver (left lobe), spleen, pancreas (gastrosplenic part), ileum, colon, kidneys, adrenal glands, testes, according to [16].

Processing of primary data in preparation of data for statistical analysis was carried out using Microsoft Office Excel 2013. Statistical analysis was carried out in SPSS Statistics v. 22.0 (IBM Corporation, New York, USA) at $\alpha = 0.05$.

The normality of data distribution was checked using the Shapiro-Wilk test, and the equality of variances was checked using the Livigne test. The presence of

statistical outliers was checked by constructing boxplots. Comparisons between groups were made using either one-way analysis of variance with Bonferroni post hoc comparisons (parametric measures) or the nonparametric Kruskal-Wallis test [17, 18]. The presence of a trend in studies (if there was a significant difference between groups) was checked using the Spearman rank correlation method (two-way analysis) [19, 20].

Results. Throughout the experiment, spontaneous death of animals and no significant differences in body weight gain were noted between experimental and control animals. The indicators of behavioral reactions and the physiological state of the nervous system in the animals of the experimental and control groups did not have statistically significant differences. In animals receiving a dose of ATX-a 1.0 μg/kg, increased aggression was observed compared to animals receiving ATX-a at doses of 0.01 and 0.1 μg/kg, and animals in the control group.

Hematological analysis of the blood of animals on days 30, 60 and 90 of the study showed that in laboratory animals receiving ATX-a at a dose of 1.0 μg/kg, starting from the 60th day of the experiment, a significant decrease in the number of leukocytes, lymphocytes and monocytes was detected compared with control animals (Table 1).

Table 1

Hematological parameters of the peripheral blood of rats under conditions of a subchronic experiment

№	Index	Deadlines, days								
		30 days			60 days			90 days		
		Dose of ATX-a, mcg/kg								
		0,01	0,1	1,0	0,01	0,1	1,0	0,01	0,1	1,0
1.	Leukocytes (10^9/l)	-	-	-	-	-	↓	-	-	↓
2.	Lymphocytes (10^9/l)	-	-	-	-	-	↓	-	-	↓
3.	Monocytes (10^9/l)	-	-	-	-	-	↓	-	-	↓
4.	Neutrophils (10^9/l)	-	-	-	-	-	-	-	-	-
5.	Lymphocytes (%)	-	-	-	-	-	-	-	-	-
6.	Monocytes (%)	-	-	-	-	-	-	-	-	-
7.	Neutrophils (%)	-	-	-	-	-	-	-	-	-
8.	Red blood cells (1012/l)	-	-	-	-	-	-	-	-	-
9.	Hemoglobin (g/l)	-	-	-	-	-	-	-	-	-
10.	Hematocrit (%)	-	-	-	-	-	-	-	-	-
11.	Average erythrocyte volume (fl)	-	-	-	-	-	-	-	-	-
12.	Average hemoglobin content in erythrocytes (pg/cell)	-	-	-	-	-	-	-	-	-

13.	Average hemoglobin concentration in erythrocyte mass (g/l)	-	-	-	-	-	-	-	-	-
14.	Distribution of red blood cells by size (%)	-	-	-	-	-	-	-	-	-

Biochemical analysis of rat blood serum after 30, 60 and 90 days of exposure revealed statistically significant changes in a number of parameters in animals receiving a dose of 1.0 μg/kg ATX compared with animals in the control group (Table 2). A significant increase in the content of total serum protein was established in animals receiving a dose of ATX-a 1.0 μg/kg on the 30th, 60th and 90th days of the experiment. An increase in cholesterol content in the blood serum was detected at all control points of the study - on the 30th, 60th and 90th day of the experiment. A decrease in triglyceride content was detected on the 60th and 90th days of exposure in the peripheral blood serum of rats. At the same time, a significant dependence of the changes in these indicators depending on the dose of ATX-a was revealed using the method of nonparametric Spearman correlations.

Table 2

State of biochemical parameters in the peripheral blood of rats under subchronic experimental conditions

№	Index	Deadlines, days								
		30 days			60 дней			90 дней		
		Dose of ATX-a, mcg/kg								
		0,01	0,1	1,0	0,01	0,1	1,0	0,01	0,1	1,0
1.	Alanine aminotransferase (U/l)	-	-	-	-	-	-	-	-	-
2.	Albumin (g/l)	-	-	-	-	-	-	-	-	-
3.	Alpha amylase (U/l)	-	-	-	-	-	-	-	-	-
4.	Aspartate aminotransferase (U/l)	-	-	-	-	-	-	-	-	-
5.	Glucose (mol/l)	-	-	-	-	-	-	-	-	-
6.	Creatinine (μmol/l)	-	-	-	-	-	-	-	-	-
7.	Total lactate dehydrogenase (U/l)	-	-	-	-	-	-	-	-	-
8.	Cholinesterase (U/l)	-	-	-	-	-	-	-	-	-
9.	Uric acid (μmol/l)	-	-	-	-	-	-	-	-	-
10.	Urea (mol/l)	-	-	-	-	-	-	-	-	-
11.	Total protein (g/l)	-	-	↑	-	-	↑	-	-	↑
12.	Triglycerides (mol/l)	-	-	-	-	-	↓	-	-	↓
13.	Chlorides (mol/l)	-	-	-	-	-	-	-	-	-
14.	Cholesterol (U/l)	-	-	↑	-	-	↑	-	-	↑
15.	Alkaline phosphatase (U/l)	-	-	-	-	-	-	-	-	-

During the necropsy carried out on the 90th day of the experiment, no significant changes were found in the relative mass of the internal organs of the experimental and control groups. In the course of performing morphological, morphometric and stereometric studies of the internal organs of animals receiving a dose of ATX-a 1.0 μg/kg, trends towards an increase in a number of morphofunctional characteristics were revealed. Namely: in the testes, an increase in the number of spermatocytes and spermatids in the seminiferous tubules was detected; in the thymus - lobes of lipomatous areas; in the lungs - lobes of emphysematously changed areas; in the large intestine - hypersecretion and blood filling of blood vessels; in the stomach - hypersecretion of its own glands, violation of the boundaries of the mucous and submucosal membranes and sparseness of fibers in the submucosal layer; in the pancreas - fibrosis of the islets of Langerhans; in the adrenal gland - ectopia of the cells of the cortical and medulla structure of the organ, characterized by the displacement of cells or tissues to unusual places.

Discussion. The reduced number of leukocytes, lymphocytes and monocytes in the animal organisms on the 60th and 90th experimental days influenced by ATX-a at a dose of 1.0 μg/kg indicates the disorders in the immune system and the reduction of both humoral and cellular immunity in the experimental animal organisms. An increase in the cholesterol content in the blood serum of experimental animals that received a dose of ATX-a 1.0 mcg/kg at all control points of the study (on days 30, 60 and 90), as well as a significant decrease in the content of triglycerides in the blood serum on days 60 and 90 of the study indicate disorders of fat metabolism in animals and subsequent changes in the cardiovascular system.

A significant increase in the content of total protein in the blood serum at all control points of the study (30, 60 and 90 days) indicates disturbances in the protein metabolism of the body of animals receiving a dose of ATX-a 1.0 mcg/kg.

The effect of ATX-a at a dose of 1.0 mcg/kg is confirmed by some morphofunctional changes in the lungs, stomach, large intestine, testes and endocrine glands: thymus, pancreas and adrenal glands.

Conclusion. The results obtained during the subchronic experiment made it possible to justify the threshold dose of ATX-a when administered orally into the body for general toxic effects at the level of 1.0 μg/kg, the maximum non-active dose is 0.1 μg/kg.

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以家禽粪便为例分析现代农业有机废物处理方法

ANALYSIS OF MODERN APPROACHES TO THE PROCESSING OF AGRICULTURAL ORGANIC WASTE ON THE EXAMPLE OF POULTRY LITTER

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抽象的。 农业生产的集约化和农业用地面积的扩大导致废物量的增加及其对自然组成部分的影响。 回收有机农业废物对于可持续经济和环境福祉至关重要。 家禽工厂和农场产生的废物（其中很大一部分是垃圾）的处理问题值得特别关注。 家禽粪便是农业有机废物的一个例子，是丰富的营养来源，如果处理和使用不当，会对环境造成危害。 开发和实施确保垃圾技术处理的高效技术对于环境保护、提高服务人员的安全、维护公众健康和提高生产利润变得越来越重要。本文以不同方式讨论了家禽粪便回收技术。 本文给出了回收技术的分类特征，并分析了主要方法和设计。

关键词：家禽垫料、回收、加工、畜牧业、有机废物、技术、环境安全。

Abstract. *The intensification of agricultural production and the expansion of agricultural land areas have led to an increase in the amount of waste and its impact on the components of nature. Recycling organic agricultural waste is critical to a sustainable economy and environmental well-being. The problem of processing waste from poultry factories and farms, a large share of which is litter, deserves special attention. Poultry litter is an example of an agricultural organic waste, a rich source of nutrients, and poses an environmental hazard if not properly handled and used. The development and implementation of highly efficient technologies that ensure technological disposal of litter are becoming important in matters of environmental protection, increasing the safety of service personnel, preserving public health and increasing the profitability of production. The article discusses technologies for poultry litter recycling bird in different ways. The presented work gives the classification characteristics of recycling technologies and analyzes the main methods and designs.*

Keywords: *poultry litter, recycling, processing, livestock farming, organic waste, technology, environmental safety.*

Russia is prioritizing the development of the agricultural sector, which is reflected in the growing attention of the country's leadership in this area. Agricultural and agro-industrial complexes are of great importance for ensuring food security. Due to the growing numerical characteristics of import substitution, the development and well-being of the country cannot be imagined without safe agro-industrial complexes. In the livestock industry, the importance of integrated development of natural and non-harmful production is often mentioned.

During the production of meat products, a large amount of waste is generated, which is an organic substance and can be used for agricultural purposes in the future. Poultry meat production is growing rapidly. It is important to note that during the production of eggs and poultry meat, various environmental problems arise, including a significant amount of poultry farm litter [5].

Every day, an average-sized poultry farm produces up to 300 tons of litter. It has been proven that pathogenic microflora develops in the litter [10]. Litter contain methane, carbon monoxide, ammonia and hydrogen sulfide. Also in the litter there are medications used to neutralize poultry houses [2]. Chicken litter has a higher content of nitrogen, phosphorus and potassium compared to manure. They also contain a variety of micronutrients such as manganese, zinc, cobalt, copper and iron. Almost three-quarters of the dry matter of the litter consists of organic components [2]. Waste from poultry factories spreads infectious and invasive diseases. Failure to take timely measures to recycle waste can lead to increased negative impacts on the ecological state of the environment. As a result, there is an impact on the economic state, environmental situation and social damage to agricultural areas and nearby settlements [12].

In the Russian Federation, the method of disposal of litter has remained almost unchanged for decades. Litter is removed from poultry houses and stored in special storage facilities reserved for litter, where it is kept for a specific period in order to ensure the composting process, and then transported to fields and scattered, followed by integration into the soil. However, its fertilizing properties are lost in most situations, because litter represent the environment most suitable for preserving various bacteria. Pathogen-causing and conditionally pathogenic bacteria are found in poultry litter obtained from poultry factories that are unfavorable for infectious diseases.

The use of litter as a fertilizer leads to environmental pollution, and when transported over long distances (more than 10 km), the costs associated with its application to the soil do not compensate for the increase in crop yields, which limits its use [3].

In poultry farming, the production process is closed, meaning waste from the main products is used to create crops and feed additives, which in turn are used to produce more poultry meat and eggs. The main problem of a closed production

cycle is waste disposal. Given the unique characteristics of poultry farming, such as bird species, housing method and climate zone, poultry litter management can be carried out using various technologies, each with its own set of machines and equipment [1].

Among the main methods of litter disposal are: direct application to the soil, chemical, biological and physical methods. In turn, biological methods can be divided into: composting, aerobic solid-state fermentation, anaerobic fermentation, vermiculture, and raising fly larvae. Physical methods include: mechanical drying, vacuum drying, thermal drying and gasification [1].

The most accessible and simplest way is to spread litter on the ground without any additional actions. This technology has some disadvantages: moving large volumes of waste is expensive, pollutes the soil, ground and surface water with harmful substances, and increases the level of nitrates, copper and zinc in food and water. As a result, this method is currently not widely used [9]. To avoid the potential transmission of diseases and germs, chemicals are used when disposing of waste.

The most common biological method is composting, which involves a combination of various organic materials such as litter mixed with substrate, peat, wood chips or other local organic waste. This mixture is stored in a room not exceeding 2.5 meters. After a period of six to eight months, the resulting mixture matures into high-quality compost suitable for agricultural needs. One of the notable advantages of this approach is its relatively low capital investment requirements and energy costs. It is worth noting that approximately 30-40% of nutrients are lost during the processing phase due to gas emissions, which can have adverse effects on the environment. Significant disadvantages of this method include the need for specialized facilities, equipment and significant volumes of peat, straw and similar materials [6].

Aerobic solid phase fermentation is carried out in drum-type plants and is capable of processing from 20 to 50 m^3 of litter daily. The essence of this technology is to mix litter with other organic materials, such as peat, straw, sawdust and lignin in certain proportions, and then long-term (1-2 years) storage of this mixture in piles for the natural maturation process [9]. This method is most suitable for small and medium-sized farms that have their own fields for applying the resulting organic fertilizers.

One of the disadvantages of this technology is the need to maintain the temperature of the substrate above the ambient temperature, which significantly reduces the efficiency of biogas production, especially in conditions with low annual temperatures [9].

Recently, more and more attention has been paid to the use of anaerobic (methane) fermentation of organic waste in specialized installations (digesters), where a certain temperature is maintained for optimal operation of anaerobic bacteria.

This approach simultaneously solves several problems: the production of environmentally friendly fertilizers and methane for mini-thermal power plants, gaseous fuel for automotive equipment, the production of "dry" ice, soda, etc. [4]. However, the use of this technology is limited by the lack of investment and the need to develop an integrated approach to the creation of basic structural elements [8].

Earthworm farming, known as vermiculture, is a promising method for recycling organic waste. Earthworms, which significantly accelerate the process of decomposition of organic materials, make it possible in a relatively short time to transform a variety of organic waste into valuable humus-rich fertilizer without any harm to the environment. An additional product of this process is the biomass of earthworms, which is successfully used as a protein additive to feed and as a biochemical raw material [9].

However, despite all the advantages of this technology, it may only be economically feasible for small farms or for producing fertilizers and using them on their own fields. Organizing large-scale vermicompost production in a region with fairly low average winter temperatures can present certain difficulties.

Growing fly larvae on organic waste, including manure and litter, is another effective way to produce biomass. Fly larvae have high growth rates, increasing their mass 300–500 times per week. Growing flies makes it possible to obtain from a ton of manure or litter in 5–6 days about 60–100 kg of biomass (fly larvae) and 640–700 kg of vermicompost, which can be used as a nutritional supplement for animals and as a high-quality organic fertilizer [9].

Of all the available physical methods, the most widely used is mechanical drying, where poultry litter is processed through press filters or centrifugation. Typically, after this process, the moisture content of the litter is about 60%. However, such droppings may become hot during storage and emit a strong odor. The use of vacuum filters to remove moisture from bird litter is not economically feasible [6]. Recently, poultry farms have been advised to use vacuum drying to eliminate accumulated manure effluent. This technology is based on a continuous, environmentally friendly, one-step vacuum drying process that preserves the beneficial elements in the organic fertilizer at mild temperatures. However, the costs of obtaining dry manure using vacuum drying are quite high, which limits its industrial use [8].

Thermal drying is a more convenient way to process poultry waste. However, the efficiency of dryers with this method depends on the initial moisture content of the material, which should not exceed 65%. In real production conditions this is not always observed. The technology of thermal dehydration, as well as vacuum drying, has not yet become widespread due to high energy consumption [6].

Combined (thermal and electrical methods) processing of poultry litter is not considered as a separate method, due to its lack of widespread use due to high in-

vestment costs and increased requirements for personnel qualifications. However, consideration of this method is possible due to the presence of such advantages as: obtaining a variety of products: synthesis gas, pyrolytic water, electrical and thermal energy, inert material, small area for placing equipment.

Gasification is the process of burning biomass at a temperature of 800-1500 °C in the presence of air or oxygen and water to produce synthesis gas or generator gas with a calorific value of 10,500 to 16,700 kJ/m^3 (under normal conditions). This gas, consisting of carbon monoxide (carbon monoxide) and hydrogen, can be used instead of gasoline in cars. Large poultry farms can provide their own electricity and heat supply using this gas [11]. However, the implementation of gasification technology requires significant investment, advanced personnel qualifications and a long payback period.

The analysis of the characteristics of various methods for processing chicken litter demonstrates the clear advantages and disadvantages of each type (Table 1).

Table 1.

Results of analysis of processing methods characteristics

Processing method	**Advantages**	**Disadvantages**
Biological methods		
Aerobic fermentation method	1. Low capital investments and energy costs (≈30 kW/h); 2. Equipment loading volume – up to 15 m^3 / day.	1. The volume of processed material is small - from 5 to 7 m^3 per day; 2. Replacement of process water in the deodorization tower occurs twice a week, volume - 2 m^3; 3. The deodorization and heat exchange tower requires insulation in low temperature conditions; 4 It is required to maintain the internal temperature of the room above the ambient temperature.
Accelerated composting method	High quality indicators of the produced fertilizer.	1. To reduce the moisture content of the produced fertilizer, a dedicated area, specialized equipment and additional loose plant material are required; 2. Time and frequency of process execution; Nitrogen emissions into the atmosphere during composting; 3. Allocation of agricultural (production) plots. Low efficiency of fertilizers; 4. Need for additional storage; 5. Significant capital investment.

Physical methods		
Mechanical method	1. Simplicity of design; 2. The volume of processed raw materials is up to 15 m3 / h; 3. Low electricity consumption up to 5.5 kW/h; 4. Presence of reverse for self-cleaning.	1. Separation of only free moisture (up to 50%); 2. High wear of parts.
Thermal method	1. Complete destruction of all harmful microorganisms and sterilization of the product during processing; 2. Obtaining fertilizer with a wide range of applications, concentrated and complex; 3. Reducing nutrient losses during processing and storage, as well as reducing environmental impact; 4. Reducing the need for space for storing fertilizers and vehicles for their transportation; 5. Using dry litter as a feed additive for ruminants; 6. Long-term use of equipment; 7. No preliminary fermentation or preparation of litter is required; it can be immediately sent for processing from poultry farms.	1. Significant costs for equipment and the processing process are expensive; 2. A large number of emissions contain pollutants such as indole, skatole, ammonia, hydrogen sulfide, nitric oxide, nitrogen dioxide, carbon monoxide and others.
Combined (thermal and electrical) method	1. Obtaining a variety of products from litter: synthesis gas, pyrolytic water, electrical and thermal energy, as well as inert material; 2. Small required area for equipment placement; 3. Litter from poultry farms does not require pre-fermentation or special preparation before being sent for processing.	1. Significant investments are required; 2. Experienced and qualified personnel are required; 3. A careful study of the resulting inert material is necessary.

Poultry litter are rich in microelements, nitrogen, phosphorus, calcium, potassium and magnesium, that is, all the components necessary for the development of fruit crops, but in unprocessed form it still has a negative impact on agricultural lands and surrounding areas. Every day, medium-sized farms produce 300 tons

of poultry litter, which today creates difficulties in processing this waste. Based on this, a comprehensive and high-quality approach to solving this problem is necessary.

When studying existing technologies for keeping poultry and recycling poultry manure at Russian poultry farms, it becomes clear that the main method of processing poultry litter can be accelerated composting with subsequent delivery to the fields of poultry farms and neighboring farms for subsequent use as fertilizer. However, this method has its disadvantages, such as high time and frequency of the process, nitrogen emissions into the atmosphere during composting, the risk of encroaching on agricultural areas, low quality fertilizers, and others [1]. One of the energy-efficient and economically clean ways to improve the process of processing chicken litter is the use of biotechnological methods, including effective organisms.

Also, modern technologies for processing poultry litter have a number of disadvantages, their criteria can be: low productivity, inflated cost of the production line, by-product yield, as well as insufficient dehydration of poultry litter, which requires additional investment in improving the line.

After studying existing methods for processing chicken litter at Russian poultry farms, it becomes clear that high-temperature drying may be the optimal way to obtain high-quality organo-mineral fertilizer. As a result of this process, the fertilizer acquires a light and porous structure, while all the valuable substances of the source material are preserved. High temperatures during drying destroy all pathogens inherent in chicken litter. The physical and mechanical characteristics of the resulting fertilizer make it possible to effectively use existing equipment at poultry farms to apply it to fields as mineral and organic fertilizers.

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用于诊断和化学成分变化的生物体电解计算机化方法
COMPUTERIZED METHOD OF ELECTROLYSIS OF BIOLOGICAL OBJECTS FOR DIAGNOSTICS AND CHEMICAL COMPOSITION CHANGES

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抽象的。 这项工作研究了通过电解来保存生物资源的过程，以分析鱼类组织的化学成分。 电解宜在计算机控制下进行，调节电解时的振幅和电流参数。
关键词：生物资源、电解、计算机、电解质、电流值、化学分析。
Abstract. *The work examines the process of preserving biological resources by electrolysis to analyze the chemical composition of fish tissue. It is advisable to carry out electrolysis under computer control to regulate the amplitude and current parameters during electrolysis.*
Keywords*: bioresource, electrolysis, computer, electrolyte, current value, chemical analysis.*

The current level of development of society is characterized by an increase in the destructive impact of technogenic factors on ecological systems. First of all, this concerns biological resources. Fish products play an important role in human life. However, environmental pollution from exhaust gases, wastewater, etc. negatively affects the nutritional quality of fish, and in some cases has a harmful mutagenic effect. Under these conditions, the role of diagnosing the chemical composition of fish products increases sharply. One of the main carcinogenic factors that pose a threat to consumers is the presence of heavy metal salts in the biological tissues of fish. There are a number of methods for analyzing the chemical composition of fish tissue. However, this requires either complex equipment or consumable chemical and biological materials.

To diagnose heavy metal salts in biological tissues of fish, it is advisable to carry out electrolysis under computer control to regulate the amplitude and current

parameters during electrolysis, as well as diagnose the control of the electrolysis process at all stages.

During the electrolysis process, the current value depends both on the concentration of the electrolyte and on its chemical composition. If you place the fish being diagnosed in an electrolysis bath and place one electrode inside the fish, connected through an insulated wire to a power source, and make graphite rods inside the electrolytic bath with the other electrode, then a current will flow through the biological tissues of the fish and the process of replacing heavy metal cations with cations will begin. lighter metals that are harmless when eating fish. Alkali or alkaline earth metals can be used as light metal cations. Electrolytes based on them are a good conductor of current. During the electrolysis process, heavy metal cations will be deposited on the external electrodes for subsequent separation and use, and light metal cations will accumulate in the fish tissues, which not only do not pose a danger when consumed, but on the contrary: they will provide the body with the necessary microelements. The table of metals is shown in Fig. 1

Figure 1. *Table of heavy metals*

During electrolysis in an aqueous solution, alkali and alkaline earth metals cannot be deposited on the electrodes, since their electrochemical activity will lead to a chemical reaction with water and such metals will remain in ionic form. Heavy metal cations have lower electrochemical activity and will not interact with water. On the contrary, by removing electrons from the electrode, the cations are neutralized and form a layer of metal on the surface of the graphite electrode, which can later be used for various purposes.

