



SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

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这些会议文集结合了会议的材料 – 研究论文和科学工作者的论文报告。它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。

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通过在生产过程中引入数字技术，将创新作为俄罗斯公司竞争战略的基础
**INNOVATION AS THE BASIS OF THE COMPETITIVE STRATEGY
OF RUSSIAN COMPANIES THROUGH THE INTRODUCTION OF
DIGITAL TECHNOLOGIES IN THE PRODUCTION PROCES**

Kostyaeva Valeria Nikolaevna

Master's student

Kharlanov Alexey Sergeevich

*Doctor of Economic Sciences, Candidate of Technical Sciences, Full
Professor*

Diplomatic Academy of the Ministry of Foreign Affairs

抽象的。在现代条件下，业务单元竞争战略的基础是创新。本文考察了俄罗斯经济各个领域数字技术的存在，并从创新发展的角度分析了俄罗斯经济数字化的趋势和前景。此外，值得注意的是，如今向数字经济转型是俄罗斯发展的主要优先事项之一，因为数字化水平以新技术方式显示了该国的竞争力。

关键词：经济数字化，专利活动，生产机器人化，数字化活动，技术改造

Abstract. *In modern conditions, the basis of competitive strategies of business units is innovation. The article examines the presence of digital technologies in various sectors of the Russian economy, and the author competently analyzes the trends and prospects of digitalization of the Russian economy from the perspective of innovative development. In addition, it is important to note that today the transition to a digital economy is one of the main priorities of Russia's development, since the level of digitalization shows the country's competitiveness in a new technological way.*

Keywords: *digitalization of the economy, patent activity, robotization of production, digital activity, technological transformation*

Competitive advantages from the standpoint of strategic management in search of profit maximization provide the enterprise with a certain superiority over its competitors as a result of the implementation of a unique strategy in the market. Today it is modern technologies, patents, exclusivity, high speed and minimum order processing time, as well as the ability to produce products at the lowest price. The most common areas for achieving competitive advantages are cost leadership, product differentiation, and early market entry.

At the same time, such business characteristics as innovation or globalization can also be the basis of a business strategy [6]. The relevance of introducing innovations into modern production by Russian companies through the transition to digital technologies is primarily due to their desire to increase productivity and reduce costs.

More than a third of Russian companies invested more than 100 million rubles in digitalization in 2019. 51% of Russian companies expect that the funds invested in digitalization will pay off in less than 2 years, another 43% of companies expect a return on their investments within 2-5 years. 36% of Russian companies decide to finance digitalization projects through individual consideration and decision-making at the top management level, another 25% of companies consider such projects together with IT projects [7].

The total amount of spending on innovation activities in 2019 amounted to 1.95 trillion rubles. Over half of these expenditures are for industrial production - 984.3 billion rubles (+6% compared to the previous year in constant prices). The service sector demonstrates a comparable scale of investment in innovation - 909.5 billion rubles.

In the program "Digital Economy" and "Strategy for the Development of the Information Society until 2030", the digital economy is defined as improving the efficiency of the modern economy, mainly due to data processing technologies and automation of all processes [2].

Digitalization entails fundamental transformations in all spheres of human life and activity. Thus, the intensive growth of information volumes determines the demand for artificial intelligence technologies and high-speed processing of big data, which in turn contributes to the growth of labor productivity, customization and improvement of the quality of products and services.

Digital technologies act as drivers for the formation and development of new markets, and also acquire important social roles, making a significant contribution to solving global problems such as population aging, disease control, social stratification, and environmental degradation [1].

More than a hundred of the largest Russian companies from key sectors of the Russian economy, including the financial, telecommunications, metallurgy, oil and gas and transport industries, as well as retail, took part in the KPMG study "Use of digital technologies in the Russian market depending on the industry".

As part of the study, top management of companies, leaders responsible for digital transformation, as well as heads of functional units within companies where they are pilot testing or already using certain digital technologies were interviewed. The percentage of use of the analyzed technologies differs depending on the industry (table 1).

Table 1.*The use of digital technologies in the Russian market depending on the industry*

	In general	Retail	Telecom	Fin. institutions	Metal-lurgy	IT	Oil and gas	Transport
Big Data	68%	55%	100%	84%	67%	100%	50%	14%
Chatbots	51%	50%	75%	60%	33%	40%	50%	29%
Robotization	50%	40%	100%	56%	83%	20%	50%	14%
OCR	36%	20%	25%	56%	67%	1%	50%	14%
AI	28%	5%	75%	40%	17%	80%	25%	1%
Iot	24%	15%	100%	12%	50%	20%	25%	29%
VR/AR	21%	20%	25%	16%	33%	40%	25%	14%
Blockchain	19%	20%	25%	32%	1%	20%	1%	1%

It follows from Table 1 that only 16% of Russian companies have introduced a new position - CDO (Chief Digital Officer) or a similar position of the head of digitalization programs, in another 44% of companies, similar functionality is distributed among previously existing top managers.

34% of companies have well-established digital competence centers. Regardless of the presence of a dedicated center of competencies, companies tend to hire specialized specialists on a full-time basis, flexible forms of employment are not common.

Large Russian companies have already embarked on the path of digital transformation. However, according to KPMG analysts, most of these companies do not yet have a comprehensive digitalization program - they are implementing packages of pilot projects to implement separate and often disparate digital solutions.

For example, the Coffeeshop Company in Moscow has installed electronic tablets on every coffee shop table, allowing customers to quickly place an order and save time by not waiting for a waiter with a traditional menu. This technological innovation, which will definitely be recognized and appreciated by visitors, can be considered a competitive strategy for the company.

The Ministry of Industry and Trade and the Ministry of Digital Development have created the "Import Substitution Exchange" digital service for interaction between companies and customers in Russia due to the increased demand for domestic industrial products. The new service will allow for the purchase of import-substituting goods of domestic production.

Robotization, chatbots, big data analysis and machine learning are the most popular technologies, already used by more than 50% of the companies participating in the study.

The share of Russia in the global number of patent applications for inventions in certain areas of digital technologies does not exceed 1% [9]. Russian applicants are most active in patenting new production technologies, somewhat less in artificial intelligence technologies (fig. 1).



Figure 1. Patent activity in Russia, 2010-2017

For quantum technologies, wireless communications, robotics and sensors, Russia has single patent applications. 3075194 patent applications were filed in the world in 2010 - 2017. The key applicants in the world are global digital corporations (Apple, Google, IBM), electronics manufacturers (LG, Samsung, Canon), telecom companies (Huawei, Guangdong ZTE).

The leaders in Russia in terms of the number of patent applications in the field of digital technologies are Kaspersky Lab, Yandex, ABBYY. The top ten applicants (with a large lag) include NPO "Iskra", RSC "Energiya" named after S.P. Korolev, Voronezh State Technical University, etc.

The structure of demand in the sectors of the Russian economy is different (fig. 2). Telecommunications and transport show the greatest demand for new digital technologies in order to develop and diversify activities.

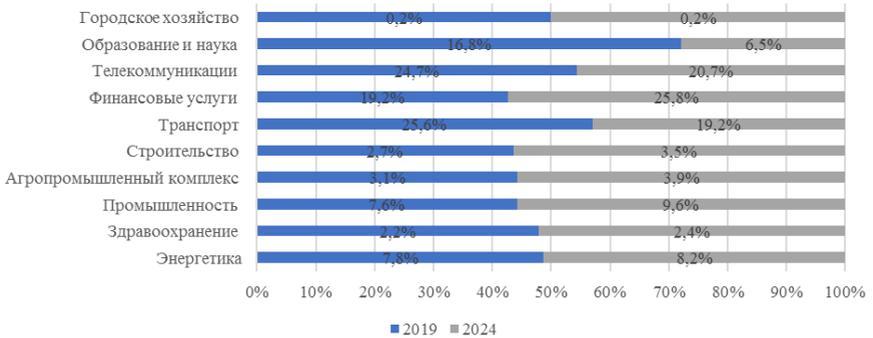


Figure 2. The structure of the demand of sectors of the Russian economy for digital technologies in the future until 2024

As can be seen (see fig. 2), the greatest demand in the sectors of the economy and the social sphere is expected by wireless communication technologies, distributed registry systems, neurotechnologies and artificial intelligence [9].

In addition, digital telecommunications are becoming more and more in demand in the field of finance (Big Data, Artificial intelligence, cloud technologies, biometrics, machine learning and others).

In 2018–2019, the share of enterprises implementing digital technologies increased by 1.8 times (fig. 3).



Figure 3. Application of digital technologies in digital industry enterprises, (in % of the total number of enterprises)

As can be seen from Figure 3, robotization has become the most demanded technology in Russian digital industry enterprises.