Figure 1 shows a block diagram of the installation for computerized electrolysis of biological objects. The computer, through an interface, acts on the regulated power source and sets the electrolysis voltage level. The current value is converted by an analog-to-digital converter and sent through an interface to a computer for analysis.

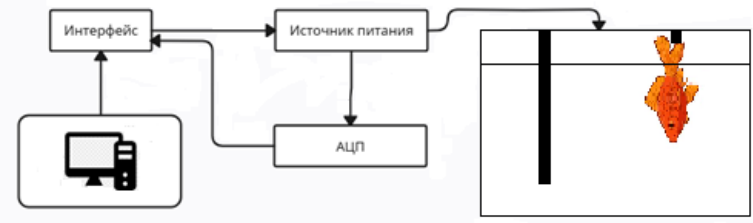

Figure 2. *Block diagram of the installation for computerized electrolysis of biological objects*

The computer operating algorithm consists of several stages. Initially, the electrolysis voltage gradually increases to a value at which the electrolysis current reaches saturation and stops increasing (Fig. 3).

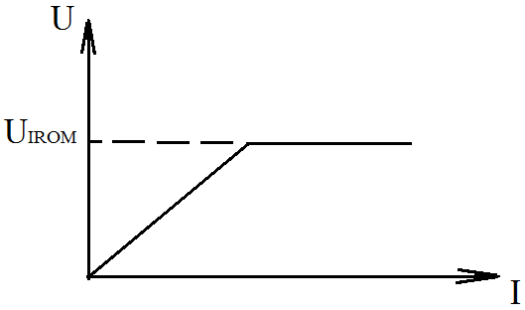

Figure 3. *Electrolysis voltage*

At this moment, all anions and cations take part in the electrolysis process and a further increase in current by increasing voltage is impossible. The computer sets the electrolysis voltage level with small variable fluctuations to adaptively adjust to the electrolysis process. As heavy metal cations transition from an ionic state to a neutral state on the graphite cathode with the formation of a metal film, the conductivity of the electrolyte decreases due to a change in the salt composition, and the current will also decrease. In this case, the computer smoothly reduces the electrolysis voltage until a new saturation current level is reached, corresponding to the new electrolyte conductivity value. Upon completion of the transition of all heavy metal cations from the ionic state to the neutral state, the final state of electrolysis occurs on the graphite cathode, in which the saturation current stops decreasing. After diagnosing this condition, the computer stops electrolysis. In Fig. 4 shows all the phases of this process.

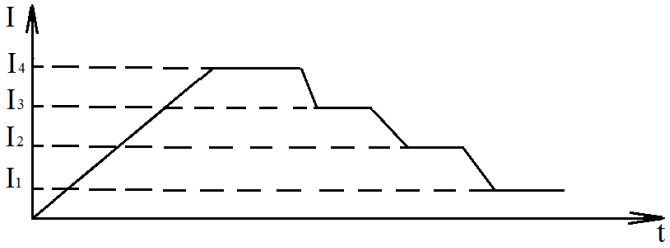

Figure 4. *Electrolysis current*

The use of computerized electrolysis allows not only to diagnose carcinogens in biological objects, but also to replace them with useful microelements. The technique can be used both in medicine and in cooking.

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温度对熔融氯化物中极化液态金属电极传质参数的影响
EFFECT OF TEMPERATURE ON MASS TRANSFER PARAMETERS OF A POLARIZED LIQUID METAL ELECTRODE IN MOLTEN CHLORIDES

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注解。 介绍了铅、镁、铝液态金属电极电解氯化物熔体时温度对电流密度和传质系数影响的研究结果。 在给定的过电压下，电流密度和传质系数随着温度的升高而增加，增加的程度取决于界面对流和电极材料引起的流动形状。

随着温度增加 100K，传质系数平均增加如下：对于铅电极的系统，增加约 37%，对于镁电极 - 约 4.8 倍，对于铝电极 - 约 3 倍。 电流密度的活化能取决于过电压，对于具有铅电极的系统，对应于扩散控制过程的特征值。 对于具有铝和镁电极的系统，活化能值对应于混合动力学特征值。

关键词：电流密度、扩散过电压、极化依赖性、温度、传质系数、活化能、熔盐。

Annotation. *The results of studies of the influence of temperature on the current density and mass transfer coefficient during the electrolysis of chloride melts with liquid metal electrodes made of lead, magnesium and aluminum are presented. At a given overvoltage, the current density and mass transfer coefficient increase with increasing temperature, and the degree of increase depends on the shape of the flows caused by interfacial convection and the electrode material.*

With an increase in temperature by 100K, the mass transfer coefficient on average increases as follows: for systems with lead electrodes by approximately 37%, with magnesium electrodes - by ≈4.8 times, with aluminum electrodes - by ≈3 times. The activation energy of the current density depends on the overvoltage and for systems with a lead electrode corresponds to the values characteristic of diffusion-controlled processes. For systems with aluminum and magnesium electrodes, the activation energy values correspond to the values characteristic of mixed kinetics.

Keywords: *Current density, diffusion overvoltage, polarization dependences, temperature, mass transfer coefficient, activation energy, molten salts.*

Introduction

The work is a continuation of the research, the results of which are presented in [1], and is devoted to the effect of temperature on the performance of electrolysis of molten salts with liquid metal electrodes.

When polarizing liquid metal electrodes in metal-electrode ions diluted in molten salts at the electrode surface, in addition to the structures characteristic of solid electrodes, namely, concentration gradients of electrochemically active particles in the electrolyte and flows caused by natural convection, structures arise due to interfacial convection (IC). IC arises as a consequence of the Marangoni effect [2] - the movement of moving interphase boundaries under the influence of an interphase tension gradient, which occurs if neighboring areas of the interphase boundary (IB) have different temperaturesand/or electrode potential values. IC manifests itself in the form of circulation cells - interconnected vortices of small diameter (CC mode) [3], moving along the IB, jets of electrolyte rising from the surface of the electrode [4], or a layer of electrolyte moving laminarly along the interphase boundary, entrained by the moving IB (CC mode) (Fig. 1). The CC mode is divided into modes of development, when the number of cells and the speed of their movement along the IB increase, and decay of the CC, when the number of cells and the speed of their movement along the IB decrease [3]. It should be noted that interfacial convection develops only on the non-passivated electrode surface, cleared of the oxide film. When an oxide film forms, the electrode behaves like a solid.

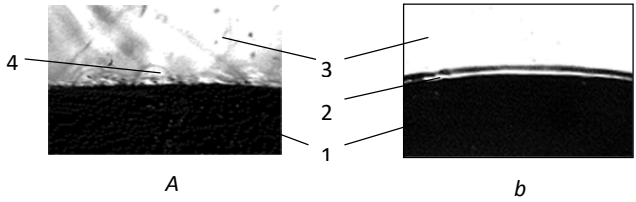

Figure 1. *Flows in the melt near the surface of a lead electrode. Magnified 14 times.*
A– CC mode; b – LT mode. 1 – liquid lead; 2 – laminar electrolyte layer; 3 – melt; 4 – circulation cell

The structures determine the conditions of mass transfer (mass transfer mode) and the type of polarization dependences (PD). If metal-electrode ions are involved in the electrode process, in the case of the occurrence of a central cell, with increasing polarization, the current density value at the PD first increases (the mode of development of the central cell), passes through a maximum at a certain potential, and then decreases (the mode of attenuation of the central cell); in the LT mode, only a monotonic increase in current density is observed.

The purpose of this work-study of the influence of temperature on the parameters (intensity) of mass transfer and on the polarization dependences during the

electrolysis of mixtures of molten chlorides with liquid metal electrodes made of lead, aluminum and magnesium.

Experimental Part

In experiments at different temperatures, polarization dependences were obtained during the electrolysis of the following melts: (0.25$BaCl_2$ – 0.75KCl) – $MgCl_2$ (0.55 wt. %) and (0.45 $BaCl_2$ – 0.55 KCl) – $MgCl_2$ (0.5 wt. %). %) with liquid magnesium electrodes; (2.56NaCl – KCl) – $AlCl_3$ (1.5 wt.%) with liquid aluminum electrodes; KCl – $PbCl_2$ (0.8 wt.%) and NaCl – KCl (1:1) – $PbCl_2$ (0.7 wt.%) with liquid lead electrodes. Cell diagrams for experiments with liquid lead electrodes and working aluminum and magnesium electrodes are shown in Fig. 1.

Experiments with all electrodes were carried out in a quartz electrochemical cell with a diameter of ≈70 mm. Working lead electrode 1 was placed in a cylindrical quartz cage, and auxiliary electrode 3 was placed at the bottom of the quartz vessel. The holder was filled with lead 8 from a pipe located above the melt. Lead flowed through pieces of quartz 9 and was cleared of the oxide film, as a result of which the surface of the working electrode was not passivated. The design of working aluminum and magnesium electrodes was more complex due to their high activity and tendency to oxidize. To obtain an electrode surface free of oxides, aluminum or magnesium was pressed through capillary 3 using an inert gas by pressing bulb 8. The metal flowed, forming a drop 4, which served as a working electrode. Since aluminum is heavier than the electrolyte, its drop was fixed on the upper cut of the alundum holder, while a drop of magnesium, which is lighter than the electrolyte, was fixed on the lowerclip cut.

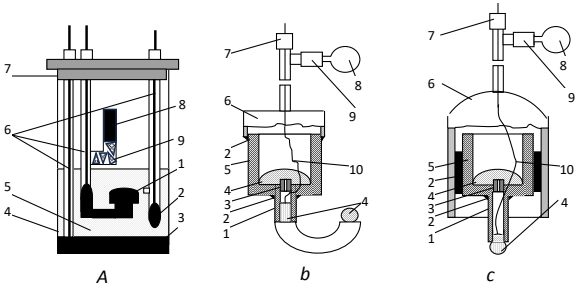

Figure 2. *Schemes of an electrochemical cell (a) and working aluminum (b) and magnesium (c) electrodes. a: 1 – working lead electrode; 2 – lead reference electrode; 3 – auxiliary lead electrode; 4 – quartz vessel; 5 – electrolyte; 6 – molybdenum current leads; 7 – plug; 8 – liquid lead in the pipe for loading lead; 9 – pieces of quartz.*

b, c: 1 – alundum holder; 2 – putty; 3 – capillary; 4 – liquid aluminum (magnesium); 5 – graphite glass; 6 – quartz holder; 7 – rubber plug; 8 – rubber bulb with inert gas; 9 – rubber hose; 10 – molybdenum current lead.

Auxiliary aluminum and magnesium electrodes were placed at the bottom of a quartz vessel in alundum crucibles (not shown in Fig. 1a).

The electrodes were polarized cathodically and anodicly using a PI-50-1 potentiostat with a PR-8 programmer with compensation for the ohmic component; magnesium and aluminum electrodes - under potentiodynamic conditions with a potential scan rate of 1–2 mV/s, lead electrodes - under potentiostatic conditions. In the case of magnesium and aluminum electrodes, the potential was set and maintained relative to the lead reference electrode Pb | NaCl–KCl (1:1) – $PbCl_2$ (10 wt.%), in the case of lead electrodes, a lead reference electrode was also used, but immersed in the melt of the original composition.

To construct the polarization dependences, the electrode potentials were recalculated to the scale of the chlorine reference electrode using the equation

$$E = 1.751743 + 0.003981 \ln(q) - 0.276899 \cdot 10^{-3} T - 0.046033 \cdot 10^{-3} T \ln(q), \quad (1)$$

where E is the potential of the electrode relative to the chlorine reference electrode, V; q – concentration of lead chloride in an equimolar mixture of sodium and potassium chlorides, wt.%; T – temperature, K.

Equation (1) was obtained by processing the values of electromotive forces (EMF), calculated using the equations for the dependence of the EMF of circuits given in [5]

$$Pb \mid NaCl - KCl\ (1:1) - PbCl_2 \mid Cl_2, C$$

on temperature at different PbCl2 contents in an equimolar mixture of NaCl and KCl.

Equation (1) is valid in the concentration range from 10.0 – 0.13 wt.% at temperatures from 940 – 1200 K. The maximum deviation of the EMF values calculated by equation (1) and using the system of equations given in [5] is ≈0.26%.

All experiments were carried out in an inert gas atmosphere; the temperature was measured with a XA thermocouple immersed in a quartz sheath (not shown in Fig. 2) in the melt.

Results and discussions

Figures 3 and 4 show the polarization dependences for systems with light metals and lead.

The type of polarization dependences indicates that during anodic polarization of the magnesium electrode, CCs arise, and during cathodic polarization, the LT mode is observed, and vice versa, CCs arise during the cathodic polarization of the aluminum and lead electrodes, and during the anodic polarization, the LT regime occurs.

All systems at a given overvoltage are characterized by an increase in current density with increasing temperature. Moreover, in systems with light metals, the dependence of current density on temperature is more pronounced than in systems with lead.

Using the results of polarization measurements for a given overvoltage value, assuming the reversibility of the electrodes, the mass transfer coefficients K_s, the

temperature coefficients of the current density i and the mass transfer coefficient, and the activation energy of the current density *U* were calculated (Table 1).

Mass transfer coefficients were calculated using the equation

$$K_s = \frac{i}{zFc_o\left|1-\exp\left(\frac{\eta \cdot z \cdot F}{R \cdot T}\right)\right|}, \quad (2)$$

where *i*– polarizing current density, A/m^2; η – diffusion overvoltage, equal to the difference between the electrode potentials under current and without current, V; c_o is the concentration of electrochemically active particles in the electrolyte volume outside the diffusion layer (initial concentration); *R* – universal gas constant, J/mol·K; *T* – absolute temperature, K; *z* is the number of electrons taking part in the electrode reaction; *F* – Faraday number, C/mol equivalent.

The activation energy of the current density was estimated using the equation

$$U = -R\frac{\Delta \ln i}{\Delta\left(\frac{1}{T}\right)}. \quad (3)$$

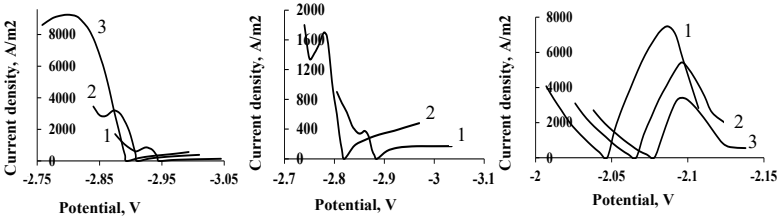

Figure 3. *Polarization dependencies. a – system (0.25BaCl$_2$ – 0.75KCl) – MgCl$_2$ (0.55 wt. %) – Mg. Drop diameter 7mm. Temperature, K: 1 – 973, 2 – 1023, 3 – 1048; b – system (0.45BaCl$_2$ – 0.55KCl) – MgCl$_2$ (0.5 wt. %) – Mg. Drop diameter 8mm. Temperature, K: 1 – 943, 2 – 1073; c – system (2.56NaCl – KCl) – AlCl$_3$ (1.5 wt.%) – Al. Drop diameter 7mm. Temperature, K: 1 – 993, 2 – 1023, 3 – 1073.*

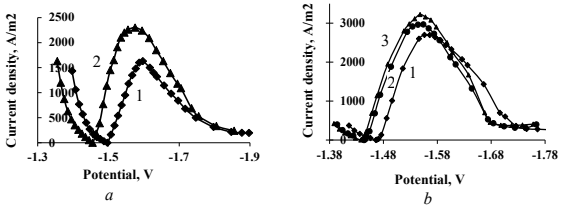

Figure 4. *Polarization dependencies. a – system NaCl – KCl (1:1) – PbCl$_2$ (0.7 wt.%) – Pb. Electrode diameter 9 mm. Temperature, K: 1 – 973, 2 – 1123, 3 – 1073. b – system KCl – PbCl$_2$ (0.8 wt.%) – Pb. Electrode diameter 9 mm. Temperature, K: 1 – 1070, 2 – 1132, 3 – 1050.*

Table 1.

Mass transfer parameters averaged over a given temperature range

System NaCl – KCl (1:1) – $PbCl_2$ (0.7 wt.%) – Pb					
η, mV	$K_s \cdot 10^5$, 973 K	$K_s \cdot 10^5$, 1123 K	$\Delta i/\Delta T$, A/m^2 K	$\Delta K_s/\Delta T \cdot 10^5$, m/s·K	U, kJ/mol
CC mode					
-70	21.3	33.9	3.7	0.084	21.0
-80	22.3	35.2	4.1	0.086	21.2
-90	23.2	35.3	4.0	0.080	19.3
-100	23.0	35.1	4.2	0.080	19.8
-120	20.4	34.0	5.3	0.091	25.9
LT mode					
30	1.35	2.87	0.48	0.010	30.5
50	1.51	2.61	0.53	0.007	15.5
70	1.70	2.63	0.40	0.006	6.1
System KCl – $PbCl_2$ (0.8 wt.%) – Pb					
η, mV	$K_s \cdot 10^5$, 973 K	$K_s \cdot 10^5$, 1123 K	$\Delta i/\Delta T$, A/m^2 K	$\Delta K_s/\Delta T \cdot 10^5$, m/s·K	U, kJ/mol
CC mode					
-50	32.9	37.5	1.42	0.058	7.7
-80	37.4	42.7	2.51	0.067	9.5
-100	36.0	43.9	5.24	0.098	18.5
-120	32.7	42.4	7.53	0.121	27.1
-140	29.0	37.7	7.12	0.108	28.0
LT mode					
10	2.4	2.7	0.02	0.004	3.2
30	2.0	2.7	0.30	0.008	17.8
50	2.2	2.9	0.62	0.009	16.0
System (0.45$BaCl_2$ – 0.55KCl) – $MgCl_2$ (0.5 wt. %) – Mg					
η, mV	$K_s \cdot 10^5$, 973 K	$K_s \cdot 10^5$, 1123 K	$\Delta i/\Delta T$, A/m^2 K	$\Delta K_s/\Delta T \cdot 10^5$, m/s·K	U, kJ/mol
CC mode					
5	1.51	4.50	0.58	0.023	59.3
15	2.44	6.44	2.50	0.031	50.5
25	1.74	6.02	5.19	0.033	66.6
35	0.98	5.99	10.08	0.039	102.2
45	0.78	4.12	9.62	0.026	91.7
LT mode					
-20	1,068	2,073	0.55	0.008	33.8
-60	0.836	1.726	1.09	0.007	40.5
-100	0.735	1.757	1.60	0.008	51.7
System (0.25$BaCl_2$ – 0.75KCl) – $MgCl_2$ (0.55 wt. %) – Mg					
η, mV	$K_s \cdot 10^5$, 973 K	$K_s \cdot 10^5$, 1123 K	$\Delta i/\Delta T$, A/m^2 K	$\Delta K_s/\Delta T \cdot 10^5$, m/s·K	U, kJ/mol

CC mode					
10	11.04	28.10	12.0	0.228	93.4
20	5.97	25.00	31.2	0.254	148.5
30	2.84	22.84	56.7	0.267	221.1
40	1.73	19.40	76.0	0.236	257.6
50	1.66	16.07	87.7	0.192	239.4
LT mode					
-20	0.616	2,312	1.80	0.0226	140.1
-60	0.597	2,310	3.78	0.0228	146.2
-100	0.641	2,786	5.77	0.0286	161.2
System (2.56NaCl –KCl) – $AlCl_3$ (1.5 wt. %) – Al					
η, mV	$K_s \cdot 10^5$, 973 K	$K_s \cdot 10^5$, 1123 K	$\Delta i/\Delta T$, A/m^2 K	$\Delta K_s/\Delta T \cdot 10^5$, m/s·K	U, kJ/mol
CC mode					
-10	15.51	20.46	5.95	0.062	20.3
-15	15.57	20.15	7.58	0.057	18.8
-25	10.14	21.07	35.18	0.137	72.4
-35	5.44	21.25	65.52	0.198	143.3
-45	2.00	18.21	77.28	0.203	237.7
LT mode					
20	1.91	3.16	6.79	0.0156	48.0
30	1.81	3.04	12.00	0.0153	48.6
40	1.71	2.80	17.18	0.0137	45.6

As follows from Table 1, in the CC mode, the mass transfer coefficients are on average approximately an order of magnitude greater than in the LT mode, and this is apparently due to the much smaller scale of movement in the circulation cells (~0.2 mm [3]) compared with that in the laminar layer (~5 mm for the electrodes used in this work). While moving along the surface of the electrode, the cells manage to wrap around the axis of the generatrix circle many times and, thereby repeatedly carry out mass transfer between the volume of the melt and the interface between the electrode and the electrolyte.

The temperature coefficients i and K_s in the circulation cell mode are greater than in the laminar flow mode and, accordingly, are approximately an order of magnitude higher than those for solid electrodes, which average $6 \cdot 10^{-8}$ m/s·K [1].

With an increase in the absolute value of the overvoltage, the values in the circulation cell mode have a maximum approximately corresponding to the situation with developed circulation cells at the interface. In the laminar flow mode, with an increase in the absolute value of the overvoltage, these values change monotonically on average. The activation energies of the current density approximately correspond to the values characteristic of processes controlled $\frac{\Delta i}{\Delta T}$, $\frac{\Delta K_s}{\Delta T}$ mass transfer

(diffusion). It should be noted that the activation energy of the current density is large in systems with aluminum and magnesium electrodes, which may indicate the contribution of chemical reactions and the discharge stage - ionization during electrolysis - to the overvoltage value. Therefore, the calculation of mass transfer coefficients under the assumption of electrode reversibility for these systems is only a first approximation estimate.

When polarizing liquid electrodes, a change in current density and mass transfer coefficient with a change in temperature is caused both by the action of factors characteristic of solid electrodes - changes in diffusion coefficients and dynamic viscosity [1], and by a change in the driving force of interphase convection, which, provided that the electrode-electrolyte interface is isothermal, is proportional value according to electrocapillary curves, which, as is known, have a shape close to parabolic [6], $\frac{\partial\sigma}{\partial E}$ Where σ – interfacial tension, *E*– electrode potential, and thus depends on the value . Taking into account the first Lippmann equation [7] $\frac{\partial}{\partial T}\left(\frac{\partial\sigma}{\partial E}\right)\left|\frac{\partial\sigma}{\partial E}\right| = q$,where is the specific charge (charge per unit surface) of the metal lining of the double electric layer and, taking into account, that the specific charge at a given potential E is equal to $q = \int_{E_{nz}}^{E} C_d \, dE$ [7], where E_{nz}– potential of zero charge, C_d –capacitance per unit area of the electrical double layer at the interface of the metal and molten salt, which increases with increasing temperature [8], it can be assumed that the slope of the electrocapillary curves, i.e. the driving force for interfacial convection also increases with increasing temperature, since we can write

$$\frac{\partial}{\partial T}\left(\left|\frac{\partial\sigma}{\partial E}\right|\right) = \frac{\partial}{\partial T}\int_{E_{нз}}^{E} C_d \, dE = \int_{E_{нз}}^{E} \frac{\partial C_d}{\partial T} dE \qquad (4)$$

Therefore, with increasing temperature, the intensity of mass transfer during the electrolysis of melts with liquid metal electrodes should increase more strongly than that of polarized solid electrodes, since interfacial convection does not occur on their surface, and the increase in the intensity of mass transfer is due only to an increase in the diffusion coefficient of electrochemically active particles and a decrease in the coefficient of dynamic viscosity electrolyte.

This conclusion is confirmed by the dependences of the mass transfer coefficient on temperature, the values of the temperature coefficients of the current density and the mass transfer coefficient in the modes of circulation cells and laminar flow at various overvoltages.

Conclusion

Thus, temperature has a significant effect on mass transfer in the CC and LT modes, and in the CC mode it is stronger than in the LT mode. In this case, the activation energy of the current density is not constant, but depends on the magnitude of the overvoltage.

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现有临床病理背景下小学生体内碘、硒含量
THE CONTENT OF IODINE AND SELENIUM IN THE BODY OF PRIMARY SCHOOL CHILDREN ON THE BACKGROUND OF EXISTING CLINICAL PATHOLOGY

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概括。 该研究论文调查了居住在跨贝加尔地区小学生的必需微量元素——碘和硒的含量，并分析了现有的临床病理。 研究表明，在尿碘含量正常和中度缺硒的背景下，呼吸道和内分泌病理、龋齿、眼部疾病、神经系统疾病和肌肉骨骼系统疾病的发病率很高。

关键词：儿童，必需微量元素，硒，碘。

Summary. *The research paper investigates the content of essential trace elements – iodine and selenium in primary school children living in the Trans-Baikal Territory, analyzes the existing clinical pathology. The study revealed the presence of a high incidence of respiratory and endocrine pathology, dental caries, eye diseases, nervous system diseases and musculoskeletal system diseases on the background of normal iodine content in urine and a moderate degree of selenium deficiency.*

Keywords: *children, essential trace elements, selenium, iodine.*

Relevance of the problem

Iodine (J) belongs to 15 essential (vital) chemical microelements [1]. Iodine deficiency is a global medical and social problem. Iodine deficiency in childhood and adolescence is accompanied by a lag in mental and physical development, and a decrease in the body's resistance [1]. The biological role of iodine is that it forms the basis for the activity of thyroid hormones, affecting all types of metabolism. There is a known connection between the metabolism of iodine and another im-

portant essential (vital) microelement – selenium [1, 2, 3, 4, 5, 6]. Selenium is actively involved in the processes of deiodination and conversion of inactive thyroid hormones into active ones [1, 7]. Selenium (Se) is an essential ultramicroelement of the human body and is considered as one of the protective factors. It is necessary for the functioning of the immune system. Selenium is part of glutathione peroxidase, a key enzyme of the body's antioxidant system [1]. Glutathione peroxidases (GPX1–6) maintain the stability of the intracellular concentration of reduced glutathione. It has been proven that GPX 1 plays a major protective role in the development of oxidative stress and affects the activity of apoptotic pathways and phosphorylation of protein kinases [1]. Experimental data have been accumulated on the relationship between changes in expression

GPX 1 with the etiology of cancer, cardiovascular and autoimmune diseases, diabetes mellitus [1].

It is believed that 80% of the Russian population has a low (less than 70 μg/l) Se supply. In addition, selenium, together with magnesium, manganese and zinc, is an integral component of extracellular and periosteal fluid and is necessary for the activation of osteoblasts and normal bone mineralization, which is important for the growing child's body [1, 8]. When it is deficient, collagen formation in organs and tissues is insufficient. Selenium deficiency conditions are accompanied by decreased immunity, slower physical development, diseases of the musculoskeletal system and skeletal muscles, insufficient surfactant activity of the lungs, decreased performance and tolerance to physical activity [1, 9, 10, 11]. A negative correlation was found between Se levels and body mass index [12]. These data are of particular interest, since the Trans-Baikal Territory belongs to an endemic area with low iodine and selenium content in soil and water [13, 14].

Purpose of the study

To study the provision of iodine and selenium to children of primary school age living in the Trans-Baikal Territory.

Materials and methods

A cohort of children (n=40) 7-11 years old, in difficult life situations, receiving rehabilitation at the State Autonomous Social Service Institution "Rehabilitation Center for Children and Adolescents with Disabilities "Spasatel" of the Trans-Baikal Territory was examined.

The children underwent anthropometry using the standard method, consultations with specialists were held: pediatrician, neurologist, pediatric orthopedist-traumatologist, pediatric endocrinologist, pediatric pulmonologist, pediatric gastroenterologist, pediatric ophthalmologist, pediatric dentist, exercise therapy doctor, physiotherapist; 24-hour urine was collected using the standard method.

Determination of iodine content in daily urine was carried out by spectrophotometry using the cerium-arsenite method on a UV-2600 spectrophotometer (Shimadzu, Japan).

Determination of selenium content in daily urine was carried out using the fluorometric method according to I.I. Nazarenko.

Statistical processing of the research results was carried out using Excel and the standard package "SSP-statistics"

Results and discussion:

Table 1

Content of essential microelements in daily urine

Chemical element	Reference values	Study group (n = 40)*	Me** (median concentration)
I	100 – 199 µg/l	111,3 µg/l	78,7:134,4 µg/l (55,7 µg/l)
Se	>100 µg/l – normal >400 µg/l – toxic concentration 50- 99 µg/l – mild deficiency 25- 49 µg/l – average deficiency < 25 µg/l – severe deficiency	46,0 µg/l	30,8:56,4 µg/l (25,6 µg/l)

Note:

*n – number of subjects studied

** Median is the average, relative to which the distribution series is divided into 2 halves: on both sides of the median there are the same number of members of the series (option).

Table 2

Median values of ioduria in iodine deficiency diseases

Median iodine concentration, µg/l ***	Severity of iodine deficiency diseases
< 20	Heavy
20-49	Moderate
50-99	Lightweight
> 100	No shortage

Note:

***According to WHO criteria, if the median iodine content exceeds 100 mcg per 1 l, this means that there is no iodine deficiency in this population [15, 16, 17]

The results of the study showed a high incidence of diseases of the upper respiratory tract (chronic nasopharyngitis in 35% of subjects), dental caries (15%), endocrine pathology (12.5%), musculoskeletal system (12.5%), eye diseases (12.5%), diseases of the nervous system (12.5%). In isolated cases, children had diseases such as abdominal hernia and diseases of the gastrointestinal tract.

The average iodine content was 111.3 μg/l, which does not deviate from the norm (see table No. 1). However, the median, which shows a range of indicators from 78.7 μg/l to 134.4 μg/l, is 55.7 μg/l, which makes it possible to see in some cases a mild degree of iodine deficiency (see table No. 1 and No. 2), since the criteria for the severity of iodine deficiency were the recommendations of ICCID, the UN Children's Fund, and WHO (mild iodine deficiency - with a median urinary iodine excretion of 50 to 99 μg/l) [15, 16, 17].

The average selenium content was 46.0 μg/l, which is 2 times lower than the reference values and constitutes an average degree of Se deficiency. The median shows a range from 30.8 μg/L to 56.4 μg/L, corresponding to mild to moderate selenium deficiency.

Despite the relatively normal levels of iodine content in children of primary school age with predominant pathology of the upper respiratory tract, diseases of the teeth, thyroid gland and eyes, we identified critically low levels of selenium content (2 times lower than the reference values), corresponding to an average degree of microelement deficiency.

Conclusions

The results of our study do not contradict existing works [15, 16, 17] and showed low selenium content and normal iodine content in children of primary school age with various clinical pathologies, mainly associated with a decrease in the body's immune resistance, metabolic disorders and collagen formation processes.

The rapidly growing body of a child, deprived of subsidies for deficiency of essential microelements against the background of high school loads, physical inactivity, poor nutrition, as well as increased computer work, tends to decompensate metabolic processes.

Based on the identified data, we consider it necessary to introduce an algorithm for timely diagnosis of selenium deficiency conditions and a program of corrective measures. The program should include rapid testing for the provision of essential microelements (iodine and selenium); if a deficiency of microelements is detected, consultation with a pediatrician to ensure timely treatment measures. When organizing school meals, it is advisable to use selenium-fortified products.

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评估胃肠道手术后微生物组对结直肠癌发展的影响

ASSESSMENT OF THE EFFECT OF THE MICROBIOME ON THE DEVELOPMENT OF COLORECTAL CANCER AFTER SURGERY ON THE GASTROINTESTINAL TRACT

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注解。 我们研究了胃肠道 (GIT) 手术干预（阑尾切除术、胆囊切除术、息肉切除术）后微生物组对结直肠癌 (CRC) 发展的影响。 分析了 381 名患者； 研究中包括了 CRC 突变活性（KRAS、BRAF、MSI、NRAS、HER2）等变量。 分析显示，既往接受过阑尾切除术的患者BRAF突变频率较高，是对照组的4.8倍。 我们将获得的数据与具核梭杆菌对结直肠癌发展的影响联系起来，现代文献中描述了其作用。胆囊切除术和息肉切除术对结直肠癌的发展没有足够的作用。

关键词：阑尾切除术、胆囊切除术、息肉切除术、微生物组、结直肠癌。

Annotation. *We studied the influence of the microbiome on the development of colorectal cancer (CRC) after surgical interventions on the gastrointestinal tract (GIT) (appendectomy, cholecystectomy, polypectomy). 381 patients were analyzed; variables such as CRC mutational activity (KRAS, BRAF, MSI, NRAS, HER2) were included in the study. The analysis showed a high frequency of BRAF mutations in patients with a previous appendectomy, 4.8 times compared to the control group. We associate the obtained data with the influence of Fusobacterium nucleatum on the development of colorectal cancer, the role of which is described in modern literature. Cholecystectomy and polypectomy did not have a sufficient effect on the development of colorectal cancer.*

Keywords: *appendectomy, cholecystectomy, polypectomy, microbiome, colorectal cancer.*

Relevance: the problem of identifying the etiological mechanisms of carcinogenesis is one of the pressing issues of global health. Today, the medical community believes that cancer develops as a result of several factors, including the influence of the microbiome. In recent years, some microorganisms have been identified that trigger or contribute to the development of oncological processes [1, 2, 3, 4]. In addition, the role of the appendix in maintaining intestinal microbiotic homeostasis has been established [5]. Appendectomy and other surgical interventions on the gastrointestinal tract can lead to changes in the human microbiome, which potentially leads to the proliferation of a protumor microbiome and the development of colorectal cancer [6, 7]. However, other studies refute these theses [8, 9], so at the moment there are 2 opinions: 1 – appendectomy increases the risk of cancer, 2 – it does not increase, and sometimes even counteracts, the development of cancer. It is believed that after an appendectomy, the intestinal microbiome cannot recover naturally and requires the use of drugs that restore microflora homeostasis [6, 10].

There are 2 theories of the mechanism of development of CRC after cholecystectomy: 1) direct pathogenic effect of secondary bile acids on DNA and activation of signaling pathways leading to malignant neoplasms (MN), 2) growth of pathogenic microflora, which has a proven effect on the development of CRC (Fusobacterium nucleatum), enterotoxigenic Bacteroides fragilis (ETBF), Clostridium difficile and Escherichia coli [11].

Benign tumors of the colon indicate a persistent disruption of the intestinal microbiome, the proliferation of the protumor microbiome Fusobacterium nucleatum, Clostridium hathewayi and Bacteroides clarus [12].

Consequently, the patient, after abdominal surgery (appendectomy, cholecystectomy, polypectomy), remains with a disturbed microbiome, which increases the risk of developing colorectal cancer.

Recent studies show that in a cohort of patients in whom protumor microorganisms were found in CRC tissue, they have their own molecular genetic characteristics in the form of CRC-associated mutations [13]. In addition, there is an opinion that the detection of Fusobacterium nucleatum DNA in CRC tissue is associated with a higher detection rate of MSI and a poor prognosis for the patient [14].

Our study did not evaluate the activation of signaling pathways such asβ-catenin, epidermal growth factor, NF-κB, through which the influence of the protumor microbiome on the development of CRC has been proven; therefore, a direct assessment of the impact of the altered microbiome on the large intestine has not been carried out.

In this study, we attempt to explore: 1) Analyze different hypotheses regarding the effects of appendectomy, cholecystectomy, and polypectomy on colorectal cancer; 2) To characterize the predominant localizations of colorectal cancer after

appendectomy; 3) Assess the influence of factors on the mutational activity of colorectal cancer.

Materials and methods: in our study, we analyzed 381 patients with a confirmed diagnosis of colorectal cancer who were hospitalized at the Surgut District Clinical Hospital in 2021 and 2022. 70 had undergone appendectomy, 4 of them less than 10 years ago, 301 without previous appendectomy. The analysis included variables such as age, location, presence of mutations (KRAS, NRAS, BRAF, HER2, MSI), history of appendectomy, and other gastrointestinal surgeries (polypectomy, cholecystectomy), medical records from the archive of the Surgut district clinical hospital, scientific research on this and related topics in PubMed databases.

A factor analysis was carried out in SPSS with dimensionality reduction (factor grouping, Kaiser-Mayer-Olkin Measure of Sampling Adequacy (KMO) = 0.505), as well as a correlation analysis of the available variables in the Stattech program.

Inclusion criteria: Age over 18 years, presence of a morphologically confirmed diagnosis of colorectal cancer.

Exclusion criteria: family history of hereditary cancer of the digestive system or diagnosis of colon cancer within 30 days after inclusion, history of inflammatory bowel disease and current history.

Results: in the factor analysis carried out by the SPSS program, the following variables were analyzed: age, appendectomy, other operations on the gastrointestinal tract, family history of cancer. During the analysis, the dimension of the variables was reduced to 2 components (using the method of identifying principal components, the criterion for the influence of a variable in a component is ≥0.5). Two components were formed: 1 included age (0.669) and appendectomy (0.807); Component 2 included other operations on the gastrointestinal tract (0.662) and family history (-0.723). Next, 4 groups of patients were formed according to the shares of influence of each variable (n): 1 group – the share of the influence of the variable up to 25% n1 = 93, n2 = 98; Group 2 – the share of influence varies from 26 to 50% n1= 96, n2= 93; Group 3 – the share of the influence of the variable from 51 to 75% n1= 97, n2= 94; Group 4 – the share of influence varies from 76% to 100% n1 = 95, n2 = 96. The number of patients in whom the share of influence of both variables was more than 75% = 19

The negative impact of a family history of cancer on the development of colorectal cancer raises doubts about the reliability of the factor analysis performed. Perhaps the results obtained are due to the inclusion in the analysis of a family history not of colorectal cancer, but of other organs and systems, which excludes the hereditary factor of an altered microbiome.

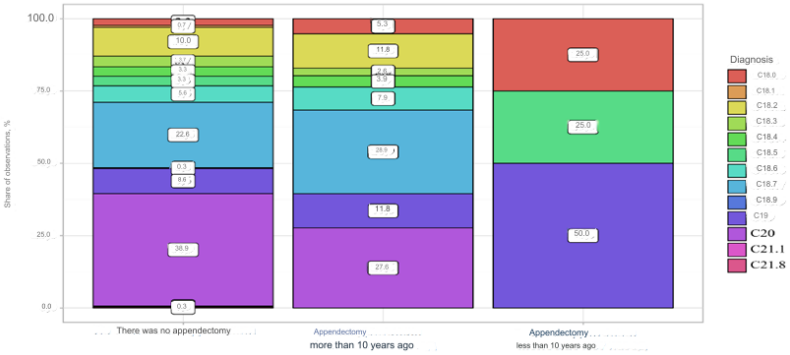

Figure 1. *Comparative analysis of the localization of colorectal cancer in patients with and without appendectomy.*

Next, a comparative analysis of the localization of colorectal cancer was carried out in patients with and without appendectomy. In patients with a previous appendectomy, the localization of colorectal cancer was more common in all parts of the large intestine, with the exception of the rectum: cancer of the cecum by 3% more often, cancer of the ascending colon by 1.8%, in the descending colon by 2.3%, in the sigmoid colon by 6.3%, in the rectosigmoid junction by 3.2% more often than in the group without appendectomy. In patients who underwent appendectomy less than 10 years ago (4 people), 25% cecum, 25% splenic angle, 50% sigmoid colon.

Comprehensive table with mutations and factors

Indicators	Categories	Abs.	%	95% CI
KRAS	No	294	77.2	72.6 – 81.3
	Yes	87	22.8	18.7 – 27.4
BRAF	No	370	97.1	94.9 – 98.6
	Yes	eleven	2.9	1.4 – 5.1
HER2	No	370	97.1	94.9 – 98.6
	Yes	eleven	2.9	1.4 – 5.1
NRAS	No	377	99.0	97.3 – 99.7
	Yes	4	1.0	0.3 – 2.7
MSI	No	375	98.4	96.6 – 99.4
	Yes	6	1.6	0.6 – 3.4
heredity for cancer	not burdened	297	78.0	73.4 – 82.0
	family history	84	22.0	18.0 – 26.6

Appendicitis	Absence	301	79.0	74.6 – 83.0
	History of appendectomy	80	21.0	17.0 – 25.4
Other operations	no history of gastrointestinal surgery	331	86.9	83.1 – 90.1
	have a history of gastrointestinal surgery	50	13.1	9.9 – 16.9

The highest mutational activity is observed when CRC is localized in the splenic angle (C18.5) = 54.5%; in cancer of the cecum and ascending colon, mutations are observed in 33.3% of cases; for rectal cancer 31.2%; cancer of the rectosigmoid junction 29.7%; sigmoid colon cancer = 27.8%; cancer of the hepatic angle and transverse colon 15.4%; cancer of the descending colon 17.4%. The association between appendicitis and CRC location was weak (Cramer's V = 0.21).

KRAS was found in the distal parts of the large intestine in 42.5% of cases (rectum = 42.5%, sigmoid colon = 23.0%); in the proximal parts, no increase in incidence was observed. BRAF - the highest frequency of occurrence in the rectosigmoid junction (27.3%) and in the ascending colon (27.3%), NRAS in 75% of cases in the rectum, HER2 amplification predominates in the distal parts (sigmoid = 27.3%, rectosigmoid junction 36.4%, rectum 18.2%), MSI predominates in the proximal colon (ascending colon = 66.7%, cecum = 16.7%, splenic angle = 16.7%).

The frequency of occurrence of mutations in the group with a family history of cancer was 1.507 times higher compared to the group without a family history of cancer; the differences in odds were not statistically significant (95% CI: 0.901 – 2.521). p = 0.117*Methods used: Pearson Chi-square.* The frequency of KRAS mutations in the first group of patients was 1.606 times higher compared to the second group (29.8% and 20.9%, respectively). the odds differences were not statistically significant (95% CI: 0.931 – 2.770). HER2 amplification in the first group of patients was 3,070 times higher compared to the second group (2.0% and 6.0%, respectively). the odds differences were not statistically significant (95% CI: 0.913 – 10.321). Although the data obtained show an increase in the frequency of mutations in patients with a family history, mathematical processing characterizes the results as insignificant.

The incidence of mutations in the group of patients with appendectomy was 1.008 times lower compared to the group without a history of appendectomy; the difference in odds was not statistically significant (OR = 0.993; 95% CI: 0.576 – 1.711).p = 0.978 methods used: Pearson Chi-square.The frequency of BRAF mutations in the first group of patients was 4,800 times higher compared to the second group (7.5% and 1.7%, respectively), the differences in odds were statisti-

cally significant (95% CI: 1.426 – 16.159). The frequency of MSI in the first group of patients was 1.904 times higher compared to the second group (2.5% and 1.3%, respectively). the odds differences were not statistically significant (95% CI: 0.342 – 10.585). With regard to KRAS, HER2, NRAS, no statistically significant differences were found in the compared groups of patients.

The frequency of occurrence of mutations in the groups of patients with cholecystectomy and polypectomy was 1.180 times lower compared to the groups of patients without these surgical interventions; the differences in odds were not statistically significant (OR = 0.848; 95% CI: 0.432 – 1.664). p = 0.631*Methods used: Pearson Chi-square.* There were no statistically significant differences in the frequency of occurrence of individual mutations in patients of both groups.

Discussions: The appendix is thought to play a role in the homeostasis of the intestinal microbiome, and its inflammation and subsequent removal causes intestinal dysbiosis, which in turn increases the risk of developing CRC. The predominant localization of CRC in patients with appendectomy does not have a clear characteristic. Some studies claim that disruption of the microbiome as a result of appendectomy increases the risk of developing CRC exclusively in the proximal parts, while other studies show that distal parts also have a high risk of developing CRC after appendectomy. Our results indicate an increase in the incidence of colorectal cancer in all sections except the rectum, but the difference in incidence in some sections of the colon is not statistically significant. We can definitely say that in the group of patients with appendectomy, CRC localized in the proximal colon is more common than in patients without acute appendicitis. The higher incidence of rectal cancer in patients without a previous appendectomy indicates a low impact of dysbiosis on this part of the colon.

When analyzing the odds of CRC-associated mutations in the compared groups of patients according to various exposure factors, statistically significant differences in the BRAF mutation were found in patients with a previous appendectomy. This may be due to exposure to Fusobacterium nuckeatum. When this bacterium is detected, the tumor has molecular features, in particular, mutations of CpG islands and BRAF [13].

It is assumed that after appendectomy and other inflammatory bowel diseases, the microbiome is restored over time, however, there are studies suggesting that the altered composition of the microbiome persists for more than 2 years in older people [6].

The mutational characteristics of colorectal cancer in patients who underwent cholecystectomy and polypectomy do not differ in comparison with patients without any history of surgical interventions, which indicates an insufficient effect of cholecystectomy and polypectomy on the microbiome. More in-depth study of the influence of these factors is necessary.

Conclusion: We assume that various interventions that change the intestinal microbiome have an impact on the development of CRC, however, their study requires a more in-depth study and assessment of the growth of pathogenic protumor microorganisms themselves, as well as various specific markers of activation of the corresponding signaling pathways of carcinogenesis. We confirmed the hypothesis of an increased frequency of BRAF mutations in colorectal cancer in patients with a previous appendectomy.

We also believe that in order to confirm the hypothesis about the influence of an altered intestinal microbiome on the development of CRC, it is necessary to conduct a prospective study with the inclusion in the postoperative period of drugs that restore the composition of the microbiome, followed by long-term observation of these patients regarding the incidence of CRC.