The market for robotics and smart sensors (sensor technologies) is one of the largest among the markets for advanced manufacturing technologies in the world. On the global and, above all, the Russian market, not robots are in demand, but, first of all, robotic systems. At the end of 2020, according to the International Federation of Robotics (IFR), the number of industrial robots installed in 2018 was 422 271 units, and the market volume reached 16.5 billion dollars (excluding components and systems engineering). Sales of industrial robots in 2019 decreased in quantitative terms by 12% compared to 2018, from 422 to 373 thousand units. At the same time, the total number of robots in operation amounted to 2.7 million units [10].

In the Russian Federation, 1007 industrial robots were installed in 2018 (in 2017 - 713 robots). According to the National Association of Robotics Market Participants (NARMP), shipments increased by 43% compared to 2017. At the same time, the robotization density indicator is quite low - 5 robots per 10 thousand employees of enterprises in Russia, which is 20 times less than the average indicator in the world, and only 5% of the installed robots were produced in the country [5].

However, according to the assessment of the National Association of Robotics Market Participants, today the density of robotization in Russia is 70 times lower than the world average.

The development and production of robots in Russia is complicated by long periods of research and development and testing, the lack of an element base (servomotors, gearboxes, linear motion systems, controllers, etc., which are imported), the need for an appropriate infrastructure for integrating the robot into the production cycle (quickly customizable software, templates, machine vision, etc.), short planning horizons and high cost of robotics projects with low manual labor costs resulting in long payback periods. However, the main reason is significant deindustrialization, reduction and destruction of manufacturing industries. The production of machinery and equipment in 2019 amounted to only 64.3%, while the volume of manufacturing industry output as a whole is only 99.4% compared to 1992; the situation is especially serious in the machine tool industry - if in 1990 in Russia, according to Rosstat, 74.2 thousand metal-cutting machine tools were produced, including 16.7 thousand with CNC, then in 2011 - 3.2 and 0.2 thousand, respectively, and in 2019, only 4719 metal-cutting machines were produced [8].

The main trends in the development of industrial robots are the introduction of machine vision, artificial intelligence, the creation of collaborative robots that can work together with a person, increasing the ease of use, deployment and maintenance. Robots are becoming more versatile, flexible, and precise. When developing them, open source code and digital control technologies are used. The most robotized industries in Russia are the automotive industry (for example, at the "KAMAZ" plant, robotization began back in 1980), chemical and petrochemical

industries. An example of a Russian enterprise using industrial robots is the Tikhvin Carriage Works, where robots are used to perform welding, painting, cleaning bodies before painting cars - more than 80 industrial robots are installed at the plant.

According to respondents, in 2019 the importance of digital technologies for the development of production has increased. More than 25% of managers noted an increase in the demand for digital technologies in production. More than 60% of managers considered the current level of digital activity to be "normal", i.e. acceptable for the conditions during the survey period.

In 2019, a third of the enterprises participating in the survey were involved in digital transformation to one degree or another, increasing the volume of digital services, striving for "data-centricity", while in 2018 their share barely reached 20%.

Most businesses saw an increase in digital activity in 2019, with the percentage of CEOs reporting a "normal" level of investment in technology rising from 32% in 2018 to 50%; investment level "below normal" was noted by 36% of respondents against 58% a year earlier.

It should be noted that for full-scale digitalization, Russian companies lack the maturity of current business processes and competent specialists. The biggest threats posed by digitalization, according to Russian companies, lie in the field of information security. Despite worries about unemployment risks, 46% of CEOs in Russia and 64% globally believe that within five years, digital technologies will be able to create more new jobs than reduce existing ones.

The development of digital technologies is a necessary condition for economic growth and improving the welfare of society, taking into account by global TNC the speed of capital turnover and areas of its potential deadness in various sectors of national economies in the era of corroratocracy[4].

Digital technologies are in demand today in almost all sectors of the economy and social sphere, contributing to the transfer of business processes to the digital environment [3]. The share of companies implementing digital transformation projects and the volume of investments in their implementation are noticeably growing, the number of specialists is increasing, their digital competencies are expanding, and the transformational goal-setting itself is becoming more and more "green". The "Green Agenda" is no longer only an element of stable goodwill and a sign of good taste, but also directly affects the cost of attracted resources to achieve ethical standards for the production of a carbon-free society of the future. All this creates positive business expectations related to the effects of using digital solutions. The number of such green ideas in business has already exceeded half of all startup projects, orienting society on the purity of the planned evolution of views on the protection of nature and the planet, bringing the philosophy of further civilizational transition to the level of risk minimization in search of a compromise for the coexistence of the "Earth-man" system [11].

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经济实现欧洲共同体目标的军事方面：过去、现在、未来

MILITARY ASPECTS OF ECONOMIC ACHIEVEMENT OF THE GOALS OF EUROPEAN COMMUNITY: PAST, PRESENT, FUTURE

Boboshko Andrey Alexandrovich

Candidate of Economic Sciences, Associate Professor

Saint Petersburg State University of Architecture and Civil Engineering

Modenov Anatoly Konstantinovich

Candidate of Economic Sciences, Associate Professor

Saint Petersburg State University of Architecture and Civil Engineering

Kharlanov Alexey Sergeevitch

Doctor of Economic Sciences, Candidate of Technical Sciences, Full Professor

The Diplomatic Academy of the Russian Foreign Ministry

抽象的。在文章中，作者描述了制裁对俄罗斯实施制裁后对欧洲和美国经济的影响，马歇尔计划的命运，以及试图对抗和制裁为竞争优势而战的方法。美国作为北约的主要受益者，从欧盟国家抽出资金。

关键词：北约、美国、欧洲、制裁、俄罗斯。

Abstract. *In the article, the authors describe the impact of sanctions on the economies of Europe and the United States after they applied them against Russia, about the fate of the Marshall Plan and about attempts to confront and sanctions methods of fighting for competitive advantages that allow the United States, as the main beneficiary of NATO, to pump out financial resources from the EU countries.*

Keywords: *NATO, USA, Europe, sanctions, Russia.*

Looking back at the existing historical aspects of the US-UK war, one encounters a set of economic challenges rather than social or geopolitical ones, which are more declared and realizable today. Thus, from the middle of the XVII century, Great Britain methodically established complete control over the economic operations of the American colonies, a scheme developed when industry imported goods to the colonies from the mother country in exchange for raw materials and agricultural goods. At the same time, neither entrepreneurs nor the government benefited from the development of the colonial industry, as well as trade with anyone other than the mother country, which formed the basis of the US war for

independence from England, for the most part, namely economic, not social reasons. In the current economic situation of Great Britain, the USA, the European Union, a war is beneficial in order to give impetus to the development of the military-industrial complex of these countries, increase the military budget and cut off countries where the economy is supported by industry and goods. In this version, the issue under consideration about the war and sanctions today is of interest for how long and where the sanctions came from and who wins in the conduct of hostilities, as well as what interest countries have in pumping Ukraine with weapons. At present and over the past 8 years, sanctions and restrictions, retortions and reprisals against Russia are being introduced because of Ukraine, continuing the policy of sanctions pressure previously imposed on other countries - Libya, Iran, Venezuela, Cuba, and this often ended in hostilities with the United States and its allies, the collapse of the economies of these countries and the destruction of the infrastructure of states [1]. Politically, the EU and Western countries justify this and are the main beneficiaries of the processes of desovereignization and the oppression of pro-Western values. But this, of course, is not the true state of affairs, and the analysis carried out will help us to understand what is happening in the world. Let's look at the data on the public debt of the EU countries, the USA, Canada, Japan and other countries that impose sanctions against Russia and imposed on other states. These will be all the countries of the European Union, the USA, Canada, etc. (take the data on the public debt of the EU and the USA on Wikipedia) [2].