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磁暴之前和期间患有共病的第二成熟女性的脉搏血氧饱和度

PULSE OXYMETRY IN WOMEN OF THE SECOND MATURE AGE WITH COMORBID PATHOLOGY BEFORE AND DURING MAGNETIC STORMS

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抽象的。 本文分析了太阳磁暴对因合并症（CP）接受门诊治疗的中年女性血氧饱和度的影响，包括无心力衰竭迹象的缺血性心脏病（IHD）、缺铁性贫血 （国际开发协会）。 和糖尿病（DM）。 作者在内科疾病临床中首次将第二成熟期划分为相等的五年时间间隔。 研究表明，随着女性护照年龄的增加，磁暴显着降低动脉血氧饱和度。

关键词：女性、第二成年期、共病病理、磁暴、脉搏血氧饱和度。

Abstract. *The article presents an analysis of the study of the influence of solar magnetic storms on blood oxygen saturation in middle-aged women receiving outpatient treatment for comorbid pathology (CP), including ischemic heart disease (IHD) without signs of heart failure, iron deficiency anemia (IDA). and diabetes mellitus (DM). For the first time in the clinic of internal diseases, the period of the second mature age was divided by the authors into equal five-year time intervals. It is shown that as the passport age of women increases, magnetic storms significantly reduce arterial blood oxygen saturation.*

Keywords: *women, period of second adulthood, comorbid pathology, magnetic storms, pulse oximetry.*

Relevance. Questions of diagnosis and treatment of KP have been constantly discussed for many years on the pages of magazines, various congresses and conferences [2, 3, 11], which is connected not only with their high incidence of morbidity, but also with significant mortality. Mortality from cardiovascular diseases (CVD) takes the first place in our country and developed countries of the world [1, 15].

It is known that the human body is affected by various weather conditions, including solar storms [12, 13].

In the available literature, we did not find studies indicating the influence of high solar activity on the suggestion of women of the second adult period living in Western Siberia with comorbid pathology.

Purpose: to determine the influence of high solar activity on the level of suggestion in women of the second mature age, who are undergoing outpatient treatment for comorbid pathology, by means of pulse oximetry.

Materials and methods. The evaluation of the function of external breathing was carried out in 28 women aged 48.4±2.9 years, who are undergoing outpatient treatment in RCH No. 2. Tyumen in connection with KP, which includes IBS without signs of heart failure, diabetes and diabetes. In accordance with the program of treatment adopted by RCH No. 2 in Tyumen, clinical and instrumental inspection is carried out by all women. We drew attention to the fact that in the period from 2 to 5 April, from 9 to 11 April and from 19 to 23 April 2024, during the period of high solar activity, the condition of women worsened. Women complained of severe headaches, insomnia, irritability, chest pain, and increased blood pressure. From the anamnesis, it was established that 8 (28.6%) women had to call an ambulance due to a sharp increase in blood pressure, 6 (21.4) went to the doctor at home, and 14 (50%) went to the clinic on their own. We decided to compare indicators of pulse oximetry in women in the period of second adulthood from KR to the field of solar magnetic storms.

When estimating the age of women, we adhered to the scheme of age periodization of human ontogenesis, adopted at the VII All-Union Conference on Problems of Age Morphology, Physiology and Biochemistry of the Academy of Sciences of the USSR in Moscow in 1965. According to this periodization, the period of the second mature age lasts from 36 to 55 years, i.e. 20 years. It is quite natural that during this period of life in women, for example, at the age of 36 years, morphofunctional indicators should differ from the age, for example, at 54 years. First of all, in the available literature, we did not find studies characterizing pulse oximetry in the same women before and after high solar activity. Secondly, there are no studies that reflect the state of pulse oximetry in women in different periods of the second adult age. We first divided the period of the second mature age into 5-year intervals: from 36 to 40 years (38.3±1.7; n = 8), from 41 to 45 (43.4±1.6; n = 6) from 46 to 50 (47.2±1.5; n = 7) years and from 51 to 55 (52.5±1.6; n = 7) years.

Currently, a non-invasive method of assessing blood oxygen saturation, called pulse oximetry [5, 7, 9, 10], widely used by us to assess the saturation of arterial hemoglobin with oxygen and determine heart rate, is increasingly being introduced into clinical practice.

Considering that many women cover their nails with gel polishes, which distort the instrument readings [6, 8], during the study we asked them to refrain from painting their nails. Normal values of transcutaneous pulse oximetry (oximetry, hemoximetry) of arterial blood in a healthy person vary from 95 to 98%. We took into account that, from a practical point of view, an error of ±2% is allowed for a pulse oximeter [14]. Back in 1992, it was noted that pulse oximetry is the only available method by which one can indirectly estimate the oxygen tension in arterial blood. The editors of The Lancet consider the threshold SpO_2 value for prescribing oxygen therapy to be 93%.

We took into account that the results of the pulse oximeter readings are also influenced by compliance with the rules of the study: movement during the examination, bright light, comfortable room temperature, interference from nearby electrical equipment (for example, a cell phone). We paid attention to the fact that during the examination women did not have paint on their nails or an artificial nail.

To study saturation, we simultaneously used a CMS 50E pulse oximeter, as well as a Fingertip Pulse Oximeter “Beurer PO40”. The devices comply with the requirements of the European Medical Devices Directive 93/42/EC, as well as the Medical Devices Act and DIN EN ISO 80601-2-61 (medical electrical devices). Saturation (SpO2) was assessed for women in a state of physiological rest while sitting for 5 minutes.

The research results were processed on a personal computer using modern electronic programs (STATISTIKA). The significance of differences was assessed using Student’s t test [4].

The principles of voluntariness, individual rights and freedoms guaranteed by Articles 21 and 22 of the Constitution of the Russian Federation, as well as Order of the Ministry of Health and Social Development of Russia No. 774n dated August 31, 2010 “On the Ethics Council” are observed and in compliance with the ethical standards of the Declaration of Helsinki and the Directives of the European Community (8/ 609EC), as well as the informed oral consent of women.

Results and discussion. Transcutaneous pulse oximetry.

Research, firstly, has shown that the percentage of blood oxygen saturation in women who were not exposed to active solar radiation was significantly ($p<0.05$) higher than in women on days of solar storms (Table 1).

Table 1

Age values of saturation of women within the period of the second mature age on ordinary days in March 2024 and during solar storms in April 2024 (M±m)

Examination time	Saturation (%)
36 – 40 years old	
Usual days in March	95,15 ± 0,53
April 2-5	93,27 ± 0,56
April 9 - 11	93,22 ± 0,58
April 19 - 23	93,18 ± 0,55
41 – 45 years old	
Usual days in March	95,12 ± 0,52
April 2-5	93,23 ± 0,54
April 9 - 11	93,18 ± 0,57
April 19 - 23	93,14 ± 0,56
46 – 50 years old	
Usual days in March	95,09 ± 0,51
April 2-5	93,16 ± 0,52
April 9 - 11	93,13 ± 0,57
April 19 - 23	93,07 ± 0,59
51 – 55 years old	
Usual days in March	94,96 ± 0,56
April 2-5	93,08 ± 0,54
April 9 - 11	93,01 ± 0,57
April 19 - 23	92,89 ± 0,58

Secondly, during three solar storms that took place in April 2024, no significant differences in blood saturation ($p>0.05$) were revealed in women of the second mature age in 5-year periods of life, and the spread in the percentage of blood oxygen saturation was insignificant – from 93.27 to 92.89. Thirdly, which we

consider important, as women's passport age increased, blood oxygen saturation gradually decreased (Fig. 1).

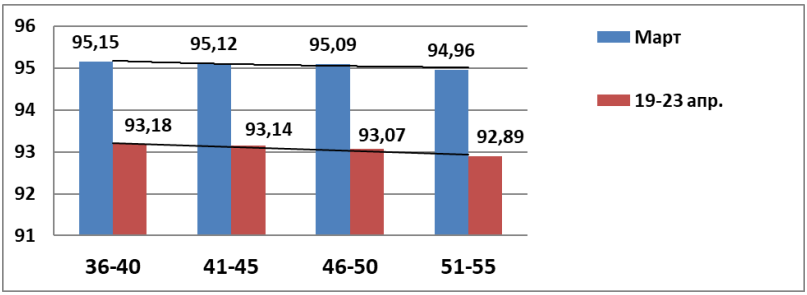

Figure 1. *Percentage blood oxygen saturation in women within the period of second adulthood.*

We can state that during solar storms, blood saturation in women was at a critical level - 93%. The difference in blood saturation values in March 2024 with saturation values in the period April 19-23 among women 36-40 years old was 1.97%, at the age of 41-45 years - 1.98%, at the age of 46-50 years - 2. 02%, at the age of 51-55 years – 2.07% (Fig. 2), i.e. they gradually decreased.

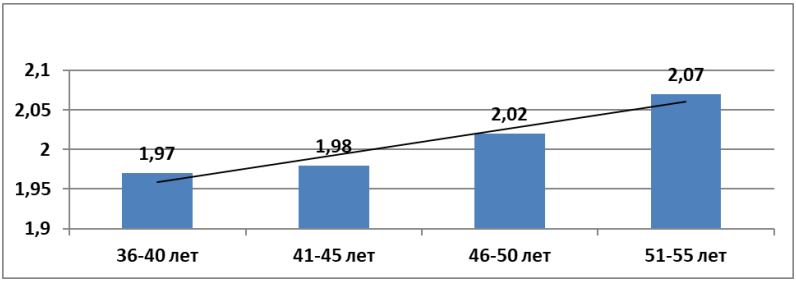

Figure 2. *The difference between blood saturation values in March 2024 and saturation values on April 19 - 23 in women within the period of the second mature age.*

Based on the study, we can conclude that in women with CP in March 2024, firstly, blood oxygen saturation over four 5-year periods of time was significantly ($p<0.05$) higher than in women during the period of high solar activity. Secondly, in all women, due to increasing passport age, blood oxygen saturation decreases, especially during periods of high solar activity.

Conflict of interest. The authors declare that there are no obvious or potential conflicts of interest in connection with the publication of this article.

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高分子量透明质酸和真皮成纤维细胞的复合物通过趋化因子信号通路 CXCL12J – CXCR4 增加 MSC 迁移至再生缺血性皮肤伤口

COMPLEX OF HIGH MOLECULAR WEIGHT HYALURONIC ACID AND DERMAL FIBROBLASTS INCREASE MSCS MIGRATION INTO REGENERATING ISCHEMIC CUTANEOUS WOUND VIA THE CHEMOKINE SIGNALING PATHWAY CXCL12J – CXCR4

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概括。 受损组织的细胞会分泌基质衍生因子-1 (SDF-1)，它是表面具有 CXCR4 受体的 MSC 的趋化剂。 本研究旨在探讨低分子量HA和真皮同种成纤维细胞移植后再生模型缺血性皮肤伤口活检标本中SDF-1的表达和CD34+间充质干细胞（MSCs）的含量。 该研究对71只5-7月龄的C57/B1系白色成熟小鼠进行，分为对照组（CG）和实验组（EG）。 两组均形成缺血性伤口模型。 移植时使用了 2% 的高分子量透明质酸 (HA) 和 133 万个同种成纤维细胞。 通过免疫组织化学测定 SDF-1 和 CD34 阳性细胞的存在。 结果显示，组织工程构建体移植后第4天，EG活检样本中表皮和真皮中SDF-1阳性细胞的指数比对照更高，这吸引了MSC。 然而，SDF-1+细胞的指数随后生长得更慢，没有达到CG中的值，并且开始提前下降（表皮第12天，肉芽组织第10天）。 MSC 指数也具有类似的趋势。 细胞间质中存在 HA 是完整组织的典型特征； 这会抑制 SDF-1 的产生，而 SDF-1 会吸引更少的 MSC。 移植的成纤维细胞以及随后的表皮细胞本身很可能在不吸引 MSC 的情况下主动分裂，并确保伤口愈合比对照早 16.94%。

关键词：再生医学，缺血性皮肤伤口，同种异体成纤维细胞，间充质干细胞，基质衍生因子1； 高分子量透明质酸。

Summary. *Cells of damaged tissues secrete stromal-derived factor-1 (SDF-1), which is a chemoattractant for MSCs with the CXCR4 receptor on the surface. This study aims at investigating the expression of SDF-1 and the content of $CD34^+$ mesenchymal stem cells (MSCs) in biopsy specimens of a regenerating model ischemic skin wound after transplantation of low molecular weight HA and dermal allofibroblasts. The study was performed on 71 white mature mice of the C57/B1 line at the age of 5-7 months, which were divided into the control group (CG) and the experimental group (EG). In both groups, a model ischemic wound was formed. For transplantation, high molecular weight hyaluronic acid (HA) 2% was used in combination with 1.33 million allofibroblast cells. The presence of SDF-1 and CD34-positive cells was determined by immunohistochemistry. It was revealed that the index of SDF-1-positive cells in the epidermis and dermis in biopsy samples of the EG on the 4th day after transplantation of the tissue-engineered construct is higher compared to the control, which attracts MSCs. However, the index of $SDF\text{-}1^+$ cells subsequently grows more slowly, not reaching the values in the CG, and begins to decrease earlier (by day 12 in the epidermis and by day 10 in the granulation tissue). A similar trend is characteristic of the MSC index. The presence of HA in the intercellular substance is typical of intact tissue; this inhibits the production of SDF-1, which attracts fewer MSCs. It is likely that transplanted fibroblasts and, following them, epidermocytes themselves actively divide without attracting MSCs and ensure wound healing 16.94% earlier than in control.*

Keywords: *regenerative medicine, ischemic skin wound, allofibroblasts, mesenchymal stem cells, Stromal-derived factor-1; high molecular weight hyaluronic acid.*

1. Introduction

Chronic skin wounds in an aging population developing against the background of hemodynamic problems, an increase in the incidence of both diabetes mellitus and obesity are becoming a global public health problem. In spite of growing prevalence of these lesions, conventional therapies have limited efficacy in accelerating wound closure and promoting healing [1]. In the case of skin injury, wound healing occurs in three overlapping stages: inflammation, proliferation, and remodeling [2]. With chronic wound healing, there may be simultaneous presence of signs of all three stages. Skin dermal cells, fibroblasts, are critical in all three phases, secreting extracellular matrix components, remodeling extracellular matrix, and shrinking the wound [3]. Fibroblasts are used in regenerative medicine, being the main cells of skin substitutes created on the basis of cell technologies. Skin substitutes can be based on intercellular substance components, such as hyaluronic acid (HA), which create a microenvironment for fibroblasts. It

is a non-branched glycosaminoglycan consisting of repeating disaccharide units of N-acetyl-D-glucosamine and D-glucuronic acid and is a non-sulfated glycosaminoglycan of the intercellular substance of connective tissue. HA is involved in many key processes, including cell signaling, wound repair, tissue regeneration, morphogenesis, matrix organization, and possesses unique physicochemical properties such as biocompatibility, biodegradability, mucoadhesiveness, hygroscopicity, and viscoelasticity [4]. Skin wound cells secrete stromal-derived factor-1 (SDF-1, also known as CXCL12), which is one of the chemoattractants for mesenchymal stem cells (MSCs) that have CXC chemokine receptor 4 (CXCR4) on the surface and bind to SDF-1 [5]. Mesenchymal stem cells (MSCs) are an important source for damaged tissue repair, both in animal models and in human clinical trials [6]. However, there is no information about the expression of SDF-1 by cells, as well as about the presence of MSCs in the tissues of regenerating skin defects against the background of ischemia after transplantation of a construct consisting of high molecular weight HA and dermal allofibroblasts, which proves the relevance of the study.

The aim of the study was to investigate the expression of stromal-derived factor-1 (SDF-1) and the number of CD34+ mesenchymal stem cells in biopsy specimens of a regenerating model ischemic skin wound after transplantation of high molecular weight HA and dermal allofibroblasts.

2. Methods and materials

The study involved 71 mature mice of the C57/B1 line aged between 5 and 7 months kept in the vivarium of Medical Academy named after S.I. Georgievsky. The animals were divided into the control group (CG) and the experimental group (EG). The distribution of the animals by groups is presented in table 1 (table 1). The experiments were carried out taking into account all the principles of humanity included into Directive 2010/63/EU and in accordance with the guidelines of ICMR on animal research (2006).

Table 1.

Distribution of mice in the control and experimental groups by times of sampling

Time elapsed after the operation	The control group (a number of mice)	The experimental group (a number of mice)
Day 4	3	3
Day 7	4	5
Day 10	3	5
Day 12	5	6
Day 15	4	5
Day 19	5	7

Day 23	3	5
Day 26	4	4
Total	31	40
Total in the study – 71 mice		

An ischemic cutaneous wound was made in the interscapular region of the mice of both groups through operative procedure. In the EG, dermal fibroblasts were obtained using fermentation process and cultured in a DMEM/F_{12} medium (Lonza). For transplantation, high molecular weight HA 2% of biosynthetic origin *Amino-jel* (manufactured by *BioFormula,* Spain) was used in combination with 1.33 million cells of allogeneic fibroblasts of the second and third passage with the phenotype CD44+CD90+CD105+CD73+CD45+CD31-CD34-CD45- in a DMEM/F12 medium.

On the 4th, 7th, 10th, 12th, 15th, 19th, 23rd and 26th days after the operation, the resulting scab or scar were intraoperatively excised and fixed in 10% buffered formalin solution. The material was embedded in paraffin and stained with H&E. The study of histological preparations was carried out using an OLIMPUS SX-31 light-optical microscope. The presence of SDF-1 and CD34-positive cells was determined through immunohistochemistry. The primary antibodies were SDF-1 polyclonal antibodies (*Gene Tex Inc.,* USA) and CD34 monoclonal antibodies (clone EP373Y) (*Abcam*, USA) at a dilution of 1:100. Universal antibodies (*HiDef Detection™ HRP Polymer system, Cell Marque,* USA) were used as secondary antibodies, which allowed to detect mouse and rabbit primary antibodies conjugated with an enzyme complex based on horseradish peroxidase. Control studies were performed to exclude pseudo-positive and pseudo-negative results for each marker. The sections were counterstained with Mayer's hematoxylin to visualize the nuclei. The index of SDF-1 and CD34-positive cells was determined by counting their number per 100 cells during microscopic examination (magnification x 1350) and then calculating the average percentage based on the results of the studied sections of each biopsy sample in the CG and EG. The data obtained as a result of the calculation were processed using the computer program SPSS 7.5 for Windows statistical analysis software suite (*IBM Analytics*, USA). During statistical processing, the following non-parametric criteria were used to assess the significance of differences in the mean values between the groups: the Mann-Whitney U-test (p-value of 0.05 was considered statistically significant), Kruskal-Wallace H-test.

Results

On the 4th day after the operation, there is no epidermis in the sections of the biopsy specimens stained with hematoxylin and eosin of the mice of both groups. In the CG, the skin defect is formed by a huge thick scab of inflammatory cells,

cellular debris and exudate. In the EG, the cutaneous wound is also closed by an extensive scab, under which there are oxyphilic-stained cavities filled with high molecular weight HA. A small accumulation of damaged leucocytes can be detected on the border with the underlying tissues. The entire skin defect in the mice of all groups was filled with white adipocytes rising from the hypodermis. Collagen fibers and capillaries are extremely few and almost never occur.

SDF-1 positive cells are present in the biopsy specimens of both experimental groups (Table 2). In the CG biopsy samples, there are 3 times fewer such cells directly under the scab (conditionally called the epidermis) than in the deep layers. In the similar layers of the EG, the index of cells with the SDF-1 marker is 71.18±0.18% and 37.45±0.18%, respectively, higher than control. MSCs expressing the CD34 marker are present only in the deep layers of the biopsy specimens of the EG.

Table 2.

The index of SDF-1 positive cells and CD34-positive cells in the epidermis (ED) and granulation tissue (GT) of biopsy specimens from the cutaneous wound in the control and experimental groups

Day after operation	Control group				Experimental group			
	The index of SDF-1+ cells (%)		The index of CD34+ cells (%)		The index of SDF-1+ cells (%)		The index of CD34+ cells (%)	
	ED	GT	ED	GT	ED	GT	ED	GT
4-e	3,21±0.01	10,22±0,07	0	0	11,14±0,11*	16,34±0,13*	0	6,15±0,01*
7-e	12,41±0.11 **	14,41±0,11 **	0	0	18,28±0,10* **	27,41±0,14* **	0	13,27±0,10* **
10-e	20.00±0,12 **	19,38±0,11 **	0	5,10±0,01 **	22,33±0,12 **	36,82±0,15* **	0	24,72±0,11* **
12-e	70,67±2,01 **	26,51±0,13 **	1,23±0,01 **	12,18±0,09 **	113,42±0,13* **	29,56±0,12**	6,24±0,01* **	19,33±0,14* **
15-e	76,23±0,22 **-	31,58±0,18 **	2,12±0,01	19,16±0,11 **	5,04±0,09* **	12,27±0,11* **	2,51±0,01**	10,47±0,11* **
19-e	72,33±0,22	29,27±0,20 **	2,12±0,01	10,09±0,05 **	0* **	3,17±0,02* **	0* **	2,82±0,05* **
23-и	39,15±0,14 **	16,10±0,11 **	0**	3,10±0,02 **	0*	0* **	0	1,02±0,01**
26-e	0**	0**	0	1,02±0,01	0	0	0	0* **

* Statistically significant differences from control, P = 0.05.

** Statistically significant differences from the previous day, P = 0.05.

On the 7th day, the silicone ring holding the edges of the wound is still firmly fixed. In the control group, the wound was covered from the outside with a

scab consisting of dead cells, under which there was partial epithelialization of the wound on the sections: an epidermis consisting of 1-2 rows of cuboidal epithelial cells was found. After transplantation of allofibroblasts associated with low molecular weight HA, the epidermis has up to 3 rows of cuboidal epidermocytes. A statistically significant increase in the index of SDF-1 positive epidermocytes providing the secretion of a chemoattractant for MSCs, continued in the biopsy specimens of both groups (see Table 2). The developing granulation tissue with a small amount of capillaries, fibroblasts and collagen fibers is localized under the epidermis. The SDF-1+ index of non-differentiated granulation tissue cells increased by 25.64±0.20% in the CG and by 40.39±0.15% in the EG from days 4 to 7. At the same time, the index of such cells in the EG is 47.43±0.20% higher. The presence of MSCs (CD34-positive cells) is still observed in the granulation tissue of the EG only.

On the 10th day, the silicone ring was absent in the EG mice. Epithelialization of the wound and spontaneous falling off of the ring was recorded on day 10.3±0.10 after the operation. In the CG, the ring was still sutured to the edges of the skin defect. The scab closing the wounds became thinner in both groups; however, the scab in the control group was much thicker and the epidermis was thinner. The SDF-1+ index of epidermocytes continued to grow in the CG and the EG and amounted to 37.95±0.19% and 18.14±0.16%, respectively. There are 10.43±0.17% more such epidermocytes in the EG than in the CG. On the 10th day of wound repair, no CD34-positive cells were found in the epidermis of both groups. The formation of granulation tissue in biopsy specimens from the wound progressed most significantly in the EG, where a network of collagen fibers with fibroblasts and blood capillaries between them had been formed. By the 10th day, the index of granulation tissue cells with SDF-1 expression increased by 25.64±0.20% in the CG and by 25.56±0.10% in the EG, still remaining 47.37±0.13% more than in the CG. At that period, isolated CD34-expressing cells were detected in the CG granulation tissue for the first time. In the granulation tissue of the EG biopsy specimens, the MSC index increased by 46.32±0.19% compared to that on the 7th day and greatly exceeded this parameter in the CG (79.37±0.20%).

In the CG mice, spontaneous falling off of the silicone ring was recorded on average on day 12.4±0.10 after the operation on formation of a model wound due to its epithelialization and eruption of sutures, which is 16.94% later than in the EG.

In the CG, complete epithelialization of the wound under the thick remnants of the scab was observed on the 12th day. The entire skin defect was filled with developing granulation tissue, where cells of granulation tissue and hematogenous origin could be found. The papillary and reticular layers of the dermis were not

demarcated and were formed by uniformly randomly localized thin collagen fibers forming a netlike structure. Functionally active fibroblasts prevail among the cells between the collagen fibers. The surface of the wound in the EG is entirely covered with epidermis. The scab is completely absent. There are signs of development of the papillary layer of the dermis in the form of a wavy border between the basement membrane of the epidermis and the underlying granulation tissue. The number of epidermocytes with the SDF-1 marker in the CG biopsy specimens is very large, the increase in their index from the 10th to the 12th day of wound healing being equal 71.70±0.26%. The index of SDF-1-positive epidermocytes in the EG decreased by 85.74±0.23%, which made it 81.01±0.06% less than control. Single MSCs were found in the epidermis of both CG and EG. Granulation tissue in the EG was characterized by the appearance of initial signs of fibrosis: oxyphilic-stained bundles of collagen fibers were located in parallel. From the 10th to the 12th day, the SDF-1+ index of granulation tissue cells in the CG continued to rise and increased by 26.90±0.22%. In the EG granulation tissue biopsy specimens, the opposite process was observed: the index of SDF-1+ cells decreased by 19.72±0.19%, which made the index of the cells with such expression in the EG 10.32±0.05% less than control. The index of the cells with the CD34 antigen increased in the CG by 58.13±0.23%, while it decreased by 21.80±0.12% in the EG. This did not lead to a change in the ratio of the MSC index in the groups: the number of the cells in the EG was still 36.99±0.16% higher than control.

During the following period up to the 26th day, the wound process in the biopsy specimens of both groups was at the stage of scar formation. This process developed most actively in the cells of the EG biopsy samples, being accompanied by the cessation of secretion of the chemoattractant MSC SDF-1 (see Table 2) and the presencce of single MSCs only in the deep layers of the scar tissue. The process was delayed in the CG.

Disucssion

Skin wounds produce a lot of chemokines, such as CXCL12 (SDF-1), which can serve as chemoattractants for MSCs [8]. MSCs are adult stem cells that have a therapeutic effect on chronic wounds and are able to differentiate into active fibroblasts [9]. We found out that on the 4th day after transplantation of allofibroblasts in combination with high molecular weight HA, the index of SDF-1+ and CD34+ cells is higher than in the EG than in the CG. Later on, the index of SDF-1+ cells rises actively in the CG, while it increases slowly in the EG, because the presence of HA in the intercellular substance is characteristic of undamaged tissue and, apparently, this inhibits the production of SDF-1+. MSCs in the EG are not actively involved, so there are relatively few of them, although the wound heals faster than in the CG. Probably, the transplanted fibroblasts themselves actively divide and form granulation tissue. Their proliferative potential is sufficient even without the

involvement of MSCs. In the CG, high concentration of SDF-1 is observed, but the emergence of MSCs is delayed and wound healing is prolonged. A.S. Grigoryan [10] showed that, despite the fact that the cells of damaged tissues secrete the SDF-1 factor in a large volume, its excessive amount does not attract and even repels MSCs. There is also evidence that the environment in the damaged area is rich in proteolytic enzymes: serine proteases, cathepsin G, elastase, and matrix metalloproteinases, which destroy chemoattractants such as SDF-1 [11].

Conclusion

Thus, we have found out that the index of SDF-1-positive cells in the epidermis and dermis of the biopsy specimens of a healing model ischemic skin wound on the 4th day after transplantation of allofibroblasts in combination with high molecular weight HA is higher than control, which attracts MSCs. However, the index of SDF-1+ cells subsequently grows more slowly, not reaching the values of the CG, and begins to decrease earlier (by day 12 in the epidermis and by day 10 in the granulation tissue). A similar trend is characteristic of the MSC index. The presence of HA in the intercellular substance is typical of intact tissue; this inhibits the production of SDF-1, which attracts fewer MSCs. It is likely that transplanted fibroblasts and, following them, epidermocytes themselves actively divide without attracting MSCs and ensure wound healing 16.94% earlier than in control.

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治疗先天性脊柱畸形儿童 Ⅰ 型脊髓纵裂的手术导航模板

SURGICAL NAVIGATION TEMPLATE FOR THE TREATMENT OF TYPE I DIASTEMATOMYELIA IN CHILDREN WITH CONGENITAL SPINAL DEFORMITY

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抽象的。 本研究评估了专为椎弓截骨术治疗脊髓纵裂而设计的定制导航指南的功效。 研究表明，利用基于术前 CT 扫描的患者特异性 3D 打印导板，可以显着提高手术精度、缩短手术时间并最大限度地减少术后并发症。 对三个临床病例进行了检查，结果显示与传统方法相比，手术时间减少了 20%，并且没有观察到并发症。 结果表明，这种创新方法提高了接受脊髓纵裂手术矫正的儿科患者的总体结果，凸显了更广泛临床应用的潜力。

关键词：脊髓纵裂，导航引导，脊柱外科，3D打印，小儿神经外科，椎弓截骨术，手术精度，术前规划。

Abstract. *This study evaluates the efficacy of a customized navigational guide designed for performing vertebral arch osteotomy in the treatment of diastematomyelia. Utilizing patient-specific 3D-printed guides based on preoperative CT scans, the research demonstrates significant improvements in surgical precision, reduced operative time, and minimized postoperative complications. Three clinical cases were examined, showing a 20% reduction in operative time compared to traditional methods and no observed complications. The results suggest that this innovative approach enhances the overall outcomes for pediatric patients undergoing surgical correction for diastematomyelia, highlighting the potential for broader clinical application.*

Keywords: *diastematomyelia, navigational guide, spinal surgery, 3D printing, pediatric neurosurgery, vertebral arch osteotomy, surgical precision, preoperative planning.*

Introduction

Diastematomyelia, a congenital spinal anomaly characterized by a split spinal cord, poses significant surgical challenges. The condition involves a longitudinal

division of the spinal cord by a bony or fibrous septum, which can cause neurological deficits, scoliosis, and chronic pain [1]. Surgical intervention aims to remove the septum and alleviate pressure on the spinal cord, but this procedure is fraught with difficulties. Traditional methods, such as wide laminectomy or resectional laminectomy, rely heavily on the surgeon's skill and experience, leading to significant variability in outcomes [2]. These techniques often result in substantial removal of the posterior spinal elements, increasing the risk of postoperative spinal deformities and instability. The complexity of achieving precise osteotomy margins further complicates the procedure, necessitating innovative solutions to enhance surgical accuracy and patient safety.

Objective

The primary objective of this study is to evaluate the effectiveness of a customized 3D-printed navigational guide in performing vertebral arch osteotomies for the surgical treatment of diastematomyelia in pediatric patients.

Materials and Methods.

Three pediatric patients diagnosed with diastematomyelia were selected for this study, conducted between January 2022 and December 2023. The patients included two females and one male, aged 7 to 12 years. All patients underwent preoperative imaging and subsequent surgical intervention using the customized navigational guide.

A detailed preoperative CT scan of the patient's spine is obtained and imported into a 3D modeling software. The software is used to create a three-dimensional model of the vertebral arches and the pathological bony septum. The optimal osteotomy trajectory is planned within this model, and a customized navigational guide is designed to fit precisely over the dorsal surface of the vertebral arches. The guide includes fixation holes for Kirschner wires and a central hollow tube aligned with the planned osteotomy path. The guide is then 3D printed using biocompatible, sterilizable plastic materials. (fig. 1).

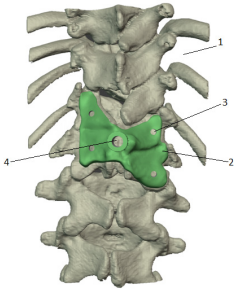

Figure 1. *Customized navigation template top view at the creation stage. 1-patient's spine, 2-template body, 3- holes for fixation with Kirschner wires, 4-tube for osteotomy performance.*

During surgery, after exposing the dorsal spinal structures, the guide is securely fixed to the vertebral arches using Kirschner wires through the pre-designed fixation holes. The osteotomy is performed through the central tube using a high-speed drill, precisely following the pre-planned trajectory to remove the bony septum. After the osteotomy, the guide is removed, and the procedure continues with the necessary spinal decompression and dural repair.

The study evaluated several parameters, including:

1. **Surgical Accuracy**: Measured by comparing preoperative planning and postoperative imaging.
2. **Operative Time**: Time from the initial incision to the completion of the osteotomy.
3. **Postoperative Complications**: Incidence of adverse events such as spinal deformities, infections, and neurologic deficits.
4. **Patient Outcomes**: Assessed using clinical follow-up data, focusing on functional recovery and pain relief.

Results and Discussion

Postoperative imaging confirmed that the osteotomy lines closely matched the planned trajectories in all cases. The precision afforded by the navigational guide significantly reduced intraoperative deviations, thereby enhancing surgical accuracy.

The use of the navigational guide resulted in a noticeable reduction in operative time. The average operative time with the guide was 151 minutes. In comparison, based on our previous experience, the average operative time using traditional methods was 194 minutes. This reflects a 20% decrease in operative time. This reduction is attributed to the ease of guide placement and the elimination of intraoperative adjustments.

In the study group, no postoperative complications were observed. However, it is important to note that the sample size is small, and larger studies are necessary to fully assess the complication rates associated with this technique.

Clinical follow-ups indicated that patients experienced better functional recovery and pain relief. The customized guides facilitated less invasive procedures, contributing to faster rehabilitation and reduced postoperative pain.

Conclusion

The use of customized 3D-printed navigational guides in the surgical treatment of diastematomyelia demonstrates substantial benefits in terms of surgical precision, reduced operative time, and improved patient outcomes. This approach represents a significant advancement in pediatric neurosurgery, offering a reliable method to enhance the safety and effectiveness of spinal surgeries. Future studies with larger patient cohorts are necessary to confirm these findings and further refine the technique.

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儿童终末丝脂肪瘤手术治疗期间的神经生理监测
NEUROPHYSIOLOGIC MONITORING DURING SURGICAL TREATMENT OF TERMINAL FILUM LIPOMA IN CHILDREN

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抽象的。 本文探讨术中神经监测在儿童终丝脂肪瘤手术治疗中的有效性。终末丝脂肪瘤是一种罕见的先天性异常，可引起儿童各种神经系统症状。 术中神经监测对于确保手术期间神经结构功能状态的实时控制起着至关重要的作用。尽管外科技术取得了进步，但仍然需要研究神经监测在这方面的具体特征。 该研究纳入了 25 名被诊断患有终末丝脂肪瘤的儿童（13 名男孩和 12 名女孩），他们在 2018 年至 2023 年间接受了手术。根据下肢麻痹的严重程度将患者分为三组：轻度（5 名患者）、中度（10 名患者） 患者）和重症（10 名患者）。 术中电生理监测评估体感诱发电位（SEP）和运动诱发电位（MEP）。 结果显示，轻度和中度麻痹患者的 SEP 振幅有统计学显着性增加（$p < 0.05$），表明感觉功能部分保留。 相反，重度麻痹患者的 MEP 振幅显着降低（$p < 0.01$），反映出运动通路损伤更大。这些发现强调了在手术期间进行细致的神经监测和及早发现异常的重要性，特别是对于患有严重麻痹的患者。 进一步的研究应更深入地探讨儿童终末丝脂肪瘤手术治疗中电生理参数与临床结果之间的关系。

关键词：终末丝脂肪瘤，术中神经监测，体感诱发电位，运动诱发电位，下肢麻痹，先天性异常，电生理监测，神经系统结果。

Abstract. *This article explores the effectiveness of intraoperative neuromonitoring in the surgical treatment of terminal filum lipoma in children. Terminal filum lipoma is a rare congenital anomaly that can cause various neurological symptoms in children. Intraoperative neuromonitoring plays a crucial role in ensuring real-time control over the functional state of neural structures during surgery. Despite advances in surgical techniques, there remains a need to study the specific features of neuromonitoring in this context. The study included 25 children (13 boys and 12 girls) diagnosed with terminal filum lipoma, who underwent surgery between 2018 and 2023. Patients were divided into three groups based on the severity of lower limb paresis: mild (5 patients), moderate (10 patients), and severe (10 patients). Intraoperative electrophysiological*

monitoring assessed somatosensory evoked potentials (SEP) and motor evoked potentials (MEP). The results showed a statistically significant increase in SEP amplitude in patients with mild and moderate paresis ($p < 0.05$), indicating partial preservation of sensory functions. In contrast, patients with severe paresis exhibited a significant reduction in MEP amplitude ($p < 0.01$), reflecting greater impairment of motor pathways. These findings underscore the importance of meticulous neuromonitoring and early detection of anomalies during surgery, particularly in patients with severe paresis. Further research should delve deeper into the relationship between electrophysiological parameters and clinical outcomes in the surgical treatment of terminal filum lipoma in children.

Keywords: *terminal filum lipoma, intraoperative neuromonitoring, somatosensory evoked potentials, motor evoked potentials, lower limb paresis, congenital anomalies, electrophysiological monitoring, neurological outcomes.*

Introduction

Terminal filament lipoma is a rare congenital malformation that can cause various neurologic symptoms in children [1]. One of the key methods in the surgical treatment of this disease is intraoperative neuromonitoring, which provides real-time monitoring of the functional status of nerve structures [2]. Despite the advances in surgical technique, there is still a need to study the peculiarities and effectiveness of neuromonitoring in the surgical treatment of terminal filament lipoma in children [3].

Purpose of the study

The aim of this study is to evaluate the efficacy of intraoperative neuromonitoring during surgical intervention for terminal thread lipoma in children.

Materials and methods

Twenty-five children (13 boys, 12 girls) diagnosed with terminal thread lipoma who underwent surgical intervention between 2018 and 2023 were included in the study. The mean age was 8.4 years (4 to 12 years). Patients were divided according to the level of lower limb paresis into three groups: mild (5 patients), moderate (10 patients), and severe (10 patients).

Intraoperative neuromonitoring included assessment of somatosensory potentials (SEP) and motor potentials (MEP). The position of electrodes for MEP was chosen according to the specific surgical task and included muscles key to the motor function of the lower extremities: quadriceps, lower leg muscles, foot muscles, and the external sphincter of the anus.

Results and discussion.

Registration of SEP in response to peripheral nerve stimulation allowed assessment of the integrity of spinal cord sensory pathways. Patients with mild and moderate paresis showed a statistically significant increase in SEP amplitude ($p < 0.05$), indicating partial preservation of sensory functions in these groups.

Group	Average SEP Amplitude (μV)
Mild paresis	15.2 ± 2.3
Moderate paresis	14.7 ± 2.1
Severe paresis	10.1 ± 1.8

As shown in the table, SEP amplitudes are significantly higher in patients with mild and moderate paresis compared to those with severe paresis, indicating better preservation of sensory pathways.

Assessment of motor potentials in the lower limb muscles showed that the level of paresis significantly affects the amplitude and frequency of motor responses. Patients with severe paresis demonstrated a significant reduction in MEP amplitude compared to other groups ($p < 0.01$).

Group	Average MEP Amplitude (mV)
Mild paresis	9.3 ± 1.7
Moderate paresis	7.8 ± 1.5
Severe paresis	4.5 ± 1.2

Patients with mild paresis showed more stable electrophysiological indicators during surgery compared to the severe paresis group. This highlights the importance of intraoperative neuromonitoring for preventing the deterioration of motor functions.

Correlation analysis revealed a significant relationship between the severity of paresis and changes in both SEP and MEP. Patients with severe paresis exhibited more pronounced reductions in the amplitudes of these potentials, indicating significant neural structure impairment.

The study results demonstrated that intraoperative neuromonitoring is an essential tool for monitoring the functional state of the spinal cord in children with terminal filum lipoma. Patients with mild paresis exhibited more stable electrophysiological indicators during surgery compared to those with severe paresis. This emphasizes the need for careful monitoring and early detection of anomalies to prevent adverse outcomes, especially in patients with severe paresis.

Conclusions

The study confirms the effectiveness of intraoperative neuromonitoring for monitoring the functional state of the spinal cord in children with terminal thread lipoma. The analysis of electrophysiological data allowed us to identify the peculiarities of parameter changes depending on the severity of lower limb paresis. Children with severe paresis present a higher risk of complications, so careful monitoring and early detection of abnormalities during surgery are important.

Further studies should be aimed at deepening the analysis of the relationship between electrophysiological parameters and clinical outcomes after surgical treatment of terminal filum lipoma in children.

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创伤患者发生筋膜室综合征的风险评估

ASSESSMENT OF THE RISK OF COMPARTMENT SYNDROME IN PATIENTS WITH TRAUMA

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抽象的。 该研究的结果取自哈萨克斯坦共和国国家预算医疗机构“辛菲罗波尔第六医院”用锁定棒闭合复位后的 93 名胫骨骨干闭合性骨折患者的病历。 本文讨论了通过比较受影响肢体和对侧肢体的空气样本获得的数据。 结果表明，骨筋膜室综合征的发生时间与患者年龄存在直接的统计显着依赖性。 作者还开发了一种用于评估接受 MGIS 后肢体状况的系统，该系统可以避免术后出现筋膜室综合征等并发症。

结论。 根据获得的预后因素，我们开发了治疗局部高血压缺血综合征的措施和策略的算法，这使我们能够为小腿骨干骨折的患者选择个体化的治疗策略

关键词：诊断、水肿、缺血。

Abstract. *The results of the study were obtained from the medical records of 93 patients with closed fractures of the tibial diaphysis after closed reduction with a locking rod at the State Budgetary Healthcare Institution of the Republic of Kazakhstan "Basic Hospital No. 6, Simferopol". The article discusses the data obtained by comparing air samples from the affected and contralateral limbs. The results show that there is a direct statistically significant dependence of the*

timing of the development of compartment syndrome on the age of the patients. The authors also developed a system for assessing the condition of the limb after undergoing MGIS, which allows one to avoid complications such as compartment syndrome in the postoperative period.

Conclusion. *Based on the obtained prognostic factors, we have developed algorithms for measures and tactics for the treatment of local hypertensive ischemic syndrome, which allows us to select individual treatment tactics for a patient with a fracture of the diaphysis of the lower leg bones*

Keywords: *diagnosis, edema, ischemia.*

Introduction.

An analysis of literature data over the past decade has shown that the problem of timely diagnosis and treatment of local hypertensive ischemic syndrome currently remains unsolved.

Target. Determining the timing of the development of MGIS based on the etiological factor allows us to determine the prognostic significance of the "trauma etiology" parameter for predicting compartment syndrome.

Material and methods. The study included 93 patients with diaphyseal fractures of the tibia. In 7 cases (2.85%) the development of compartment syndrome was observed. In 2 patients, MGIS developed repeatedly in this segment, with an interval of 7 and 8 days.

The obtained trauma data showed the presence of statistically significant differences in the timing of development of MGIS ($p<0.001$). In case of lower leg injuries, the development time was up to 4.03±3.2 days ($F=49.9$; $p=0.0001$), which indicates a statistically significant dependence of the development time of MGIS on the etiology of the injury.

In the presence of MGIS on two segments of different limbs, as a rule, these were both lower limbs; for comparison in the "norm" variant, we took samples of the air surrounding both upper limbs. In case of pathology of one limb, control was carried out on the contralateral side of the same segment (tibia-tibia, etc.). The age group ranged from 20 to 80 years, with a mean age of 41.32 years.

The dependence of the timing of development of MGIS on age (correlation-regression model) is presented in Fig. 1.

The results obtained show that there is a direct statistically significant dependence of the timing of the development of compartment syndrome on the age of the patients. At the age of up to 50 years, there were no significant differences in the timing of development of compartment syndrome, but at older ages, a significant prolongation of the timing was noted ($p<0.01$), which is due to a change in the speed of the body's reaction to injury.

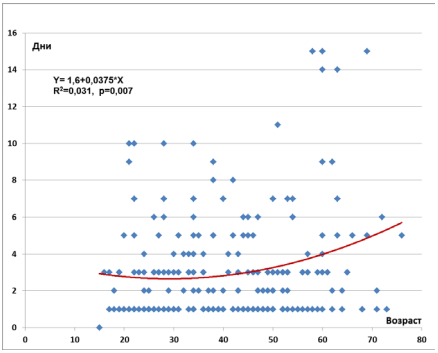

Figure 1. *Dependence of the timing of development of MGIS on age (correlation-regression model).*

The timing of the development of MGIS, depending on the age of the victim, is indicated in Table. 1.

Table 1

Timing of development of compartment syndrome depending on the age of patients

Age groups (years)	Deadlines (X±σ)	Estimate p (ANOVA)
Up to 30	2,8±2,5	F=7,2 p=0,0009
31-50	2,6±2,0	
Over 50	4,3±3,3	

These differences in age groups (F=7.2; p=0.0009) indicate the prognostic value of the "age" factor for the timing of development of MGIS.

We analyzed the timing of development of MGIS depending on the value of systolic blood pressure, Fig. 2.

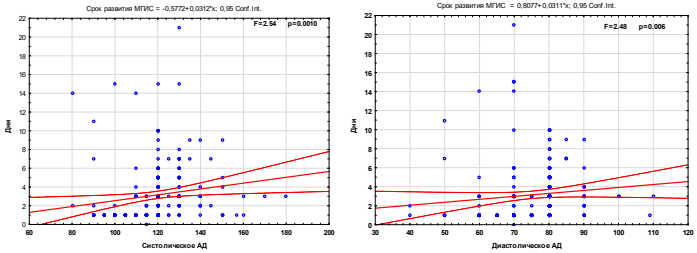

Figure 2. *Models of the dependence of the development of MGIS on the level of systolic and diastolic pressure*

With systolic pressure up to 120 mm Hg the period of formation is 2.0±1.8 days; as it increases, the period of onset of development of this syndrome increases (3.8±2.0 days ($p<0.001$)). The prognostic significance of this factor was ($p=0.001–0.006$).

We have also developed a system for assessing the condition of the limb after undergoing MGIS. This system includes three groups of patients: good (preservation of discrete sensitivity, preservation of full range of motion, absence of pain), satisfactory (hypostesthesia, but pain sensitivity is preserved, limitation of movements in the joints of the fingers no more than 10%, sporadic pain syndrome), unsatisfactory (anesthesia in the foot area, flexion contracture of the toes and equinus position of the foot).

The analysis of treatment of patients with tibia fractures allowed us to develop an algorithm of measures and treatment tactics (Fig. 3).

The use of the proposed treatment tactics in 25 patients allowed avoiding severe ischemic disorders in 96%. In 1 patient (4%) there were consequences of compartment syndrome - delayed fusion, scar-fibrous degeneration of muscles with partial impairment of their function, and neurological deficits. We consider the primary severity of the injury to be the cause of this case.

Conclusions.

Based on the obtained prognostic factors, we have developed algorithms for measures and tactics for the treatment of local hypertensive ischemic syndrome, which allows us to select individual treatment tactics for a patient with a fracture of the diaphysis of the shin bones, which allows us to avoid the development of characteristic complications.