List of countries by external debt

Rating	Country/Region	<u>External debt</u> U.S. dollars	Date	<u>Per capita</u> U.S. dollars	<u>% GDP</u>
1	 USA	30 trillion	2022 est. ^[1]	60.526	102.00
2	 United Kingdom	9.02 trillion	December 31, 2017 ^[2]	127.000	345.00
3	 France	7.32 trillion	December, 2021 ^[3]	87.200	230.00
4	 Germany	5.74 trillion	March 31, 2020 ^[4]	69.000	165.00
5	 Japan	4.77 trillion	March 31, 2020 ^[5]	38.000	96.00
6	 Netherlands	437 billion	October 2021 ^[6]	26.540	52.00
7	 Italy	2.51 trillion	December 31, 2017 ^[7]	42.300	141.00
8	 Spain	2.26 trillion	December 31, 2017 ^[8]	48.700	170.00

List of countries by external debt

Rating	Country/Region	<u>External debt</u> U.S. dollars	Date	<u>Per capita</u> U.S. dol- lars	<u>%</u> <u>GDP</u>
9	 China	2.09 trillion	March 1, 2020	1.326	29.00
10	 Canada	1.93 trillion	December 31, 2017 ^[9]	52.300	143.00
11	 Switzerland	1.82 trillion	December 31, 2017 ^[10]	213.100	285.00
12	 Australia	1.83 trillion	September 31, 2020 ^[11]	71.906	130.00
13	 Singapore	1.67 trillion	June 30, 2021 ^[12]	231.000	471.00
14	 Belgium	1.28 trillion	June 30, 2017 ^[13]	112.000	269.00
15	 Sweden	994 billion	June 30, 2017 ^[14]	94.500	169.00
16	 Austria	757 billion	December 31, 2020 ^[15]	84.061	165.00
17	 Norway	604 billion	June 30, 2017 ^[16]	117.000	181.00
18	 India	571 billion	June 2021 ^[17]	571.00	20.00
19	 Brazil	556 billion	September 30, 2017 ^[18]	3.200	38.00
20	 Russia	489 billion	September 1, 2021 ^[19]	3.700	32.00
21	 Denmark	492 billion	June 30, 2017 ^[20]	85.700	158.00
22	 Finland	483 billion	June 30, 2017 ^[21]	87.500	223.00
23	 Greece	442 billion	December 31, 2017 ^[22]	42.800	298.00

Sanctions against Russia for actions in Ukraine, support for the LPR and DPR, in fact, are neither legitimate nor competitive. This is evidenced by the analysis of the public debt of the above-mentioned states. We see that the external debt is cumulative per inhabitant (see Wikipedia public debt per 1 inhabitant of the country). And we see that not only the United States, as is well known, but also the European Union has a public debt that is even larger than that of the United States, Germany, France and amounts to 5 trillion dollars each, which is extremely burdensome and hinders the growth of these economies [3]. However, analyzing further, Russia itself is in the analysis, according to Wikipedia, in 22nd place, but if the public debt that Russia has, with its population of 146 million people, then we get a total amount of 4 thousand US dollars per inhabitant. And it's not really a

critical amount. For example, take Finland, it has a debt per person of 111000 US dollars, in Greece it is 150000 US dollars. Therefore, in comparison, the amount of debt for big Russia is small [4]. If we compare the data on the public debt of the countries that have announced sanctions against Russia, we will see that in these countries the debt is significant and it is almost impossible to pay it off in the near future. As a source of potential enrichment, Europeans need sanctions, in order to temporarily ward off debt payments themselves, which, in our opinion, is being done today, and despite the fact that there would be any actions of Russia in Ukraine in this case or not, the sanctions themselves would be inevitable [5]. In this case, the EU countries use Russia as a donor country in the field of resources, China - from the standpoint of import dependence on cheap and affordable industrial goods and electronics, etc. [6]. At the same time, the national economies of Europe are so heavily indebted and corporate debts are rarely restructured for cheap and long money, which means that the public debt of the European Union in this case does not decrease, but grows. This is especially noticeable and deadly in the case of refusal to import energy resources from Russia at low and predictable prices and an attempt to switch to expensive LNG from Qatar and America in 2 years [5].

If we look at a similar rating table for countries with the largest external debt, compiled based on the results of 2017:

Country name	External debt (million dollars)	External debt to GDP (%)
USA	16 893 000	/ 101
United Kingdom	9 836 000	/ 396
Germany	5 624 000	/ 159
France	5 633 000	/ 188
Netherlands	3 733 000	/ 309
Japan	2 719 000	/ 46
Spain	2 570 000	/ 165
Italy	2 684 000	/ 101

Source: <https://finbasis.ru/vneshnij-dolg-stran-mira-na-2016-god-tablica> we will see that these are, at their core, again those countries that benefit from hostilities.

Recently, NATO has increasingly acted as a platform for solving common economic issues of the countries of the North Atlantic Alliance, which leads to the fact that the cost of maintaining NATO is growing (up to 2 percent of the GDP of these countries annually), and as such, protection of countries does not exist in practice and is unlikely. The role of this block is lost. The media working for the NATO bloc [1] are connected, tension is created in the region, after which the expectation of an aggravation of the situation follows. As such, Ukraine is of no in-

terest to anyone in Europe, because it acts as a buffer and lightning rod, first of all, for the EU countries to avoid paying debts, it also contributes to the acceleration of the US military-industrial complex [2], and bringing mechanisms to transfer their debts to the same Ukraine. Potentially, this sanctions policy has a double-edged price and increases the debt burden on the entire pool of anti-Russian coalition states, which leads to even greater dependence on the United States and the NATO bloc [3], creates food for global TNCs [4], deciding their capitalization in the troubled waters of European global industries in favor of those who are not interested in preserving Europe as one of the traditional centers of power and independent world domination. The growing debt load itself leads to the energy paralysis of the innovation sector and contributes to the decline in industrial capacities and scientific competencies of the Old World, which is abandoning the ideas of Eurasianism and finally becoming a creditor of the Marshall Plan that is ending its history [7].

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稀土元素成为中美贸易战持续的决定性因素
**RARE EARTH ELEMENTS AS A DECISIVE FACTOR IN THE
CONTINUATION OF THE TRADE WAR BETWEEN THE PRC AND
THE USA**

Yarovova Tatiana Viktorovna

*Candidate of Pedagogic Sciences, Deputy Scientific Director
International Institute of Energy Policy and Innovation Management
Associate Professor*

Mark Y. Cherkasov

Student

*Odintsovo Branch of the Moscow State Institute of International
Relations (University)*

抽象的。文章构建了中美之间新的贸易战开始的可能情景；以稀土元素(REE)为例，探讨中国经济在冲突再次爆发时的优势；将描述中国对稀土市场的影响，这将使预测经济冲突结束的时间成为可能。

关键词：REM、REE、贸易战、经济危机、垄断、稀土金属

Abstract. *The article constructs a possible scenario for the start of a new trade war between the USA and the PRC; explores the advantages of the Chinese economy in the event of a resumption of conflict, using the example of rare earth elements (REE); the impact of the PRC on the rare earth market will be described, which will make it possible to predict the timing of the end of the economic conflict.*

Keywords: *REM, REE, trade war, economic crisis, monopoly, rare earth metals*

The risk of the continuation of the trade war

The trade war between the PRC and the USA (2018 - January 2020) creates a veil of uncertainty in the field of economic and political development of both countries. By the end of 2020, the US economy "sank" by 316 billion dollars, which deprived up to 300 thousand people of their jobs [10]; China also faced big economic problems and took retaliatory actions in order to regulate the economic situation - in response to the USA's increase in customs duties in 2018-2020, the PRC, based on Table №1, mirrored the USA's authorities, but reduced the duty percentage for WTO member countries to 6.7% in order to cover costs and increase trade.

In general, since 2018 there has been a significant decline in trade compared to 2016-2017.

In January 2020, the parties met in Washington and agreed to increase US imports to China by 200 billion dollars over 2 years (76.7 billion dollars and 123.3 billion dollars, respectively). The first phase of the trade deal could effectively end the trade war, but according to Myron Brilliant, executive vice president and head of international relations at the USA Chamber of Commerce, "China hit less than 60% of its purchasing target, failing to meet its promise to increase purchases from the USA are 200 billion dollars above 2017 levels during 2020 and 2021" [6]. The fact of violation of the bilateral agreement prompted the current president of the USA, Joseph Biden, to maintain increased duties for the PRC, thus the conflict is still in a "frozen" state.

The reason for the escalation of the trade war can be:

1. The proposed extension by the Biden Administration of duties on imports of solar panels and the growth of the quota from 2.5 gigawatts to 5 gigawatts [9].

2. Future Congressional and Presidential approval of the USA bipartisan Restoring Essential Energy and Security Holdings Onshore for Rare Earths Act of 2022 [8]. The bill calls for a four-year cessation of the use of Chinese rare earths by Pentagon weapons contractors, which will cause significant damage to Chinese production.

General information about rare earth elements at the PRC

Rare earth elements are a group of 17 elements of the periodic table and are an integral part of modern history. For example, the operation of the touch panel of a smartphone requires a combination of indium and tin oxides; lanthanum, gadolinium and yttrium are used in night vision devices; samarium is used to provide control rods for nuclear reactors; windmills require rare earth magnets; for Tesla cars lanthanum and neodymium; and without neodymium magnets, the operation of any modern device is completely impossible.

The world of hi-tech and green economies would be unimaginable without the resources of China. According to the Center for Strategic and International Studies, the PRC's share of the REM market is 85% [3], and according to the US Geological Survey, more than 40% of the world's REM reserves are located in China [4].