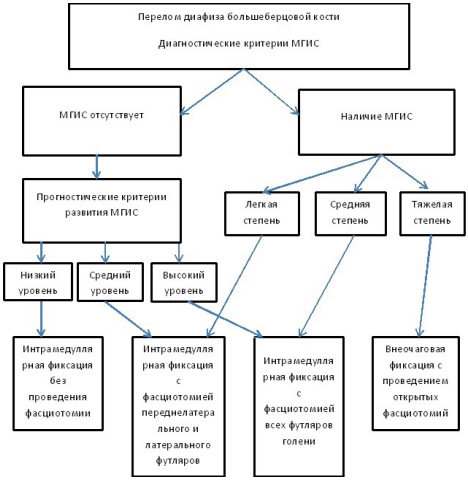

Figure 3. *Algorithm of measures and treatment tactics*

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2013-2014年期间阿拉伯叙利亚共和国消除化学武器的问题
THE PROBLEM OF THE ELIMINATION OF CHEMICAL WEAPONS IN THE SYRIAN ARAB REPUBLIC IN THE PERIOD 2013-2014

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抽象的。 叙利亚内战早已不再是纯粹的地区冲突，而是一场“代理人”战争。除了难民问题、人道主义灾难、被禁止的恐怖组织活动之外，还有一个问题不仅威胁着地区脆弱的平衡，而且威胁着整个世界的安全：禁止化学武器的使用。 本文讨论了2013年以来内战期间化学武器消除进程的特点。到2014年

关键词：叙利亚、化学武器、沙林毒气、禁化武组织、联合国、消除、化学武器。

Abstract. *The civil war in Syria has long ceased to be exclusively regional conflict, it turned into a "proxy" war. Besides refugee issue, humanitarian disaster, activities of prohibited terrorist organizations, there is a problem threatening not only the fragile balance in the region, but also the security of the whole world as a whole: the use of prohibited chemical weapons. This article discusses the features of the process elimination of chemical weapons during the civil war since 2013. By 2014*

Keywords: *Syria, chemical weapons, sarin, OPCW, UN, elimination, chemical weapons.*

The history of the creation and use of chemical weapons of mass destruction goes back a long way. On For many centuries, people have used poisonous sub-

stances for various goals: hunting, extermination of pests, reprisal against rivals. For the first time as a means mass destruction in its modern form, chemical weapons were used on the battlefields in the years First World War. Nowadays, the invention, use and storage of such substances are strictly controlled by international organizations (primarily the UN and OPCW), since there are international projects and agreements to regulate this process. However, the development and use of chemical weapons still occurs. The Syrian Arab Republic has been developing a chemical weapons program since the 1970s. The Syrian Arab Republic's chemical industry, both in civilian and military dimensions, was one of the most developed in the Middle East. Syrian chemical weapons capability held a clear strategic significance for Damascus in the context of its long-standing confrontation with Israel. Since 2011, without any serious justification, the United States has been making various threats against Syria at different levels, including the presidential level, regarding the possibility of crossing a so-called "red line" if Damascus used chemical weapons. The threats warned of potential military action against Syria by the United States. There was no credible evidence at that time of the Syrian government's use of chemical weapons. However, there was an increase in the use of chemical weapons by various anti-government forces, including terrorist groups, that were supported by the US government and its allies.

Mass production of sarin was established - nerve agent. However, the country has long been did not officially recognize the presence of chemical weapons [1]. It is worth considering the fact that Syria has acceded to the Convention on the Prohibition of the Development, Stockpiling and the use of chemical weapons and their destruction only on October 14, 2013 [2]. However, cases of chemical weapons use that began during civil wars on the territory of the country did not stop after the signing of the Convention. Allegations about the use of chemical weapons in Syria began to appear in 2012 the world community, led by the UN, could not ignore these events. The situation was complicated by the current internal political situation: the country's government and the opposition accused each other and extremists of terrorist groups in the use of chemical weapons. On March 19, 2013, in the village of Khan al-Asal (a suburb of Aleppo), 28 people were killed, including 17 Syrian army personnel, and more than 130 received various degrees of poisoning gravity.

While Oke Sellström's group was in the village of Eastern Ghouta (a suburb of Damascus), on August 21, 2013, opposition militants committed a large-scale provocation using sarin gas. The number of dead and injured has not yet been definitively established (according to American estimates - about 1,500 people, including more than 400 children). The Syrian government sent an official request to UN Secretary General Ban Ki-moon asking him to investigate the use of chemical weapons in Aleppo that occurred the previous day. From that moment

on, an official investigation by the Organization for the Prohibition of Chemical Weapons began [3].

After the incident, the parties to the conflict repeatedly declared their innocence, blaming their opponents for the incident. After this, the West began openly talking about possible intervention in the Syrian conflict. In turn, Russian President Vladimir Putin condemned the position of those who call for a military solution to the conflict in Syria.

Damascus immediately took the necessary steps to launch a mechanism to investigate cases of the use of chemical and biological weapons, however, due to the position of the United States, France and Great Britain, which delayed the consideration of this issue in the UN Security Council for several months, the arrival of UN experts led by Professor Åke Sellström (Sweden) to Syria took place only on August 14, 2013.

Even before the Syrian Arab Republic joined the OPCW Convention, in August 2013, a UN commission of experts headed by an independent Swedish scientist began working in the country [4, p. 182]. The purpose of this commission was to identify facts of the use of chemical weapons, provide reports to the UN and neutralize Syria's chemical weapons stockpiles. On October 11, 2013, the UN Security Council approved the UN-OPCW mission to eliminate chemical weapons in the Syrian Arab Republic, and by the end of October all Syrian warehouses and storage facilities for chemical weapons were sealed.

Commercial enterprises from partner countries took part in the elimination of exported toxic substances: the USA, Great Britain, Finland. However, the elimination of chemical weapons stockpiles and the cessation of their development by the official government of Bashar al-Assad did not eliminate the problem.

Despite the positive results achieved in the work of the OPCW-UN commission in cooperation with the government, which was confirmed in December 2014 by the OPCW conclusion, the threat of chemical attacks has not disappeared. The threat of the use of chemical weapons from the Syrian opposition and IS extremists remains. Cases of the use and use by IS suicide bombers of homemade shells with the addition of reagents were recorded in the province of Al-Hasakah [4; p.193].

In December 2014, official Damascus reported information about the seizure by opposition militants of facilities storing substances containing chlorine [4; p.193].

It is worth saying that the UN and OPCW were promptly familiarized with the materials reports on the involvement of the opposition and IS in chemical attacks, however, they did not receive official recognition [4; p.192], which only gave rise to political disagreements within the country and aggravated the situation of the population.

The destruction of Syrian chemical weapons began on July 7, 2014 on board the American specialized vessel Cape Ray and ended on August 18, 2014. The reaction masses formed during the hydrolysis of toxic chemicals were disposed of at industrial enterprises in Finland and Germany, and their precursors were disposed of in the UK and the USA, including such a sarin precursor as methylphosphonyl difluoride - DF.

The Russian Foreign Ministry notes that by disposing of some of the precursors on the Cape Ray ship, the Americans gained full access to the specific recipe and production technologies for "Syrian" sarin. Moreover, when Syria joined the CWC in 2013, Damascus provided the OPCW with detailed data on methods for producing sarin.

Summarizing all of the above, it should be noted that the OPCW-UN mission was a necessary tool to ensure regional and global security in the current situation. At the same time, the conclusions and results of the commission's work had a controversial impact on the global process of chemical disarmament and called into question the competence of the OPCW. Carrying out the elimination of the chemical weapons of the official government in the context of an active civil war was a complex but vital undertaking that guaranteed the safety of the population of Syria, surrounding states and the entire world during the period under review.

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通过闪点温度和粘度评估萃余油质量的虚拟分析仪

VIRTUAL ANALYZER FOR EVALUATING THE QUALITY OF OIL RAFFINATE BY FLASH TEMPERATURE AND VISCOSITY

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抽象的。 选择性萃取纯化在石油生产的工艺过程中发挥着重要作用，在此过程中，从原料中去除不需要的成分并获得萃余液。 该产品的质量指标为密闭坩埚闪蒸温度、运动粘度、折射率。 文章提出使用虚拟分析仪来实时控制这些指标。

关键词：石油、萃取物、萃余液、运动粘度、闪点、虚拟分析仪。

Abstract. *Selective purification by extraction plays an important role in the technological process of petroleum oils production, during which undesirable com- ponents are removed from the feedstock and raffinate is obtained. The quality indicators of this product are flash temperature in a closed crucible, kinematic viscosity, refractive index. The article proposes to use a virtual analyser to control these indicators in real time.*

Keywords: *Petroleum oil, extract, raffinate, kinematic viscosity, flash point, virtual analyzer.*

Introduction

Petroleum oils are a mixture of high molecular weight hydrocarbons with a boiling temperature of 300 - 650 °C. The main process of petroleum oil production is the vacuum distillation of fuel oil to produce oil distillates and tar (concentrate). All subsequent stages of oil production are reduced to the purification of these products from undesirable components that deteriorate the performance properties of oils, such as viscosity, pour and flash temperatures, and oxidation stabil-

ity. Undesirable products include, in particular, resinous asphaltene substances, polycyclic hydrocarbons with short side chains, high molecular weight paraffin hydrocarbons, sulphur-, oxygen- and nitrogen-containing compounds. Depending on the composition and properties of the feedstock, it contains up to 80 % of undesirable products to be removed, so it must be purified by different methods and with different depths.

The choice of optimal raw materials and operating costs for purification determine the main technical and economic indicators of oil production [1].

As a result of purification, base oils are obtained, which are the basis for preparation of most commercial lubricating oils. The latter are obtained, as a rule, by mixing distillate and residual components and adding various additives.

The petroleum base oil should provide the necessary operational properties and meet the quality requirements. Sometimes these requirements contradict each other, for example, to obtain high viscosity index and low pour point of the oil, which is technologically difficult.

For purification of oil distillates, the extraction process is used, which provides separation of the distillate into two parts without changing the chemical structure of hydrocarbons of the initial raw material. This process is based on the use of different solubility of hydrocarbons in solvents, in particular, in N-methylpyrrolidone, which has recently become widespread [2]. At the same time fractionation of oil raw materials is carried out not on the basis of boiling temperature limits, but on the basis of chemical hydrocarbon composition. Some chemical group components of the feedstock are well soluble in the solvent selected for this extraction process, and others, on the other hand, are poorly or not at all soluble. As a result of such purification, the most important operational properties of oils - stability against oxidation, viscosity-temperature characteristics and thermal stability - are significantly improved.

Oil vacuum distillates and deasphaltisate-hydrons deasphaltised with liquid propane are used as oil raw materials (Fig. 1). The target product is raffinate (contains naphthene-paraffin and low-viscosity polycyclic aromatic hydrocarbons), the by-product is extract (contains high-viscosity polycyclic aromatic hydrocarbons and resinous substances).

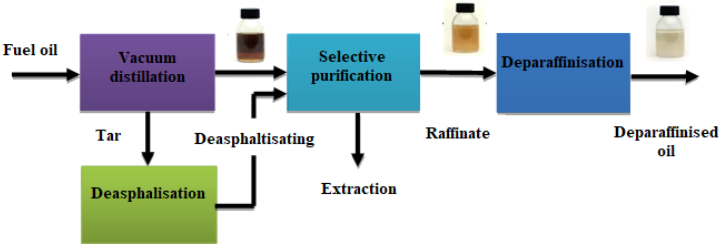

Figure 1. *Technological process for obtaining petroleum oils*

The extraction process can be controlled by several process parameters. As a rule, extraction temperature, solvent/raw material ratio (solvent ratio) and critical dissolution temperature (CDT), which is a function of these parameters. To increase the efficiency of selective purification it is necessary to optimize their values, i.e. to analyze their mutual influence on each other and on the target function of the purification process - quality and final product outlet. Quality indicators of commercial oil obtained from selective purification products are flash temperature in a closed crucible, kinematic viscosity at 100 °C, refractive indication at 50 °C.

In this article, the issues of oil raffinate quality control will be considered.

Comparative analysis of technological process control by readings of laboratory and in-line analyzers

When choosing methods and means of control of any quality indicators, first of all there is a question of choice between laboratory and in-line analyses. There are quite a lot of researches devoted to this question [3 – 5], and the majority of researchers are adherents of in-line analysis. Indeed, from the point of view of using the measurement results directly in the process control system operation, in-line analyzers win over laboratory analyzers in terms of analysis efficiency, possibility to correct the process in real time, higher reproducibility of readings. In fact, analyzers used in process control systems often require high reproducibility of measurement results rather than high absolute accuracy. Process control flow analyzers always provide advantages in measurement objectivity by reducing subjective errors and inaccuracies in laboratory measurements. They compensate for systematic errors and reduce random errors in measurements that are statistical in nature. The task of laboratory control in such situations will be to perform the necessary calibrations of in-line analyzers and to periodically confirm the measurement results.

Purpose of the study

When using in-line analyzers, the issue of their metrological reliability, or metrological failures - that is, situations when the analyzer works, but its readings are outside the specified inaccuracies - becomes acute. Such failures are very difficult

to detect [6], and their influence on the efficiency of process control is significant. In addition, the widespread use of in-line industrial analyzers is limited by their high cost and insufficient level of completeness and responsiveness.

As an alternative to in-line industrial analyzers, the use of virtual analyzers (VA), which are software-algorithmic complexes that evaluate the current properties of feedstock and target product using a mathematical model, has been proposed.

Controlled technological parameters are fed to VAs, which calculate product quality indicators according to the laid mathematical models. This makes it possible to control the technological process by product quality indicators with correction in case of changes in the parameters of the technological object [7].

The purpose of this study is to obtain a model of a virtual analyzer that determines the flash temperature and viscosity of raffinate.

Results and their discussion

To build the model of the VA, the temperatures of the top and bottom of the extraction column, the flow rate of raw materials and solvent, and the flow rate of raffinate were taken as technological parameters:

$$T_{fl.}=f(F_{raw}, F_{sol.}, T_{raw}, T_{sol.}, T_{top}, T_{bot.}, F_{raf.}),$$
$$\upsilon = f(F_{raw}, F_{sol.}, T_{raw}, T_{sol.}, T_{top}, T_{bot.}, F_{raf.}).$$

The output parameters of the virtual analyzer are flash temperature ($T_{fl.}$) and viscosity (υ), i.e. the vector of output parameters has the form . Input parameters (function arguments): raw material flow rate (F_{raw}), solvent flow rate ($F_{sol.}$), raw material temperature (T_{raw}), solvent temperature ($T_{sol.}$), column top (T_{top}) and bottom ($T_{bot.}$) temperatures, raffinate flow rate ($F_{raf.}$), i.e. the vector of input parameters is of the form

$$Y=\{ F_{raw}, F_{sol.}, T_{raw}, T_{sol.}, T_{top}, T_{bot.}, F_{raf.} \}.$$

The conceptual model of VA is illustrated in fig. 2.

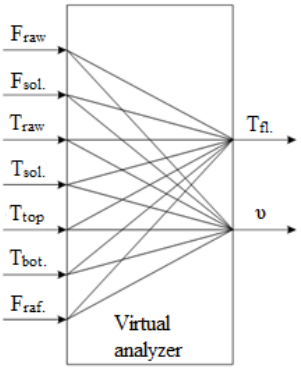

Figure 2. *Conceptual model of the virtual analyzer*

Laboratory data obtained from the extraction column of the selective oil purification unit with N-methylpyrrolidone were used in the process of the analyzer development.

Correlation coefficients between all parameters (input and output) were calculated to find out the static relation between the values. The result was formatted as a square matrix. If the correlation coefficient between input and output parameters is close or equal to zero, it means that this input parameter does not influence the output parameter and is not considered in the function of the virtual analyzer. If the coefficient is equal or close to one ($r_{ij} \in [0{,}9; 1]$), it is concluded that the parameters are highly correlated and the value of one of them is calculated through the value of the other. In such a case, one of the parameters is not used in the virtual analyser function to avoid redundancy (see fig. 2).

At the first step, an approximating expression in the form of a polynomial of degree 1 is compiled:

$$V^{calc.} = \Sigma K_i * Y_i,$$

where K_i - coefficients of the polynomial; $V^{calc.}$ - output parameters vector of calculated values; Y_i - input parameters vector.

Then the calculated values of VA output parameters will have the following form

$$\vartheta^{calc.} = K_{11} * F_{raw} + K_{21} * F_{sol.} + K_{31} * T_{raw} + K_{41} * T_{sol.} + K_{51} * T_{top} + + K_{61} * T_{bot.} + K_{71} * F_{raf}$$

$$T_{fl}^{calc.} = K_{12} * F_{raw} + K_{22} * F_{sol.} + K_{32} * T_{raw} + K_{42} * T_{sol.} + K_{52} * T_{top} + K_{62} * T_{bot.} + K_{72} * F_{raf}.$$

The next step is to calculate the coefficients of the virtual analyser function. The approximation of tabular data was carried out in the Approx programme.

After substituting the obtained coefficients into the above expressions, the following approximating expressions are obtained:

– for viscosity:

$$\vartheta = 0{,}002565 * F_{raw} + 0{,}060755 * F_{sol.} + 0{,}091986 * T_{raw} + 0{,}120597 *,$$
$$T_{raw} - 0{,}026158 * T_{top} + 0{,}002315 * T_{bot.} - 0{,}121984 * F_{raf}$$

– for flash temperature:

$$T_{fl.} = 03{,}055209 * F_{raw} + 0{,}217154 * F_{sol.} + 0{,}014863 * T_{raw} + 0{,}959100 * .$$
$$T_{sol.} - 0{,}075486 * T_{top} + 0{,}190067 * T_{bot.} - 0{,}266680 * F_{raf}$$

The mean relative inaccuracy for viscosity was 2.69 % and for flash temperature 1.23 %.

Conclusion

Based on the results of approximation, we can conclude that the inaccuracy for each of the quality indicators does not exceed 5 %, that is, the accuracy of

approximation makes it possible to use this model for operational assessment of product quality indicators.

The obtained relations allow to speed up the process of obtaining control actions, to increase the quality of products, as in this case, laboratory analysis of raffinate quality is not required.

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设计用于膳食补充剂摄入控制的移动应用程序的架构
DESIGNING THE ARCHITECTURE OF A MOBILE APPLICATION FOR DIETARY SUPPLEMENT INTAKE CONTROL

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Scientific supervisor **- Pavlova Elena Alexandrovna**
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注解。 本文考虑了一种用于控制生物活性添加剂（以下简称膳食补充剂）摄入量的移动应用程序的架构设计。 该移动应用程序解决的主要任务是提高用户服用膳食补充剂的有效性，以及遵守可持续发展和ESG原则。 在开发过程中，我们研究了竞争对手的解决方案，并确定了需要改进以提高用户舒适度的领域。 通过遵循个性化等现代趋势，信息产品生态系统的使用使得定性地开发正在开发的产品成为可能。 通过使用定量和定性的方法，可以创建直观易懂的界面和移动应用市场上最流行的功能。 一项重要任务是在用户中形成环境和社会责任，并唤醒自觉消费，从而带来普遍福祉。

关键词：移动应用、移动应用架构、膳食补充剂、设计、ESG。

Annotation. *The paper considers the design of the architecture of a mobile application for controlling the intake of biologically active additives (hereinafter referred to as dietary supplements). The main tasks solved by this mobile application are to increase the effectiveness of taking dietary supplements by users, as well as compliance with the principles of sustainable development and ESG. During the development, competitors' solutions were studied and areas that need to be improved for user comfort were identified. By following modern trends such as personalization, the use of information product ecosystems makes it possible to qualitatively work out a product under development. Through the use of quantitative and qualitative methods, it is possible to create an intuitively understandable interface and the most popular functions in the mobile application market. An important task was to form an environmental and social responsibility among users, as well as to awaken conscious consumption, which can lead to universal well-being.*

Keywords: *Mobile application, mobile application architecture, dietary supplements, design, ESG.*

At the moment, there is a trend towards awareness and responsibility towards life. This is because people strive to follow a healthy lifestyle and preserve the environment from excessive pollution. Modern food products do not allow to fully saturate the human body with the necessary amount of vitamins and minerals. Eventually, the additional use of food additives to food increases. The relevance of the study lies in providing the user with a tool through which he can more effectively monitor the course of dietary supplements. In conditions of limited time, people need to keep a lot of information in their heads. Some of the information may be forgotten. Therefore, modern people need a portable assistant, thanks to which they will be able to monitor their health status and the progress of taking dietary supplements [1-4].

The reasons for the development of a mobile application for taking dietary supplements are due to:

– The desire to preserve and improve the health of the body;
– Digitalization of the healthcare sector in the Russian Federation;
– Not meeting the needs of users with existing mobile applications and alternative solutions on the market;
– The rapid development of social responsibility in a deteriorating environmental situation.

Having studied the needs of users and conducted an in-depth interview, the necessary functions for a mobile application in the field of healthcare were identified. The main requirements are ease of use, intuitive understanding of the interface, absence of errors, confidentiality of user information. Table 1 shows the features of mobile applications with similar functionality.

Table 1

Analysis of mobile applications on the market

App	MyTherapy	Medisafe	Pill Reminder by Medisafe	Health from Apple	PillPack
Main functions	Reminders, health tracking, symptom diary, support for different types of medications	Reminders, inventory management, information base, interaction with doctors	Similar to Medisafe with additional purchase reminders	Integration with iOS, health tracking, interaction with Apple Watch	Pharmacy service, dose packaging, automatic delivery, integration with prescriptions
Advantages	Intuitive, wide range of tracking, family access	Visual reminders, extensive information support	Similar to Medisafe with additional features	Deep integration with Apple, lots of health features	Convenience, delivery automation, clear organization

Disadvantages	Limited features without subscription, may not be as functional for complex reception schemes	The difficulty of setting up for complex treatment regimens	The difficulty of setting up for complex treatment regimens	Available only for iOS, limited personalization	Limited availability, requires subscription
Availability	International	International	International	Only for iOS	Available in certain countries (USA)
Price	is Free, there is a paid subscription for advanced features	For free, there are in-app purchases	For free, there are in-app purchases	Is free	Varies depending on the subscription plan
Interface	Simple and clean	Interactive and vivid	Interactive and vivid	Apple's high standard of design	Simple and functional
Support	Responsive customer support	Good support	Good support	Apple Support	Customer and pharmacist support
User Reviews	Mostly positive	Mostly positive, some complaints about the difficulty	Mostly positive, some complaints about the difficulty	Mostly positive, some comments on the limitations of the functions	Mostly positive, some problems with logistics

At the moment, mobile app stores have a large number of offers in the field of health in various categories: tracking health indicators, telemedicine, healthy lifestyle and sports. Having studied the mobile application market, it is possible to identify free niches for the implementation of a project that is in demand by users.

A significant number of mobile applications with similar functionality have:

- Complex design;
- Poor reliability;
- A complex notification system;
- Reduced functionality is provided to users in order to motivate the user to purchase a paid subscription;
- Not all competitors have the ability to install on different smartphone operating systems, but are exclusive, thereby reducing their target audience who want this functionality;
- Some of the applications are not available for use by users located in Russia;
- Lack of integration with other medical services.

One of the main tasks in designing the architecture of a mobile application is the formation of an intuitive design, namely interfaces and icons. Architecture and design are necessary so that the target audience does not have problems using the application (Figure 1) [7].