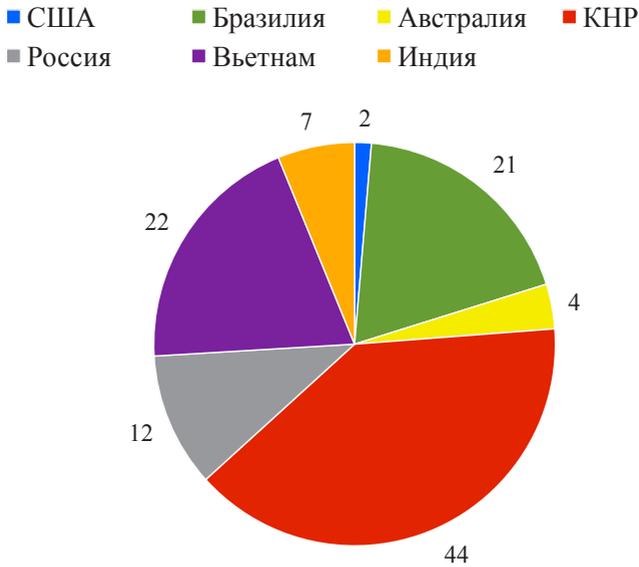
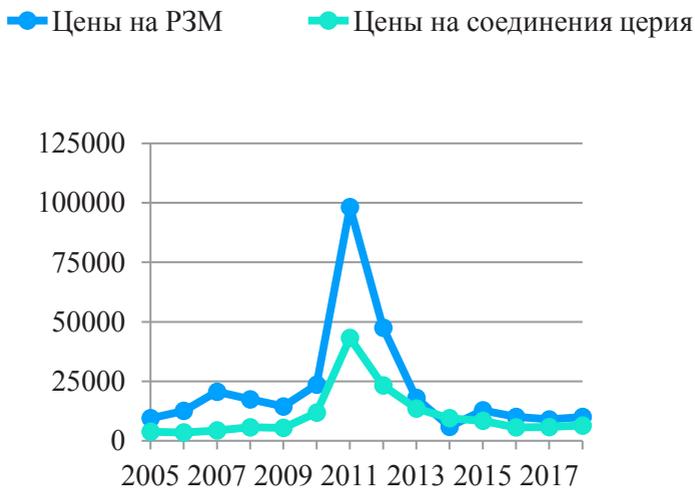


Diagram №1. Comparison of the world stock of REM (million metric tons)

China's dominance in the rare earths sector began in the late 1980s, when many foreign companies were engaged in mining, attracted by cheap labor and the absence of strict environmental regulations. However, this trend did not last long, and already in the early 1990s, the Chinese Communist Party declared "REM as protected and strategic minerals", thereby forbidding foreigners to take any part in the extraction and processing of rare earth elements. This allowed Chinese companies to gain foreign know-how while gradually cutting off foreign competition from the supply chain. In addition, REM producers must adhere to mining and processing quotas. This system was created by the government, de jure, to combat the illegal production and sale of rare earth elements, but, de facto, this system was created to strengthen the geopolitical role of the Chinese Communist Party (CCP) in the field of REM export. It is noteworthy that, starting in 2019, quotas set by the government forced to outsource a certain part of REM production to Myanmar (provides China with up to 50% of imported REM), the USA and Australia, which made China not only a world exporter, but also an importer [7].

Currently, there are 3 companies in the rare earth industry in China: China Northern Rare Earth, China Nonferrous Metal Mining Group and a conglomerate created in December 2021 by merging large mining companies, China Rare-Earths Group [1].



Data: UN Comtrade Database

Figure 1. Price comparison of REM and cesium compounds from 2005 to 2017

REM as China's geopolitical weapon. As the absolute leader in the export and import of rare earth elements, essential components for all the technology in the world, the PRC has a serious geopolitical influence in the global market. Noted earlier, the system of quotas for the production and processing of resources shows what a serious geopolitical weapon this can be. For example, in 2010, the PRC sharply cut its tiered export quotas to 30259 metric tons, down 37% from the previous figure. The decision of the authorities showed how much China influences the entire metal market: the prices of REM, cerium compounds and other metals, on average, soared from 9461 dollars in 2009 to 71000 dollars in 2011. (see chart №1)

It should be noted that this is not the only example of the PRC's tough geopolitical strategy to protect its interests. In 2010, the captain of a Chinese fishing vessel was arrested by the Japanese Coast Guard for 2 months after ramming a Japanese vessel, in response to this, the PRC authorities restricted the export of REM to the country for 2 months, which led to a sharp increase in prices and revealed how Japan is dependent on China's resources. Having achieved the result, the Japanese authorities released the captain, and the ban was lifted. But despite the reopening of supply chains, Japan has boosted Australia's mining industry with a 250 million dollars investment in Lynas Corporation, and the company now supplies Japan with almost a third of its rare earth imports. Thus, China's geopolitical move brought more losses than benefits.

Over time, the West seriously thought about displacing China from its position as a monopolist in the REM market. First, China's cuts in export quotas in 2012, which led to a rise in metal prices, seriously puzzled the Obama administration and the governments of Japan and the EU. A joint complaint was filed with the WTO, which ended in favor of the Western plaintiff, and the quotas were partially cancelled. Secondly, in addition to lifting Chinese export quotas, after the events of 2010, Western countries have taken a course to reduce dependence on Chinese raw materials by investing in mines in Australia, reopening the Mountain Pass mine in California, stimulating Blue Line in Texas and developing industry in countries Europe. As a result, according to the US Geological Survey, in 2010 there was a significant decline in China's share in the mining industry to 63%, and by 2020 to 57% [5].

Despite encouraging performance in the West, the PRC's influence on the REM market has not changed. The Chinese government was able to proportionately and effectively change its resource policy in response to two steps by the West:

1. Following the decision of the WTO, China significantly reduced prices for some rare earth elements in order to discourage foreign investors from investing in foreign companies, which led to the bankruptcy of Molycorp, which owns the world's largest REM Mountain Pass mine.

2. Regarding the Western initiative to invest in non-Chinese companies, the PRC decided to respond symmetrically and invest more than 36 billion dollars in African countries; 780 million dollars to Venezuela, of which 180 million dollars is earmarked specifically for nickel mining; bought a 55 percent stake in the copper reserves of Chile and Peru and a 49 percent stake in the lithium industry in Bolivia. In addition, the Chinese giant Shenghe entered into an agreement with the Australian company RareX in 2020 to jointly mine REM; acquired minority stakes in mining companies in Greenland; and also saved the American mine Mountain Pass from bankruptcy by buying out a 7% stake in MP Materials [12]. China's final step was for Wang Yi, the PRC's foreign minister, to meet with the Taliban*¹ to set up export chains for REM from Afghanistan to the PRC (Afghanistan's reserves are estimated at about 1 trillion dollars).

The Chinese party was able to skillfully take advantage of the situation in the rare earths market when Donald Trump and his administration drafted tariffs on Chinese REM, but due to China's threat to completely cut off supplies, this package of economic regulation was not introduced. Indeed, otherwise, America risked completely paralyzing its own defense industry from sonars to F-32 fighters, the production of which requires about 427 kilograms of rare earth resources [13].

*¹ Organization illegal in the RF

Although, based on the report of Rajeev Biswas, chief economist for Asia-Pacific at IHS Markit, the US government managed to accumulate strategic reserves of REM for the defense sector for 1-2 years in case of supply interruptions from the PRC [4]. Nevertheless, China decided to take advantage of the vulnerability of the industry and raised duties on rare earth elements imported from the USA for processing from 10% to 25%, the benefit of this decision was the growth in the value of securities of leading Chinese companies: China Northern Rare Earth Group High-Tech - by 8.7%, China Rare Earth Holdings - by 24%, China Minmetals Rare Earth - by 10% [11]. China also threatened to impose sanctions on the USA's defense contractors (Lockheed Martin, Raytheon) if they continue to export weapons to Taiwan (a partially unrecognized republic) [2].

Conclusion

All of the above data allow us to conclude that the People's Republic of China still remains in the leading position as an exporter / importer of rare earth metals, and in the hands of the leader of the Communist Party Xi Jinping, the geopolitical leverage of pressure is concentrated both on the government of Joseph Biden and on the whole world as a whole. If the USA decides to resume the trade war, then the situation on the world market may turn out to be irreparable, because, despite the stocks of REM in Western countries, their number will not be enough to continue the production of equipment in the same quantities. Countries, in the event of REM export restrictions by the PRC, will have to urgently open new production and mining enterprises, as the supply-production chain will be disrupted, which will entail an increase in costs that will affect the cost of the final product - it will be significantly increased. It is worth noting that both sides of the conflict will remain in the red from this decision, because China also uses Western products, especially microcircuits, processors and magnets. Accordingly, the geopolitical function of the Chinese REM is more preventive than punitive, in order to warn the US government of the possible consequences for the military and private industrial sectors of all countries.

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数字经济下农村劳动力资源开发存在的问题与前景

**PROBLEMS AND PROSPECTS FOR THE DEVELOPMENT OF LABOR
RESOURCES IN RURAL AREAS IN THE DIGITAL ECONOMY**

Solodovnik Aleksandra Igorevna

Candidate of Economic Sciences, Chief Specialist

Savkin Vladimir Ivanovich

Doctor of Economic Sciences, Professor

Parshutina Inna Grigorievna

Doctor of Economic Sciences, Professor

Orel State Agrarian University named after N.V. Parakhin

抽象的。本文讨论了农村地区和农工综合体可持续发展的人力资源问题。现代经济部门的就业结构发生了变化和复杂化。生产竞争力高度依赖科学、创新和劳动力资源。劳动力资源也是数字农业经济的战略发展资源。农业生产中的数字经济模式需要面向知识和数字技能的专家。农业经济的数字化影响着农村地区的就业动态和对劳动力资源的需求。在为农业提供高素质专家方面存在问题。国家对人员编制的监管将有助于解决农业创新发展的问题。劳动力资源是更新农工综合体的技术、工艺和科学信息库的优先领域。特别注意分析和评估农工综合体的人员配置。劳动力资源管理是农工综合体可持续创新发展的最重要条件。

关键词：劳动力资源，社会和劳动关系，数字经济，农产综合体，劳动经济学。

Abstract. *The article discusses the issues of human resources for sustainable development of rural areas and the agro-industrial complex. There is a change and complication of the structure of employment in the sectors of the modern economy. The competitiveness of production is highly dependent on scientific, innovative and labor resources. Labor resources are also a strategic development resource for the digital agrarian economy. The digital model of the economy in agricultural production needs specialists oriented towards knowledge and digital skills. The digitalization of the agrarian economy affects the dynamics of employment in rural areas and the need for labor resources. There are problems in providing highly qualified specialists for the agriculture. State regulation of staffing will allow solving the problems of innovative development of agriculture. Labor resources are a priority area for updating the technical, technological and scientific information base of the agro-industrial complex. Special attention is paid to analysis and assessment of the staffing of the agro-industrial complex.*

Labor resources management is the most important condition for sustainable innovative development of the agro-industrial complex.

Keywords: *labor resources, social and labor relations, digital economy, agro-industrial complex, labor economics*

Introduction

Global development trends (ecology and digital economy) have an impact on labor resources and career prospects. The relevance of the study is associated with the development of the information-digital agrarian economy.

The purpose of the article is to consider the quantitative and qualitative characteristics of the staffing of the agro-industrial complex, as well as the directions of the strategy for the development of the personnel policy of the agro-industrial complex.

A lot of publications are related to human potential, digital economy, agriculture 4.0, circular economy and ecology. On the basis of digitalization, diversification of agricultural production takes place, which needs skilled labor resources. The development of a digital agrarian economy is causing socioeconomic shifts in the labor market. There is a need to investigate the factors and risks that affect the workforce in digital agriculture. Statistics on equipping agriculture with technical and labor resources are available. Information and digital technologies are driving the transformation of staffing. The study shows that increasing labor productivity means changes in the management of human capital. The development of agriculture 4.0 creates new employment opportunities in rural areas. Further research is required to apply the experience of developed countries in the field of agri-foodtech and agriculture 4.0.

Materials and Methods

The purpose of the article is to consider the essence of labor staffing in the digital agrarian economy and study the indicators of the digital economy for the labor market. Agriculture 4.0 enables agribusiness to be sustainable and innovative. But it also has risks in the management and provision of resources. As the labor potential and human capacity for digital agriculture is not yet deeply understood we used an exploratory approach.

To grasp the various labor potential and human capacity we selected multiple case-study research strategy, allowing us to conduct the cross-analysis. These problems can be successfully solved if we apply to statistical analysis methods, expert assessments and normalized indicators. We followed two types of grounding processes. Theoretical grounding: comparing statistical data with those in the existing literature on human capital, labor resources and digital agrarian economy. Empirical grounding: statistical reports and forecasts from economic literature, Internet resources of government and public organizations.

Results

The issues of accelerating the rates of economic growth and staffing discussion in the scientific and expert community. Within the framework of this research, we focus on the intersectional nature of relations within the digital information economy. Special attention is paid to the development of labor potential and entrepreneurial activity, innovative technological development, participation in the global division of labor and global value chains. In order to achieve scientific, technological and innovative results and system transformations, it is necessary to analyze and evaluate scientific, personnel, and resource opportunities in the economy and agriculture.

The agro-industrial complex provides food and economic security. The agro-industrial complex is a complex of industries and industries. The agro-industrial complex is associated with related sectors of the economy and is of strategic importance for economics. Research by Helena Lenihan, Helen McGuirk, Kevin R. Murphy confirms the importance of public policy and human capital. “Highlights the need to consider the role of policy interventions to support the motivationally-relevant elements of human capital. Proposes a new policy program offer to support the motivationally-relevant elements of human capital in order to increase firms' innovation activity [1] ". Each job in agricultural production creates several jobs in interrelated and interdependent industries. Digitalization in the agricultural inevitably affects changes in multi-unit production and non-production areas of the economy. However, insufficient innovation activity with high investment volumes does not allow achieving high competitiveness of Russian agricultural products in world markets. Investments in the development of the material and technical base of the agro-industrial complex, selection and seed production determine the technical and technological modernization of the agricultural sector. In our opinion, the number of high-performance high-tech jobs characterizes the competitiveness of the industry (table 1).

*Table 1.
The number of high-performance jobs by type of economic activity
for 2013-2020, thousand [2]*

Branch of the economy	2014	2016	2018	2020
Russian Federation (total)	18280,9	15983,3	19638,3	21946,6
Agriculture, hunting and forestry	368,2	335,1	516,6	653,5
Manufacturing industries	3722,9	3333,9	3942,5	4483,7
Building	1028,0	871,9	1015,2	1165,0
Wholesale and retail trade	1609,4	1548,5	2008,1	2333,2
Financial and insurance activities	949,9	907,6	815,5	799,4
Public administration	2458,9	2307,4	2021,6	2007,3

This means an increase in labor productivity, the number of highly productive jobs and a lot of demand for a highly skilled workforce. In agriculture there is a demand for end-to-end solutions that have specific advantages in the automated solutions for digital platforms [3]. We would like to note the opinion of Ekaterina Albats, Marcel Bogers, Daria Podmetina on the co-operation of production and education. «Applying a micro-foundational lens and building on 10 qualitative case studies, we identify how companies' labor capital helps overcome barriers and enhance the drivers of university and industry collaboration» [4]. The traditional management approach to staffing the following categories: chief specialists, middle managers, industry specialists, chief agronomists, chief livestock specialists, chief veterinarians, chief engineers, chief economists, chief accountants, and other positions of chief specialists. However, the information-digital economy is constantly changing the labor market. There is a need for specialists with interdisciplinary knowledge and skills. The most popular digital skills for collecting, processing and analyzing information belong to the group of professional activities in communications, information and communication technologies, but such specialists are also required in other industries (table 2).

Table 2.

Employed in professions related to the intensive use of IT, by type of economic activity for 2017-2019, percent of the number of employed [5]

Branch of the economy	2017	2018	2019
Information and communication	34,1	40,4	42,3
Manufacturing industries	15,1	2,6	2,6
Public administration	6,3	1,9	1,7
Wholesale and retail trade	0,6	0,8	0,9
Financial and insurance activities	4,8	5,3	5,4
Building	2	1	0,9
Agriculture, hunting and forestry	0,5	0,3	0,3

To characterize the general level of development of the digital economy of the state of the country various indices are used: the Global Digital Economy Competitiveness, the Global Innovation Index, the Knowledge Index, the Knowledge Economy Index, Human Development Index (table 3)

Analyzing statistical data, the following contradictions and problems of the development of a digital information agrarian economy can be identified. Based on research and practical experience, the use of digital information technologies in the agricultural economy leads to an economic effect. Consequently, there are environmental, institutional and social effects, as well as the quality and standard of living.

The Human Development Index includes information about labor capital and its progress - health, education, income. It is necessary to improve the system of indicators of labor resources in the digital information economy for the agricultural sector with functional, temporal and spatial characteristics. There are quantitative estimates - the number by profession, by region, by industry; the share of the able-bodied population in rural areas, the unemployment rate in rural areas, labor costs, average wages in agriculture. There are author's developments of qualitative characteristics of labor resources: structure and professional composition, labor productivity, skill level, soft and hard skills, digital skills of labor resources, accumulated production experience, educational level, health and psychological health. The quality of life, health care in rural areas, housing, digital information infrastructure and the Internet in rural areas, and the environmental component matter. Discussion takes place regarding the composition and structure of indicators and the system of indicators. For example, the author's structural model of the labor stimulation policy in the agro-industrial complex and a system of indicators that allow assessing its effectiveness are proposed [7].