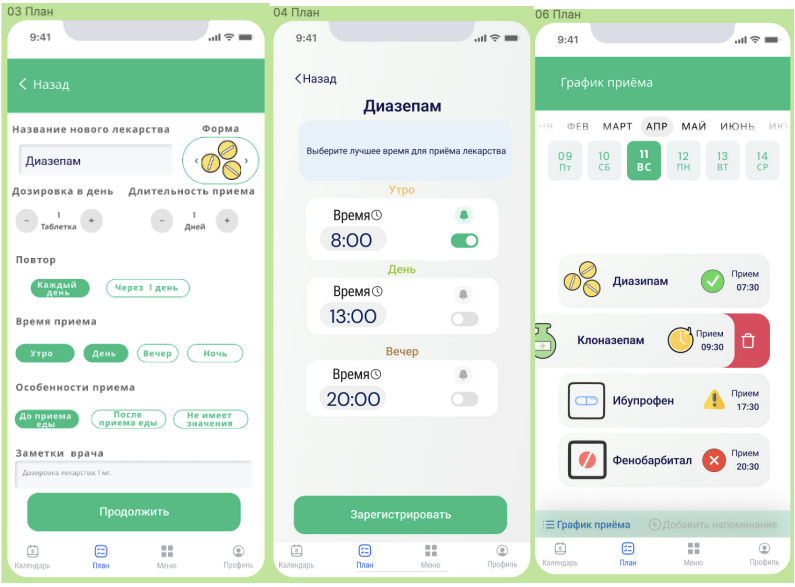

Figure 1. *Design of the designed application architecture*

The motivation for using the mobile application is due to the competent interaction of the user with all functions, including medical personnel. And also through the provision of training materials on the competent application of dietary supplements, environmental principles, conscious consumption, responsible use and conservation of natural resources. Compliance with the principles is realized by ensuring compliance with the ESG principles. However, before launching a mobile application, it is necessary to test the system for the convenience and operability of the designed architecture (Figure 2) [5,6].

Технология. Принцип действия

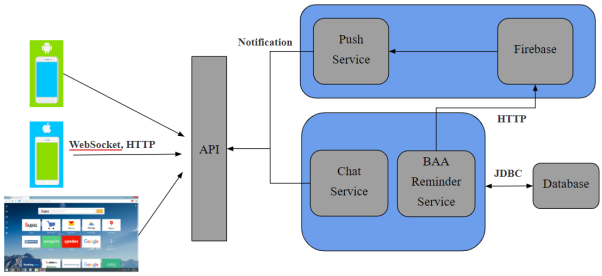

Figure 2. *Designed application architecture*

A list of technologies used for mobile application development (programming languages, frameworks, libraries).

The following technologies will be used in the Frontend (client-server maintenance) development technology:

– Development on Flutter/Dart;
– Version control system: Git;
– Sending data: WebSockets and HTTP;
– Development environment: Android Studio;
– Storing data on the device: NoSQL;
– State management: Block.

The following technologies will be used for the development of Backend (client-server maintenance):

– Programming language: Java;
– Development environment: Intellij IDEA;
– Database: PostgreSQL;
– Build automation: Gradle;
– Frameworks: Spring Boot, Spring Data, Spring Web;
– Backend and frontend interaction: REST.

Thus, based on the conducted research, it can be concluded that the developed application meets current trends and needs in the field of health and personal well-being. By following current trends and the needs of society, the mobile application being developed will be an assistant for maintaining health, increasing sustainability, as well as observing the principles of ESG. By solving the issue of conscious consumption and sustainable development of society, it allows us to form new values of society aimed at awareness.

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使用 PLA 聚丙交酯工具对铜 M2 制成的薄壁板坯进行成型

SHAPING OF THIN-WALLED SHEET BLANKS MADE OF COPPER M2 WITH A PLA POLYLACTIDE TOOL

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注解。 展示了使用通过 3D 打印获得的聚丙交酯工具从 M2 级铜片形成毛坯的数据，并显示了所发现的材料屈服应力与变形的关系。 给出了使用 QForm 程序对过程进行建模的结果以及全面的实验，确认了建模结果与实际过程之间的准确一致性。

关键词：铜片、模具加工、计算机建模、聚丙交酯、微观结构、成型。

Annotation. *Data on the formation of blanks from sheet copper of grade M2 using a polylactide tool obtained by 3D printing are presented, and the found dependences of the yield stresses of the material on deformation are shown. The results of modeling the process with the QForm program and a full-scale experiment are presented, confirming an accurate agreement between the modeling results and the real process.*

Keywords: *sheet copper, die tooling, computer modeling, polylactide, microstructure, shaping.*

Introduction

A variety of stamping types, the use of dies of different designs and the use of appropriate materials for their manufacture ensure cost-effective production in both large and small-scale production.[1].However, their implementation is accompanied significant costs for the manufacture of die equipment, which is especially noticeable in the context of a constant increase in production volumes [2]. To solve this problem, many enterprises, since the 70s of the last century, have attempted to use polyurethane stamping equipment as working parts [3-5]. However, due to low durability and the need for increased allowances, this material has not found widespread use.

There is information in the literature about the use of tools made by 3D printing, mainly for stamping decorative parts. For example, there is information about the manufacture of a “Snail” type product using a forming tool made of PLA plastic [6]. A number of attempts have been made to implement bending operations

with polymer tools on work pieces made of martensitic-aging steel DP600 [7] and profiling thin-walled aluminum sheets [8], for pulse stamping of work pieces from aluminum sheets with a thickness of 0.5 [9]. The 3D printing method has found relatively wide application, which can be used to manufacture tools from polylactide for bending pipes with a diameter of up to 28 mm from steel 12X18H10T [10]. Published data relate mainly to experimental data and there is practically no data on the durability of polymer tools.

Purpose This work was to determine the possibility of using stamping tools made of polymer material for mass production.

To achieve this goal, it was necessary to select the deformable material under study, determine the dependence of its deformation resistance on thermomechanical parameters, simulate the process in order to determine the resulting contact stresses, and evaluate the properties of the resulting work pieces at the microstructure level using the metallographic method.

Methodology

Copper M2 was chosen as the material under study. Considering that, the yield stress of commercially pure copper M2 depends on both the magnitude of the deformation and its rate. In open sources [11], hardening curves for M2 copper were found, shown in Figure 1.

The microhardness of the sample material was determined using EMCO TEST DuraScan 20 device with an indenter load of 50 g.

To simulate the bending process, the QForm 10.3.0 software package was used [12]; initial data for modeling:

- processed material – M2 copper using the deformation resistance model shown in Figure 1;
- tool material – polymer material PLA;
- work piece temperature – 20 °C;
- instrument temperature – 20 °C;
- friction factor – 0.8;
- tool movement speed - 2 mm/s;

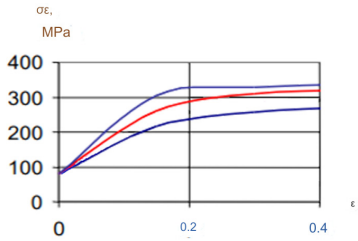


Figure 1. *Strengthening curves for copper M1 at room temperature temperature and strain rates, s-1 (from bottom to top): 0.005; 15; 50 [11]*

A three-dimensional model of a die block (section) manufactured by 3D printing is shown in Figure 2.

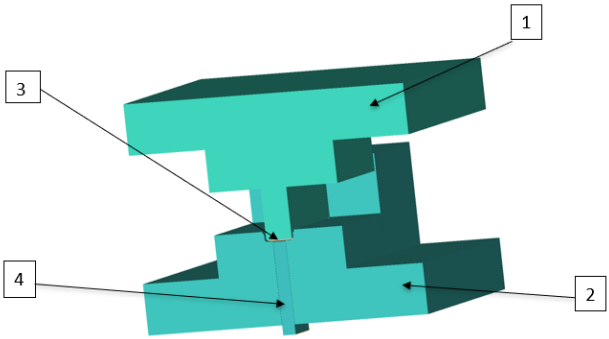


Figure 2. *Three-dimensional model of the die block*
1 - punch, 2 - die, 3 - blank, 4 - ejector

The material chosen for the stamping tool was PLA from ESUN, which was manufactured by 3D printing using FFF (Fused Filament Fabrication) extrusion technology on a Raise 3D Pro2 Plus printer. To achieve maximum tool life, a fill factor of 100% with a straight fill shape was selected.

The initial blanks for stamping were obtained by cutting in a die from a sheet 1 mm thick. Metallographic studies of stamped blanks were carried out using an Olympus Delta and FEI QUANTA 650 binocular optical microscope with a magnification of x500.

Metallographic studies of the evolution of the structure of the work piece material, M2 copper, were also carried out using an optical microscope. To conduct the study, cylindrical samples measuring 10 mm in diameter and 10 mm in height were made. The samples were subjected to compression using a universal testing machine model LFM250 (cold deformation) and model LFM50 (warm deformation, taking into account that the thermal effect of plastic deformation is observed during stamping). Test temperature: 20, 50, 100°WITH; strain rate at each temperature – 0.4; 0.01; 0.001 s-1. Compression of M2 copper samples was carried out without lubrication and the relative strain was 50%; during warm deformation, the compression tool was heated to the test temperature, i.e. up to 50 and 100°WITH.

Experiments and discussion

A study of the microstructure of copper billets deposited by 50% (Table 1) showed that the change in temperature in the range of 20 - 100 ° C and the strain rate in the range of 0.4; 0.01 and 0.001 s-1 have little effect on its change, and the grain size remains within the range of 50 - 500 microns.

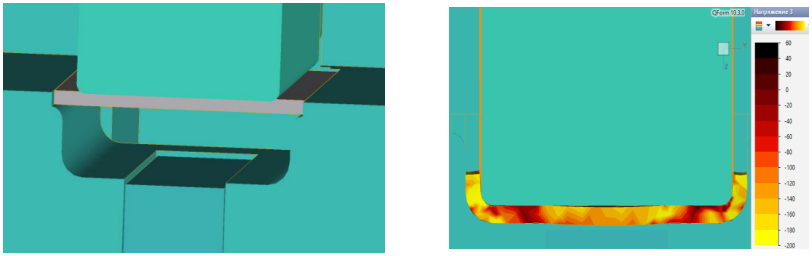
Table 1

Microstructure of M2 copper samples deformed by 50%

Sample microstructure, magnification x500	**Sample temperature, °C**	**Strain rate, $\dot{\varepsilon}$**
	20	0.001
	50	0.001
	100	0.001

The microhardness in the center of the samples deformed at temperatures of 20, 50 and 100 °C remained practically unchanged and was in the range HV0.05 = 122 - 128. It should be noted that the strain rate at a temperature of 100 °C has a slight influence on the microhardness, decreasing from 122 to 113 units with an increase in speed to 0.4, which can be explained by some heating of the material.

Modeling using the M2 copper model shown in Figure 3 allowed us to determine that the stress in the direction of tool movement (Z axis) ranges from 40 to 150 MPa. Considering that the yield stresses during compression of PLA samples reach 100 - 150 MPa [13], we can expect reliable operation of the plastic tool. Since the heating temperature of the workpieces does not exceed 40 °C, the dependence of stress on the magnitude of deformation was determined for three temperatures - 20, 50 and 100 °C. The accumulated deformation in the calculation does not exceed 0.40, which corresponds to the relative deformation of the cylindrical samples on which the evolution of the microstructure was studied (see Table 1).



A *B*

Figure 3. *Simulation of the stamping process*

A– position of the workpiece before stamping, b – the magnitude of contact stresses in the direction of tool movement, MPa.

Experimental work on bending work pieces made of M2 copper was carried out using PLA stamping equipment installed on a hydraulic drawing press (Figure 4). The geometric parameters of stamped blanks were controlled using a universal measuring tool. The measurement accuracy was ±0.1 mm. The blanks after stamping are shown in Figure 5.

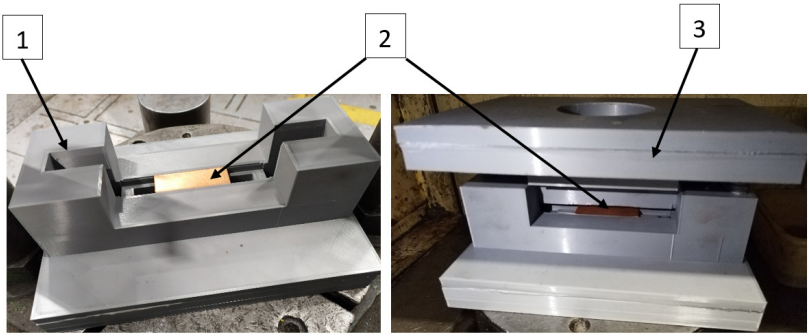


Figure 4. *PLA die tooling on a hydraulic drawing press*
1 -matrix, 2 - blank, 3 - punch

Figure 5. *Blanks after deformation*

The quality of the produced parts met the requirements of the drawing, and the geometric dimensions of the parts were within the tolerance established by the drawing. Despite the calculated high stresses arising during the forming process, no noticeable wear of the tool was noticed, which was confirmed by the stable geometric parameters of the manufactured parts. The amount of springback of the workpieces during stamping was close to the calculated value obtained by modeling.

Discussion

The geometric parameters of stamped work pieces are subject to high demands on geometric accuracy and surface roughness. The performed studies made it possible to establish that despite the high contact stresses that arise during the deformation of work pieces, a bending tool made of PLA polylactide ensures the production of work pieces with the required geometric parameters, which allows us to recommend it for wider use in sheet metal stamping production.

Conclusions

1. Analysis of the stress-strain process, performed using the QForm 10.3.0 software package, made it possible to determine that the stress in the direction of tool movement (Z axis) ranges from 40 to 150 MPa. Considering that the yield stress of the PLA polymer material is 100 - 150 MPa, reliable operation of the polymer tool can be expected.
2. A study of the microstructure showed that the change in temperature was in the range of 20 - 100 ° C and the strain rate was in the range of 0.4; 0.01 and 0.001 s-1 have little effect on its change; The grain size remains in the range of 100 - 400 μm, which makes it possible not to take into account the evolution of the copper microstructure during its deformation when modeling the bending process.
3. The microhardness in the center of the samples deformed at temperatures of 20, 50 and 100 °C remained practically unchanged and ranged from 122 to 128 HV0.05. It should be noted that the microhardness is slightly affected by the strain rate at a temperature of 100 °C, which decreases from 112 to 123 units with an increase in the rate to 0.4 s-1, which can be explained by slight heating of the material.
4. The performed studies made it possible to establish that despite the expected high contact stresses during bending that arise during the deformation of workpieces, a bending tool made of PLA polymer material provides satisfactory durability, which makes it possible to recommend it for wider use in sheet metal stamping production. For example, small- and medium-scale production of flexible products from sheet metal M2 copper with a thickness of 1 mm.

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小型飞艇总体设计的主要问题
MAIN ISSUES IN THE GENERAL DESIGN OF SMALL AIRSHIPS

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抽象的。 本文讨论了小型飞艇总体设计中的主要问题，并对设计过程中的关键因素进行了分析。 该项目旨在提供飞艇设计的全面视图，涵盖空气动力学设计等关键方面； 电力系统； 建筑材料； 能源供应；导航和自主； 安全和应急措施； 价格。 研究确定，小型飞艇的设计需要改进性能特征，包括飞行稳定性、电力系统效率、轻量化设计和可持续电力供应。 通过分析这些复杂性，本文为未来小型飞艇的设计提供了有用的背景信息。

关键词：小型飞艇、气动设计、动力系统、结构材料、供电、导航、安全、经济可行性。

Abstract. *This article discusses the main issues in the general design of small airships and also analyzes the key factors in the design process. The project aims to provide a comprehensive view of airship design, covering key aspects such as aerodynamic design; power systems; construction materials; energy supply; navigation and autonomy; security and emergency measures; price. The study determined that the design of small airships requires improved performance characteristics covering flight stability, power system efficiency, lightweight design, and sustainable power supply. By analyzing these complexities, this paper provides useful background information for future small airship design.*

Keywords: *small airships, aerodynamic design, power systems, structural materials, power supply, navigation, safety, economic feasibility.*

Introduction

Airships, as a type of balloon, have a number of unique advantages: the ability to hover in the air, energy savings, long-term endurance, wide range and high payload.

Due to their unique hovering capabilities, airships are widely used in monitoring, patrol, and search and rescue operations.

The evolution of airships was significantly influenced by fields such as aeronautical engineering, materials science and aerodynamics. Early airships relied on buoyancy achieved by filling the airbag with hydrogen or helium. However, due to the flammability of hydrogen, later airship designs gradually switched to using helium and were additionally equipped with propulsion devices such as engines and propellers to provide forward propulsion.

The design of the airship is a complex system, the main structure of which includes the hull, the power plant, the tail and the nacelle. The hull is the core of the airship's structure, and is usually made of lightweight materials to ensure the aircraft has sufficient strength and durability.

The body of the airship is filled with hydrogen or helium, which provides buoyancy and allows the airship to stay in the air; The power plant is the airship's propulsion engine, consisting of an engine and a propeller.

The engine provides the necessary power, and the propeller is responsible for creating thrust, allowing the airship to move forward. Another key part of the airship is the tail, which provides stability and maneuverability during flight. The design of the tail affects the position and direction of the airship under various flight conditions.

The gondola is part of the airship's payload, and serves to transport people, equipment and cargo.

Aerodynamic design and stability

The stability of an airship's flight depends to a decisive extent on its aerodynamic design.

In the aerodynamic design of an airship, consideration of dynamic changes in airflow during different phases of flight is critical to ensure safe and smooth flight under varying environmental conditions. The key elements of aerodynamic design are the shape and tail of the airship, which should be given the highest priority.

Excellent appearance reduces drag during flight and improves aerodynamic efficiency. The design of the tail affects the maneuverability and lift of the airship. It must provide sufficient lift while maintaining controllability.

Experiments carried out in a wind tunnel and numerical modeling make it possible to simulate the flight of an airship under various air flow conditions. This helps optimize the aerodynamic design of the airship, ensuring its stability in a variety of flight conditions.

Some small airship designs also include automatic adjustment systems that can automatically adjust the flight attitude according to airflow conditions in real time. This system receives real-time airflow information through sensors and adjusts the position of the control surface to ensure smooth flight of the airship.

Advanced flight control algorithms play a key role in aerodynamic design. These algorithms make it possible to adjust the flight control surface in real time, respond to external disturbances and maintain the specified flight path of the airship.

The aerodynamic design of a small airship must adapt to different flight scenarios such as low altitude, high altitude and changes in wind speed. This guarantees the stability of the airship in a variety of conditions.

Powertrain and performance

Some airships use electrical systems as their main power source, powered by batteries. This option is lightweight, reduces dependence on external energy sources and offers the benefit of zero emissions. Hyundai's continuously improving advanced battery technology can improve energy density and charging efficiency. However, compared to fossil fuel power systems, there are disadvantages in terms of durability and quick response.

Hybrid systems can combine multiple power sources, such as electric motors and gas engines, to meet the need for high efficiency and range. Hybrid systems provide greater flexibility in terms of payload and flight duration.

The use of solar energy during flight allows the airship's batteries to be recharged through solar cells, increasing the duration of the flight

It uses highly efficient electric motors with optimized design to improve power output and energy conversion efficiency. This makes it possible to cover significant distances with limited energy reserves.

Construction materials and lightweighting

Carbon fiber composite material, due to its high strength and low weight, is used for the manufacture of structural elements of small airships. Its use can significantly reduce the overall weight of the structure. Modern metal alloys such as aluminum and titanium are also used to provide lightness while maintaining structural strength. These alloys are widely used in the aerospace industry and provide high corrosion resistance and strength.

Various technologies are used to improve the design of the airship. The use of 3D printing technology ensures the production of parts with complex shapes; reduction of connection points and welds; increasing overall strength; more precise lightening of the structure.

Studying the structure of nature and applying bionic design principles will help optimize the structure of the airship, improve wind resistance and overall stability.

In turn, dividing the airship's modular design into independent modules helps reduce maintenance costs and improve overall reliability. And the modular design

is designed to be easily assembled and disassembled to facilitate maintenance and replacement of airship parts and reduce maintenance time.

Navigation and autonomy

The Global Positioning Satellite System is used in navigation to accurately determine the position of the airship. GPS technology provides the basic data needed to navigate airships on a global scale.

In the presence of strong electromagnetic interference, older mechanical positioning systems, gyroscopes and accelerometers remain indispensable.

In applications that require high precision, such as scientific research and geological surveys, it is necessary to apply differential GPS technology to improve navigation accuracy by correcting the signal through the base station.

If satellite signals are lost, reliable navigation can be provided by an inertial navigation system, which is equipped with high-precision gyroscopes and accelerometers. Such systems are used in difficult environments, such as when studying urban canyons and dense forests.

Visual navigation technology uses high-definition cameras and various sensors to detect landmarks, obstacles and important features during flight.

Safety and emergency procedures

To prevent and protect against collisions, the airship is equipped with various obstacle avoidance sensors, such as laser radar and ultrasonic sensors. These sensors provide real-time environmental monitoring and feedback to help the airship detect obstacles and reduce the risk of collision.

In the event of an imminent collision, the design of the airship must include materials and structures that absorb shock. This will help slow the impact of the impact and ensure maximum safety for the airship and its payload.

To ensure continued normal flight, the flight control system uses a redundant design. If a component fails, redundant systems such as redundant sensors, actuators, and computing units can take over control.

Cost and commercial feasibility

To reduce production costs, it is important to select cost-effective materials that meet performance requirements. Reducing material waste and optimizing structural design also improves production efficiency. Advanced manufacturing technologies such as 3D printing and automated lines reduce labor costs and improve accuracy, further reducing costs and increasing production efficiency.

To operate airships economically, choose cost-effective energy sources that meet specific missions and flight requirements, such as solar power, batteries, or fuel cells. Consider serviceability when designing your airship, using a modular design that reduces maintenance and repair costs. Easily replaceable parts and modules reduce maintenance time and costs.

Conclusion

This article aims to provide a comprehensive study of aspects of airship design and technological innovation, covering elements such as construction materials, navigation systems, power supply, and safety.

Through in-depth research and detailed developments, the authors provide comprehensive information on the design, performance and commercial use of airships.

The results of these studies not only provide a deep understanding of the design and application of small airships, but also lay the foundation for future developments and innovations in the field. We expect these results to play a positive role in the field of aerial unmanned systems and contribute to the continuous improvement of small airship technologies.

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通过监测工作环境气体含量来检测碳氢化合物泄漏点
DETECTION OF HYDROCARBON LEAKAGE POINTS BY MEANS OF MONITORING OF THE WORKING ENVIRONMENT GAS CONTENT

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抽象的。 本文考虑了石油和天然气工业设施中现有的大气自动监测类型，分析了俄罗斯联邦石化、炼油工业和石油产品供应设施的事故统计数据。 提出了提高石油天然气工业设施运行安全水平的方法。

关键词：大气空气监测、气体分析仪、污染控制、石油和天然气工业。

Abstract*. The article considers the existing types of automated monitoring of atmospheric air at the facilities of oil and gas industry, analyzes the statistics of accidents at the facilities of petrochemical, oil refining industries and oil product supply facilities in the Russian Federation. The method for improving the level of safety in the operation of oil and gas industry facilities is proposed.*

Keywords*: Atmospheric air monitoring, gas analyzers, pollution control, oil and gas industry.*

Introduction

The oil refining industry faces a number of serious problems related to controlling the level of gas contamination at production facilities. The presence of hazardous gases such as hydrogen sulfide, methane and flammable organic compounds creates constant risks of fires, explosions and poisoning among personnel [1]. Timely detection and monitoring of concentrations of these substances becomes critical to ensure safety and environmental protection at refineries.