Table 3.
Trends in the Human Development Index in United Nations Development Program report from 2015 to 2019 [6]

Country	2015 (rating / value)	2017 (rating / value)	2019 (rating / value)
Norway	1 / 0,949	1 / 0,953	1 / 0,954
Switzerland	2 / 0,939	2 / 0,944	2 / 0,946
Ireland	8 / 0,923	4 / 0,938	3 / 0,942
Germany	4 / 0,926	5 / 0,936	4 / 0,939
Hong kong, china	12 / 0,917	7 / 0,933	4 / 0,939
Australia	2 / 0,939	3 / 0,939	6 / 0,938
Iceland	9 / 0,921	6 / 0,935	6 / 0,938
Sweden	14 / 0,913	7 / 0,933	8 / 0,937
Singapore	5 / 0,925	9 / 0,932	9 / 0,935
Netherlands	7 / 0,9924	10 / 0,931	10 / 0,933
...
Oman	52 / 0,796	48 / 0,8821	47 / 0,834
Argentina	45 / 0,827	47 / 0,825	48 / 0,830
Russian Federation	49 / 0,804	49 / 0,816	49 / 0,824
Belarus	52 / 0,796	53 / 0,808	50 / 0,817

Kazakhstan	56 / 0,794	58 / 0,800	50 / 0,817
...
Burundi	184 / 0,404	185 / 0,417	185 / 0,423
South Sudan	181 / 0,418	187 / 0,388	186 / 0,413
Chad	186 / 0,396	186 / 0,404	187 / 0,401
Central African Republic	188 / 0,352	188 / 0,367	188 / 0,381
Niger	187 / 0,353	189 / 0,354	189 / 0,377

In general, information and digital technologies have a positive effect on the labor market. New teleworking jobs are being created, and the sphere of high-quality online education is expanding. This requires a change in the assessment of trends in the development of labor resources for the agro-industrial complex. Consequently, there are changes in the state employment policy. It is important to analyze and predict the time of job search, labor productivity, interact with universities, and stimulate investment in labor capital. Another direction is the introduction of professional standards with interdisciplinary, cross-cutting characteristics and skills. It is required to substantiate and develop a set of measures of state support for the national innovation system, the development of the institutional environment and digital infrastructure for the agro-industrial complex.

Discussion

The value of the contribution of the information and digital sector to the gross domestic product of the Russian Federation is inferior to developed and some developing countries. We note the following trends. The first one is, an increase in employment in the service sector with a constant decrease in the number of workers in the field of material production. The second one is, growth of labor productivity under the influence of innovative technologies. The third one is, growth in demand for highly qualified labor resources in the structure of total employment.

For the further development of the digital economy, it is necessary to improve the methodological support for monitoring the labor market and human resources. The imperfection of existing analysis methods and assessment makes it difficult to plan the needs for professional training of labor resources.

The promising areas are the following: the first one is, joint projects to assess labor resources with the scientific and business sectors; the second one is, to introduce additional quantitative and qualitative indicators of the development of the digital economy into statistical surveys. The analysis of the personnel potential of the agricultural sector for planning and forecasting economic development must be carried out taking into account not only economic and technological factors, but also taking into account managerial, territorial, organizational, institutional

and environmental factors. State policy on the regulation of labor potential and the labor market should not be limited to the development of regulatory and methodological documentation. A lot of attention is needed for social lifts, interaction with the education sector, in which professional competencies and skills are formed, and the entrepreneurial sector, which is interested in continuous professional development and education.

Conclusion

Thus, this study makes it possible to clarify the indicators for assessing the human potential of the agricultural sector of the economy and rural areas. Several year data show contradictory trends: on the one hand, the gap in basic living conditions is narrowing, on the other hand, the gap in the availability of higher education and access to high-speed information transmission channels is widening. Agriculture is an investment-attractive industry. Therefore, the role of state employment policy and labor market regulation is growing. The public administration system is able to provide the agro-industrial complex with the necessary staffing with the appropriate skills, knowledge, skills in demand in digital agricultural production. The obtained results of the research serve to understand the role of the state in the formation of the personnel potential of the agro-industrial complex, the development of approaches to the organization of statistical analysis and assessment, the training of personnel with the appropriate competencies for the agro-industrial complex.

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俄罗斯联邦近期互联网贸易增长的特征

CHARACTERISTIC FEATURES OF THE RECENT INTERNET TRADE GROWTH IN THE RUSSIAN FEDERATION

Egorova Yuliya Alexandrovna

Candidate of Philological Sciences, Associate Professor

Shishkina Larisa Sergeevna

Student

Russian Presidential Academy of National Economy and Public Administration

抽象的。本文重点关注 2017 年至 2021 年间俄罗斯互联网贸易的增长情况，简要分析俄罗斯零售总额和 GDP 中在线贸易的增长率、地域和部分。作者讨论了最近流行的商品销售趋势，例如市场、全渠道零售和有意识的消费。作者还描述了 2021 年在 RF 中规范在线贸易的规则，并强调了迅速规范框架对技术或社会领域的任何重大变化做出反应的重要性。底线是——由于互联网技术和电子商务的快速发展，监管框架暂时落后。

关键词：互联网贸易、COVID-19 大流行、俄罗斯在线市场、十大在线零售商、在线贸易监管框架。

Abstract. *The article focuses on the growth of the Internet trade in the RF in the years between 2017 and 2021, giving a brief analysis of the rates of increase, geography and parts of online trade in the total retail turnover and the GDP of Russia. The authors discuss the recent popular trends of selling goods such as marketplace, omnichannel-retailing and conscious consumption. The authors also describe the rules regulating online trade in 2021 in the RF and stress the importance of prompt normative framework reaction to any substantial changes in technological or social sphere. The bottom line is - due to the rapidity of development of Internet technologies and electronic commerce the regulatory framework is temporarily lagging behind.*

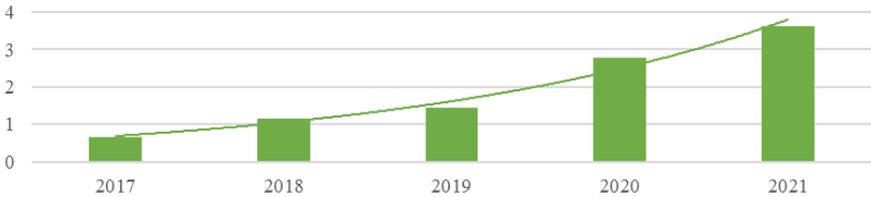
Keywords: *Internet trade, the COVID-19 pandemic, Russian online market, top 10 online retailers, regulatory framework for online trade.*

Introduction

The Internet trade of commodities had been gradually developing for years before it was significantly enhanced by the recent global events, i.e. the COVID-19

pandemic. This is undoubtedly connected with such restrictions imposed on the society as lockdown and self-isolation making customers shop online.

Data analysis: The figures of the internet-trade growth rate vary in different sources. In this research we shall rely on the AKIT and Data Insight records. For the period of 2017-2021 there is a sharp increase – from halve a billion to 3,6 billion in online retail sales value of Russian online-stores.



▲ The size of the Russian internet trade in bln rubles.

The diagram shows that the rates of increase before 2020 were rather low, for instance, the growth rates of retail value in 2018-2019 was 25%. However, by the end of 2020 the sales soared to 92% and, consequently, the abrupt increase of online trade can be attributed to changing patterns of consumption [2]. In 2021 there was a 33% increase in respect to 2020 as the sum reached 3,6 billion rubles [3]. Concerning the e-commerce fraction in the total retail sum, it was 4% in 2018, then it rose moderately to 5% in 2019 [1] and increased to 8% in 2020 [2]. The figures are expected to reach 26% by 2025. However, according to Rosstat the share of online sales in the total retail turnover was 1,7%; 2,0%; 3,9% and 4,3% in 2018; 2019; 2020 and 2021 respectfully [4]. Evidently, the incongruences in the figures can be attributed to different approaches to the calculations.

Moreover, examining the e-commerce fraction in the GDP of the RF in 2019-2021, there is a clear evidence of it being on the rise - in 2019 the proportion was 1,3%; in 2020 it increased to 2,5% and it reached 2,7% in 2021 [3].

The geography of online shopping is of relevance too. If we consider the major shipping places of 2021, apparently, Moscow comes number one in online trade, making 19,9% of online orders. However, Moscow is significantly more integrated in the world online trade accounting for 24,2% of orders. Moscow Oblast with 10,8% and Saint Petersburg with 7,1% follow it by a wide margin. The next places in the list are taken by Krasnodar Kray (4.4%), Sverdlovsk Oblast (2,5%), Nizhny Novgorod Oblast (2.0%), Samara Oblast (2,0%), Tatarstan (1,9%) and Bashkortostan (1,6%) [3]. Although in the 2020 data there were the same leaders, the figures were substantially more different [2]. So, we may suggest that the geography of the Russian online market is becoming more even.

Online trade is to stay – modern tendencies in the RF

As mentioned above, the divide between online and in-store sales widened significantly in 2020 and in 2021 as a result of the coronavirus pandemic. But it's not the only reason. The advancement of technology definitely helped to further online purchases worldwide [5].

Online sales in Russia are expected to grow as consumers feel comfortable with the ease of shopping on mobile devices. The other factor for online purchases is the fact that they are time saving while payment is becoming quick, safe and convenient. Still one of the key factors for consumers is the price and possibility to compare prices on the platform to make a bargain. That is why Marketplaces – full scale supermarkets with warehouses and delivery services - have been developing so quickly to answer the needs of both the buyers and producers. In 2020 marketplaces in Russia were growing more than twice quicker than the whole market of online trade [6].

Marketplaces can be good partners for companies which prefer D2C if they have a significant community of buyers. Then a marketplace serves as a good chance to attract even more buyers and to receive the feedback from them and stay emotionally involved.

In 2021 the combined turnover of top 10 online retailers reached 57% of domestic e-commerce market, while in 2020 their share remained 45,3% and in 2019 – 32,9%. According to statistical data, among top five of them are Wildberries, OZON, AliExpress Россия, М.ВидеоЭльдорадо, СБЕР [7].

The peculiarity of Russian e-commerce is the growing influence of top Russian bank Sberbank in becoming a retailer and creating its own ecosystem. The bank focuses on covering all the basic needs of its clients – food, taxi, entertainment, etc. –to provide services under the brand СБЕР. It has registered more than 180 trademarks with their brand component, the most prominent of them at the moment are already well-known - СБЕРМАРКЕТ, СБЕРМЕГАМАРКЕТ, СБЕР ЕАПТЕКА [8].

Omnichannel-retailing has received a fresh impetus due to the pandemic situation. Different means to reach a customer have become more popular. A good example was set by Lamoda which demonstrated an integration of a physical channel (offline) and digital channel (online) to offer a unified customer experience to high school students before a senior school prom. Special Lamoda vans were placed in most popular with school leavers locations offering an assistance of a stylist to choose a dress for the prom and then students got links and discounts to buy it online [9].

There is a recent trend supported by more and more of the Russian buyers and sellers for conscious consumption and social commerce. A trend of social commerce has been taken up by a number of messengers Facebook, Instagram,

YouTube, TikTok either redirecting their clients to online shops or offering direct selling.

Conscious consumption is a new philosophy for those who care about the future of our planet. Supporters of the conscious consumption offer consumers a more responsible approach to shopping. Activists emphasize that since it is the common problem, it must be solved by joint efforts. Not only consumers should be more conscious and prudent in their purchases, but also global corporations and brands are also required to provide safer and cleaner production. Among the Russian companies which follow this trend is Eldorado, which is engaged in recycling, launched a programme “Beautiful world” to preserve beautiful nature of Russia, introduced paper bags instead of plastic and has supported Earth Hour initiatives. Earth Hour is a global event held annually on the last Saturday of March. It aims at raising awareness about climate change among individuals, governments and businesses and urge them to take steps to reduce greenhouse gas emissions and save energy [10].

Legal and regulatory framework governing Internet commerce

On January 1, 2021, a new Decree of the Russian Federation Government № 2463 [12] came into force. It is more detailed and specific than the previous document. For instance, Clause 21 of Chapter 2 of Section I states the obligation of the Seller to provide the Consumer with applicable information about the form and methods of claims submission [12]. In the previous Decree [11], there was no information about filing claims against the Seller.

It is worth mentioning, however, that the Decrees mentioned above are based on the Russian Federation Law № 2300-1 “Protection of Consumer Rights” and the Civil Code of the Russian Federation.

The new regulations

Due to the COVID-19 Pandemic it was crucial to adopt new Internet commerce regulations in accordance with current sanitary and epidemiological standards. The main concern was about the relations between parties during the delivery of goods. The Moscow Region website published the requirement to use a contactless method of passing the goods at Internet orders delivery points; allowing only one customer and an employee of the online store be at the delivery point simultaneously; using fitting rooms was temporarily suspended [13].

Conclusion

Thus, taking into consideration all mentioned above, we suggest that the Russian online market is evolving at a high rate. While the share of e-commerce in the total retail sum remains rather low, the growth trend is evident. Furthermore, Moscow is the obvious leader in the online trade. It can be concluded that not only the demography but also the severity of epidemiological measures in Mos-

cow contributed to this fact. The rapidity of online market evolving is also worth mentioning as the figures reached 92% for the years of 2019-2020 and 33% for 2021-2022. In fact, the data reflect the impact self-isolation regime had on the e-commerce development. Besides, figures are expected to rise to 10,9 by 2025 according to certain predictions.

It is also crucial to note that the online market of Russia has some substantial trends. One of them is the essential role of market giants which combined turnover comprises more than a half of the domestic market value. It is clearly connected with another considerable tendency for launching the so-called ecosystems, presented basically by SBER. It specializes mostly in services, providing some goods selling platforms as well. It is debated, however, that such systems pose a threat to economic growth in some fields as it can lead to a complete monopoly.

Considering the rapidity of development of Internet technologies and, accordingly, electronic commerce, it is apparent that the regulatory framework is not always up-to-date. The law, which was in force from 2007 to 2020, contained outdated information, for example, it practically was based on the form of a so-called catalog from which goods were to be ordered. Consequently, it has been transferred completely to electronic form: the buyer is to make purchases entirely through the website, pay for their purchases using electronic money, etc. Additionally, there is currently a more significant certainty in legal provisions, as well as greater consumer protection. However, the specifics of Internet commerce imply a large field for fraud. Consequently, this area needs to be controlled by properly updated regulations. The pandemic years have exposed this problem. Although, the rules related to the implementation of Internet orders delivery were often not supported by specific laws, they still implied penalties for their violation.

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2020 年封锁对俄罗斯联邦创新活动的影响
**THE IMPACT OF THE 2020 LOCKDOWN ON THE INNOVATION
ACTIVITY OF THE RUSSIAN FEDERATION**

Semenova Anna Robertovna

Candidate of Physico-mathematical Sciences, Associate Professor

Spirina Polina Vladimirovna

Student

Siberian Federal University

抽象的。在持续的系统性经济危机的背景下，在对俄罗斯联邦实施许多限制和制裁期间，因此我国跨区域市场竞争加剧，创新及其大规模引入社会的经济生活在家庭再生产过程中变得越来越重要。创新是社会经济体系现代化过程中经济增长的主要因素之一，有助于提高和加强竞争力以及经济活动效率的增长。

综上所述，在当前的地缘政治形势下，如果不引入创新，就不可能实现俄罗斯联邦追求的高水平经济发展和高水平进口替代。商品和服务的生产。

本文分析了 2020 年封锁对创新商品、工程和服务数量、创新活动融资以及俄罗斯联邦创新结构的影响。

关键词：封锁、危机、进口替代、制裁、创新发展、经济发展、创新活动、创新、数据分析。

Abstract. *In the context of the ongoing systemic economic crisis, during the period of the introduction of many restrictions and sanctions against the Russian Federation and, as a result, the toughening of competition in interregional markets within our country, innovations and their large-scale introduction into the economic life of society are becoming increasingly important in the domestic reproduction process. Innovations act as one of the main factors of economic growth during the modernization of the socio-economic system, contribute to the increase and strengthening of competitiveness and the growth of the efficiency of economic activity.*

Based on the foregoing, it can be concluded that it is impossible to achieve a high level of economic development, as well as a high level of import substitution, which the Russian Federation is striving for in the current geopolitical situation, without introducing innovation in the production of goods and services.

This article analyzes the impact of the 2020 lockdown on the volume of innovative goods, works and services, on the financing of innovative activities,

and on the structure of innovations in the Russian Federation.

Keywords: lockdown, crisis, import substitution, sanctions, innovative development, economic development, innovative activity, innovations, data analysis.

An analysis of the main statistical indicators of innovation activity in the period 2019-2020 (see figure 1) showed, that with a decrease in the value of the indicator "Shipment of goods of own production, work and services performed on their own" by almost 1.1%, other indicators that directly characterize the sphere of innovation activity increased.