Traditional methods of gas monitoring, such as manual measurements and periodic inspections, suffer from insufficient responsiveness and high dependence on human error. These limitations increase the likelihood of accidents that can lead to catastrophic consequences for production, workers and the environment. This is

why the need for automated gassing control systems that can provide continuous monitoring, timely notification and effective risk management is at the forefront.

For effective continuous control of gas contamination at oil and gas production facilities, the correct choice of methods and means of control of the corresponding monitoring systems is of great importance. There are two main approaches that are widely used in practice - the use of stationary and mobile gas monitoring systems. Stationary gas analyzers are used for continuous monitoring, while portable and mobile gas analyzers are required for periodic monitoring.

Stationary systems provide continuous monitoring of the air environment and online data transmission [1]. This allows to respond promptly to changes in concentrations of hazardous gases and comply with legal requirements.

In turn, mobile systems of gas control are characterized by high adaptability and the possibility of rapid deployment. They provide autonomous operation for up to 30 days, making them ideal for temporary works or areas with unstable conditions.

Each of the described approaches to installing gas control systems has its own advantages and disadvantages that must be considered when selecting the best solution for a particular refinery.

The advantages of stationary systems include high accuracy and reliability of measurements, the possibility of long-term continuous operation, and integration with other production systems. However, they are characterized by higher initial equipment and installation costs and relatively low mobility.

Mobile inspection systems are characterized by lower capital costs, ease of installation and the ability to move quickly. At the same time, they require more frequent maintenance and limited autonomous operation time [1]. It is also necessary to take into account that in mobile systems control can be performed in a less automated format, which imposes an additional burden on personnel.

Thus, mobile systems do not provide timely identification of sources of possible danger at hazardous production facilities. In this paper, we are more interested in continuous monitoring of concentrations of harmful substances in the air of industrial areas.

According to the annual data of the Federal Service for Environmental, Technological and Nuclear Supervision, we systematized and analyzed the data of accident statistics at petrochemical, oil refining and petroleum product supply facilities in the Russian Federation, presented in Figure 1, for the period 2019-2023 [2].

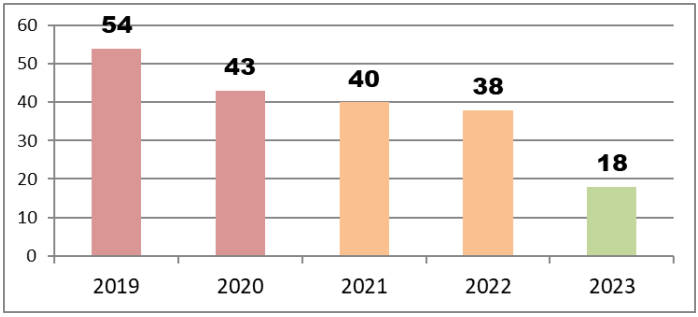

Figure 1. *Accident rate dynamics in the oil and gas industry at OPOs in 2019 – 2023*

Thus, in 2020, 50% of cases are related to depressurization and destruction of technical devices, 35% of cases are due to the lack of proper control of gassiness in the industrial zone where the explosive fire mixture accumulates, and 15% of cases are due to such factors as: personnel errors, violations of organization and poor quality control of work, lack of industrial safety expertise of technical devices at the end of their service life and others.

Only in the last 2-3 years, after the active implementation of air monitoring systems, the number of accidents and incidents at hazardous production facilities has a positive trend [3]. So for 2023, 18 accidents were registered, which is 47% less compared to 2022. Including in 2023, the negative impact on the atmosphere from oil and gas enterprises was significantly reduced due to strict 24-hour control.

Purpose of the study

In the operation of oil and gas facilities, there is a problem of timely detection of hydrocarbon leakage location [4]. Hydrocarbon leaks can occur for various reasons, such as accidents, equipment wear and tear, violation of operating rules, etc. Reducing the time to identify the source of danger of airborne gassiness allows us to promptly take measures to eliminate the source of emission, ensure environmental safety, prevent emergencies and save human life and health.

To solve this problem, we propose a method of increasing the level of safety in the operation of oil and gas facilities by increasing the reliability of localization of hydrocarbon leakage, which involves the construction of a mathematical model of hydrocarbon distribution in the air, taking into account the influence of atmospheric factors. The mathematical model should describe the process of hydrocarbons diffusion in the air taking into account various transport mechanisms. This will make it possible to determine the concentration of pollutants in different points of the airspace and assess the influence of atmospheric factors on this process.

The algorithm for automated monitoring is performed in several stages. The first stage is receiving a signal from the gas analyzer that the concentration of a harmful substance in the air has been exceeded, then the location of the triggered gas analyzer and its physical and chemical properties are compared with meteorological indicators such as wind direction and strength.

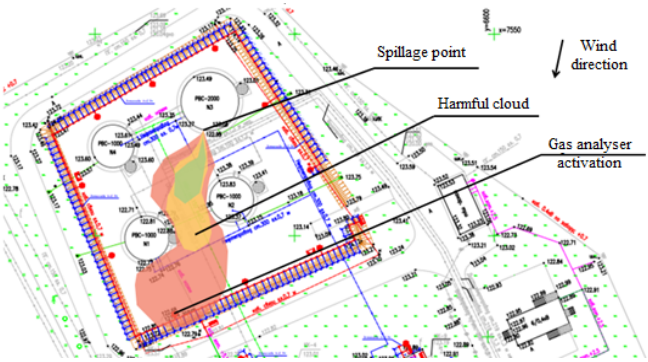

Figure 2. *Scheme of the tank farm on the territory of Buzovyazovskoye oil field*

Conclusion

As a result, we get the estimated location of hydrocarbon leakage, which serves as a prompt for operators to support and make decisions on timely elimination of the problem. Figure 2, which shows the scheme of the tank farm in the territory of Buzovyazovskoye oil field, illustrates the realization of this algorithm in practice.

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提高加油站运营效率的模拟可能性
SIMULATION POSSIBILITIES TO INCREASE THE EFFICIENCY OF PETROL STATION OPERATION

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抽象的。 本文讨论了加油站运营过程的仿真建模。 为了模拟加油站的运行，使用了 AnyLogic 模拟环境中的工具。 构建的仿真模型使我们能够评估系统应对加油站申请流程的能力。

关键词：AnyLogic、仿真、排队系统、随机过程、请求流、代理、实验。

Abstract. *The article discusses simulation modeling of the gas station operation process. To simulate the operation of a gas station, tools from the AnyLogic simulation environment are used. The constructed simulation model allows us to evaluate the system's ability to cope with the flow of applications at gas stations.*

Keywords: *AnyLogic, simulation, queuing systems, random process, flow of requests, agent, experiments.*

Introduction

The development of models using a simulation approach is associated with the need to study complex systems encountered in practice.

When constructing analytical models for complex systems, researchers have to make serious simplifications. At the same time, the complexity and unforeseen behavior of the system may well lead to the fact that the simulation results will differ significantly from the actual behavior of the system, both quantitatively and qualitatively. In such situations, it is recommended to use models that simulate the behavior of a real object (1). Simulation modeling, in addition to assessing the influence of the parameters of a complex system, makes it possible to monitor the behavior of individual components of this system over a certain period of time. When carrying out simulation modeling, the sequence of events in the complex

system being designed is of primary importance. A simulation model is used to predict the functioning features of a complex system, the difficulties associated with adding new elements to the system, and changing its parameters (2).

Currently, it is generally accepted that simulation modeling includes four main areas: modeling of dynamic systems; discrete event modeling; system dynamics; agent-based modeling (2-6). For each of these four areas, their own tools are being developed.

Agent-based modeling of complex systems can be useful when agents can change their behavior over time; when it is important in the model to reflect the interaction of agents with each other, changing their behavior. Simulation software allows you to successfully integrate system dynamics with agent-based modeling. One of the effective programs for combined modeling is the Anylogic system of the Russian company XJ Technologies, which successfully integrates agent-based modeling into system-dynamic and discrete-event modeling.

In many queuing systems (QS), the input receives many sequential requests requiring service. For example, legal entities or individuals come to the bank who want to carry out transactions with money, patients come to the clinic, cars arrive at the gas station that need to be refueled. In queuing systems, situations arise in which it is necessary to remain in a state of anticipation. Simulation models of QS are discrete-event. The QS operating process is usually a random process with discrete states and continuous time. There are many programs that allow you to create QS models of varying complexity. Problems associated with queuing systems are effectively solved by the AnyLogic simulation system.

In this article, the AnyLogic simulation environment tools are used to simulate the operation of a gas station (gas station). The constructed simulation model allows us to evaluate the system's ability to cope with the flow of applications at gas stations.

Description of the model and its technical implementation

To create a gas station model, you will need several types of process modeling library blocks:

- Source – for creating agents, the starting point of the agent flow;
- Sink – for destroying agents, the end point of the agent flow;
- Delay – delays agents for a certain specified period of time;
- SelectOutput5 – directs incoming agents to one of five output ports depending on the fulfillment of specified conditions;
- MoveTo – moves the agent to a new location;
- Queue – models a queue of agents waiting to be received in the next blocks.

The implementation of standard Enterprise Library objects is available to users; their functionality can also be expanded, even creating their own libraries. To

create agent streams, the Source block is used. By attaching a Delay block, time is simulated. The SelectOutput5 block is used to model the choice of four types of fuel: AI-92, AI-95, AI-98 and DT. The agent's choice of one of the fuel types is given by the following probabilities: 0.3, 0.4, 0.2, 0.1. The movement of agents to the gas pump is carried out using the MoveTo block, which must be connected to all four output ports of the previous block. In front of each gas pump, we will form a queue of cars using the Queue block. This block has several types of outputs, we use two of them: out and outTimeout. The agent will leave the block through the out port if it waits its turn before the delay time expires, and through the out-Timeout port otherwise. The resulting process diagram of the gas station model is presented below.

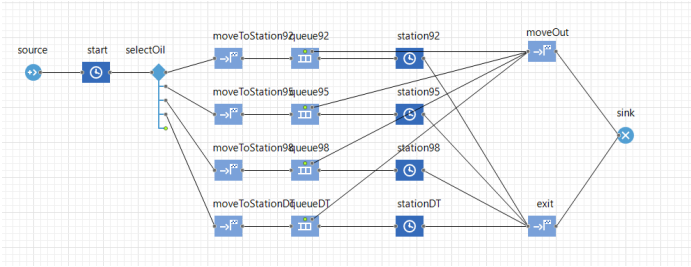

Figure 1. *Final process diagram*

Model visualization

To visualize the constructed model, the basic elements of space marking are used: a path and a point node.

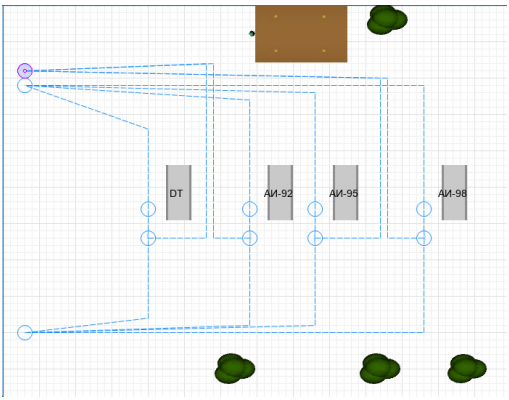

Figure 2. *General visualization diagram of the constructed model*

Let's create four nodes, attaching them to the moveToStation92 and other blocks. These nodes will mark the place where agents wait for their turn in front of the gas pump area. The result of the model visualization process is presented in the figure.

AnyLogic provides many tools for collecting and visualizing statistics, including charts, graphs, histograms and others. In this work, we calculate the average length of the queue of cars in front of a gas pump, as well as the average service time at a pump with a certain type of fuel. During the model launch, statistics for all four gas dispensers are calculated and visualized.

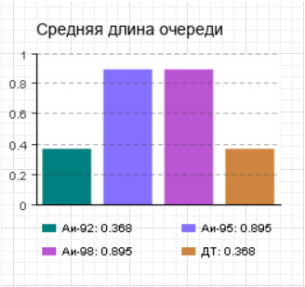

Figure 3. *Average queue length in a certain period of time*

The Delay block contains the statsUtilization variable, which returns statistics on the use of this block and is calculated as size/capacity. During the model launch, statistics for all four gas dispensers are calculated and visualized.

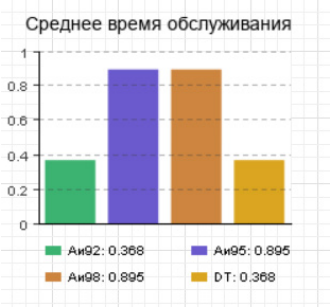

Figure 4. *Average service time over a period of time*

Of interest is the change in the number of gas stations at a pump with a certain type of fuel. Larger numbers potentially reduce queue lengths for motorists. The capacity parameter for station92 and other blocks is controlled using the Slider element.

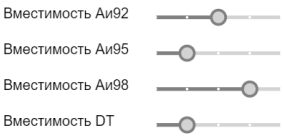

Figure 5. *Dispenser capacity control*

Demonstration of the model's operation

After launching the program and a certain amount of time, you can notice that the average queue length is greatest at a gas station with AI-95 fuel, which is consistent with the probabilities of fuel choice indicated during the construction of the model (this type of fuel is chosen by motorists most often).

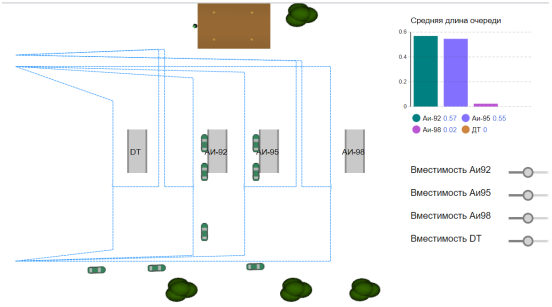

Figure 6. *Example of the model*

As the capacity of the AI-95 filling dispenser increases, the queue length naturally decreases.

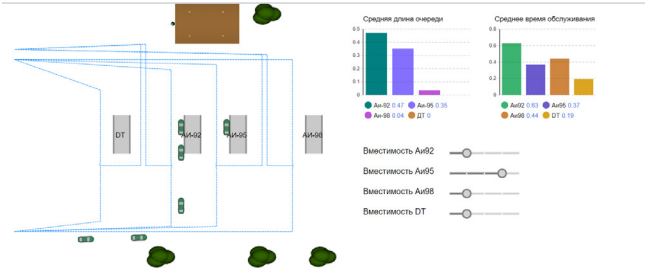

Figure 7. *Example of model operation when increasing the capacity of the Au-95 column*

With a discrete-event approach to modeling, it is possible to analyze the statistics of a given model over time and with various properties. The model allows you to observe activity and statistics by introducing different data values and parameters during experiments. At the same time, it becomes noticeable how the behavior of the participants in the processes changes, that is, the adaptation of the simulation model occurs.

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沉积条件对乌斯秋尔特地区砂质侏罗系含油、含气沉积物分布的影响
INFLUENCE OF SEDIMENTATION CONDITIONS ON THE DISTRIBUTION OF SANDY JURASSIC OIL AND GAS BEARING SEDIMENTS IN THE USTYURT REGION

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注解。 乌斯秋尔特地区的天然气饱和层位仅限于侏罗纪时期的陆源沉积，由于沉积的特殊性，其特征是复杂的相结构。 在寻找和勘探凝析气矿床时，改变圈闭的深度和横向配置和类型存在一定的困难。 在这方面，有必要整合识别油气藏砂体分布区域的方法，包括属性分析，作为陆源沉积物岩性变化和地层可能含气饱和度的指标之一[1]。 以确定进一步的找矿工作。

关键词：侏罗纪、沉积、砂岩、粘土、前景、油气潜力、结构、井。

Annotation. *Gas-saturated horizons in the Ustyurt region are confined to terrigenous deposits of Jurassic age, which are characterized by a complex facies structure due to the peculiarities of sedimentation. When searching and exploring gas-condensate gas deposits, there are certain difficulties associated with changing the configurations and types of traps in depth and laterally. In this regard, the integration of methods for identifying zones of distribution of sand bodies, which are qualified as hydrocarbon reservoirs, including attribute analysis, as one of the indicators lithological changes in terrigenous sediments and possible gas saturation of formations [1], is necessary to determine further prospecting work.*

Keywords: *Jurassic, sedimentation, sandstone, clay, prospects, oil and gas potential, structure, well.*

Gas condensate fields of the Ustyurt region were discovered in terrigenous deposits of Jurassic age. In structure, they are multi-layered, in which deposits of

various types are found: structural, lithological, tectonic, etc. Prospecting and exploration work is complicated not only by the variety of forms of host sediments, but also by changes in reservoir properties and material composition of sediments both vertically and laterally .

To analyse changes in the forms of terrigenous sediments accumulation in different periods, the territory of the eastern part of the North Ustyurt depression in the area of junction with the East Aral depression was selected, where signs of oil-bearing were obtained, which dictates the need to continue geological exploration at a qualitative level. In addition, the marginal part will most expressively reflect different types of forms of terrigenous accumulations of Jurassic age, because in pre-Jurassic time it represented a sharply dissected relief formed by Palaeozoic formations [2].

In Early Jurassic times, the territory represented a denudation-accumulative plain, where the central parts of the troughs were gradually filled with the formation of sandy- silty - argillic rocks. Next, sediments of the continental proluvial-alluvial and lacustrine-marsh complex accumulate, where sediments of temporary streams, river beds, floodplains, eluvial -deluvial and colluvial slope deposits are widely developed . At the same time, differentiation is observed: a natural increase in coarse clastic accumulations near the uplifts, and in the central parts of the depressions, finer-grained sandy sediments accumulate with interlayering silty-argillic rocks.

A comprehensive analysis of core and seismic data showed the development of a vast zone of proluvial and deluvial deposits covering the ancient eastern side of the North Ustyurt depression (Fig. 1).

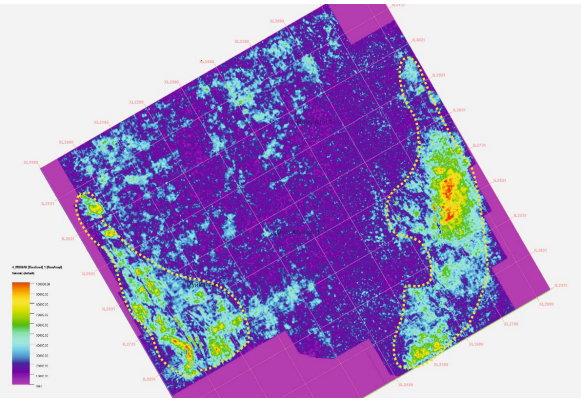

Figure 1. *Map of the amplitudes RMS attribute along the horizon, confined to the depth of Lower Jurassic deposits minus 2930 m (yellow dotted line shows areas of accumulation of sand deposits of colluvial and proluvial origin).*

Here we can note the zones of accumulation of the largest sandy material, where amplitude anomalies are identified, indicating that they accumulated near the sources of demolition. In this case, the RMS attribute was used, which can be used to identify isolated sand bodies by high amplitude values, which correspond to sand-enriched facies, while clay deposits are characterized by low amplitude values [3-6].

In Middle Jurassic time, a further expansion of the sedimentation area occurred due to the subsidence of the adjacent land, which can be traced by the reduced thickness of Middle Jurassic deposits in these territories. At the same time, the expansion of the Middle Jurassic basin occurred gradually, and the territory was a zone of accumulation of terrigenous sediments in the conditions of river valleys, interfluve spaces and lakes, where a characteristic feature of the rocks is the enrichment of dispersed organic matter. The identification of sand bodies in plan is characterized by the presence of a river network in the form of small channels and small isometric sections, formed by possibly partially continuing proluvial fans or coastal shoals (Fig. 2).

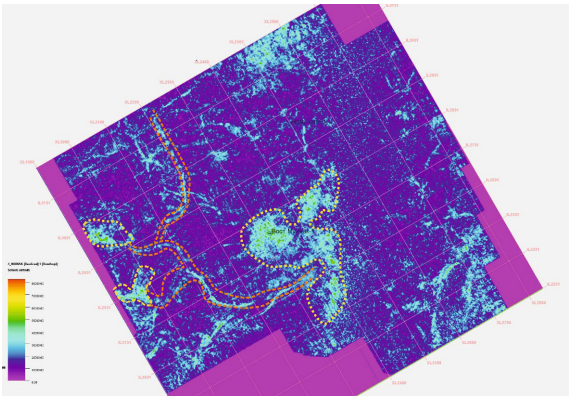

Figure 2. *Map of the amplitudes RMS attribute along the horizon confined to the depth of Middle Jurassic sediments minus 2204 m (yellow dotted lines show areas of accumulation of sandy sediments of alluvial fans, brown - paleochannels).*

In Late Jurassic time, a wide network of alluvial branched river valley was formed, where terrigenous sediments of a specific configuration accumulated in the form of extended winding paleochannels, bends, meanders [7], which are composed of sorted sandy sediments, interspersed with clayey-silty rocks (Fig. 3). Further in the Tithonian age, a transgression of the sea occurs, which led to the accumulation of carbonate rocks crowning the Jurassic section of Ustyurt.

Thus, a review of the change in facies settings for three large Jurassic divisions showed that the history of sedimentation significantly influences the formation of sand bodies as the main reservoirs of gas and condensate.

It can be noted that when preparing structures for drilling and choosing the location for the first exploration wells, it is necessary to focus, in addition to the structural factor, on the facies situation for each target horizon. In the case of non-conformal development of the territory, each well must be oriented towards a certain type of trap, otherwise drilling may not hit a sandy object that is a reservoir of hydrocarbons.

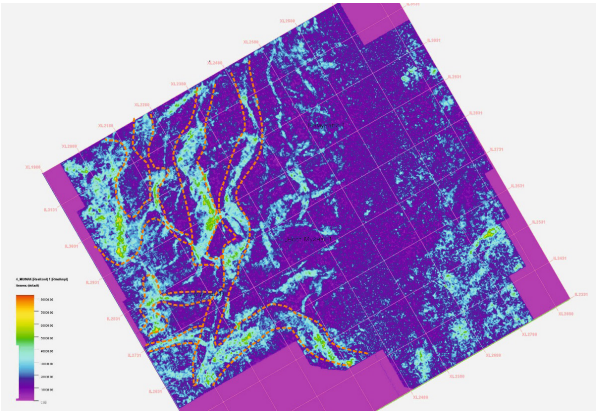

Figure 3. *Map of the amplitudes RMS attribute along the horizon, confined to the depth of the Upper Jurassic deposits minus 1820 m (the brown dotted line shows paleochannels).*

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