Dynamics of the main indicators of innovation activity in the Russian Federation

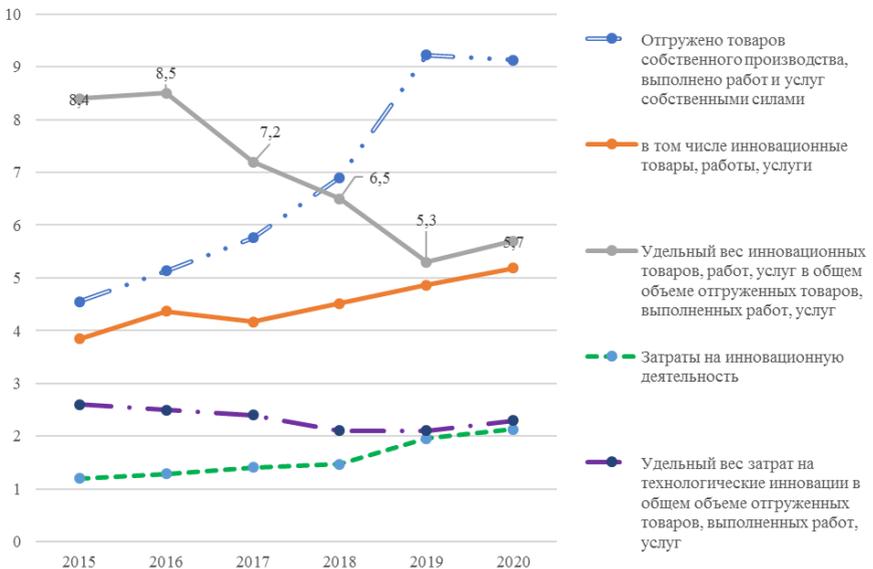


Figure 1. Dynamics of the main indicators of innovation activity in the Russian Federation

Thus, the indicator "Share of innovative goods, works, services in the total volume of shipped goods, works, services" declining in 2016-2019 at an average annual rate of 84.7%, in 2020 increased for the first time in 5 years. Thus, it can be assumed that the start of the lockdown in 2020 did not have a negative impact on the innovation sector in the Russian Federation in the short term.

To test this hypothesis, consider the change in the level of innovative activity of organizations in the Russian Federation.

Table 1.

The level of innovative activity of organizations, in the Russian Federation, by type of economic activity [6], %

Type of economic activity	2017	2018	2019	2020
Total	14.6	12.8	9.1	10.8
including:				
cultivation of annual crops	5.1	4.0	4.8	7.1
cultivation of perennial crops	4.6	1.4	2.4	4.8
seedling cultivation	6.3	5.6	5.0	8.7
animal husbandry	4.8	4.2	4.0	7.5
mixed agriculture	1.3	9.4	2.8	2.5
auxiliary activities in the field of crop production and post-harvest processing of agricultural products	3.1	3.4	4.3	4.5
provision of electricity, gas and steam; air conditioning (excluding trade in electricity; trade in gaseous fuels supplied through distribution networks; trade in steam and hot water (thermal energy)	8.4	6.9	8.1	9.9
water supply; wastewater disposal, organization of collection and disposal of waste, activities for the elimination of pollution	4.2	3.4	4.6	5.8
construction	–	–	3.6	3.9
transportation and storage	–	–	2.8	4.0
publishing activity	2.6	2.1	2.5	3.8
activities in the field of telecommunications	16.6	12.4	12.6	13.1
development of computer software, consulting services in this area and other related services	11.4	10.1	11.1	13.2
activities in the field of information technology	7.1	5.0	5.5	10.2
activities in the field of law and accounting	2.6	2.8	1.9	4.2

activity of head offices; management consulting	3.9	4.0	3.6	5.2
activities in the field of architecture and engineering design; technical testing, research and analysis	13.0	12.4	9.7	10.7
research and development	66.7	61.4	51.3	51.1
promotional activities and market research	2.2	3.7	3.0	2.6
other professional scientific and technical activities	1.1	2.3	4.3	8.8
activities in the field of health and social services	–	–	5.3	8.6
industrial production	17.8	15.6	15.1	16.2

The highest level of innovative activity in 2019 - 2020 is observed in such industries as research and development (51.1%), industrial production (16.2%), development of computer and software, industrial production (13.2%), activities in the field of telecommunications (13.1%). All these industries have in common that a significant part of the innovations used in them are technological, which is quite logical, since they are "traditional" and the easiest to learn. From 2017 to 2019, the level of innovative activity of organizations decreased, in 2020, on the contrary, there was an increase. Among all types of economic activity in 2020, there was a decrease in the level of innovative activity of organizations engaged in mixed agriculture (from 2.8% to 2.5%), as well as organizations engaged in research and development (from 51.3% to 51.1%). It is important to note that in 2020, the level of innovative activity of organizations engaged in activities in the field of information technology almost doubled (from 5.5% to 10.2%), as well as organizations engaged in professional scientific and technical activities. This fact is associated with the growing importance of digital technologies in the 21st century, as well as with the transition of most of the business to the digital space in connection with the introduction of lockdown.

An important aspect is the cost of innovation. Under lockdown conditions, most organizations are in need of additional financial sources, as well as reducing current costs. In this regard, a hypothesis can be put forward about reducing the cost of innovation and increasing the cost of "life support" of organizations.

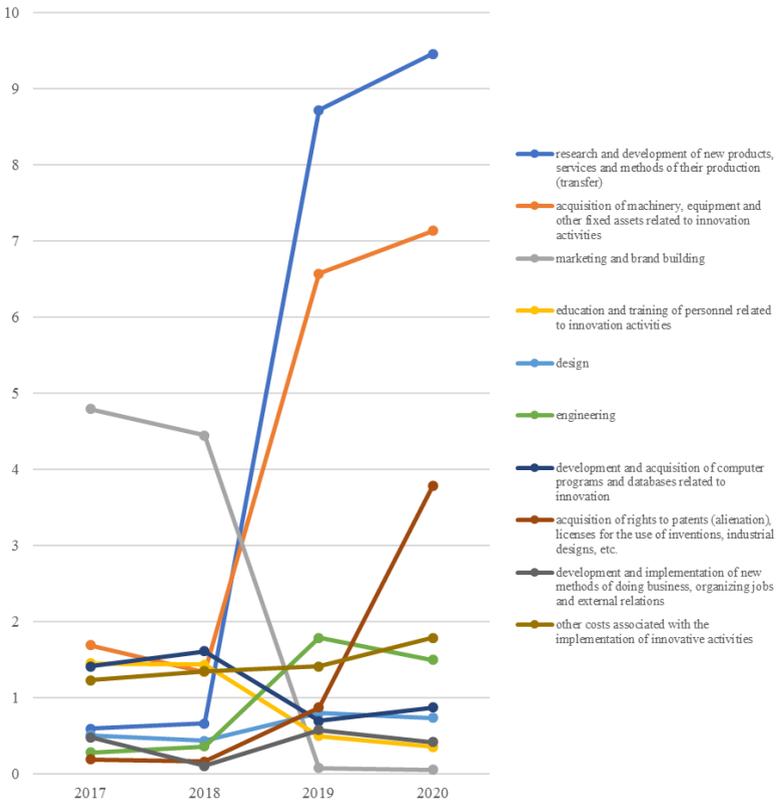


Figure 2. Dynamics of costs for innovative activities of organizations by types of innovative activities

From 2017 to 2020, there is a gradual increase in the costs of innovation. It can be assumed that this is due precisely to the increase in prices for products necessary for the implementation of innovative activities, as well as for the development of innovations themselves. According to figure 2, in 2020, organizations reduced the costs of such types of innovative activities as marketing and brand building, education and training of personnel related to innovative activities, design, engineering, planning, development and implementation of new business methods. For comparison, in 2019, there was a reduction in the costs of two types of innovative activities (marketing and brand building, education and training of personnel related to innovative activities), in 2020, 5 types of costs were reduced. The previously put forward hypothesis about the change of priorities in the implementation of costs is confirmed.

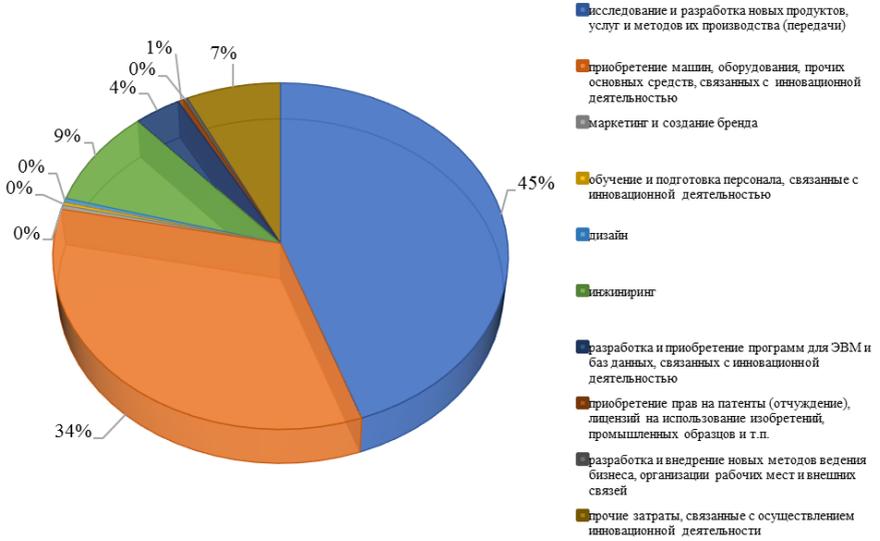


Figure 3. The structure of costs for innovative activities of organizations by types of innovative activities in 2019

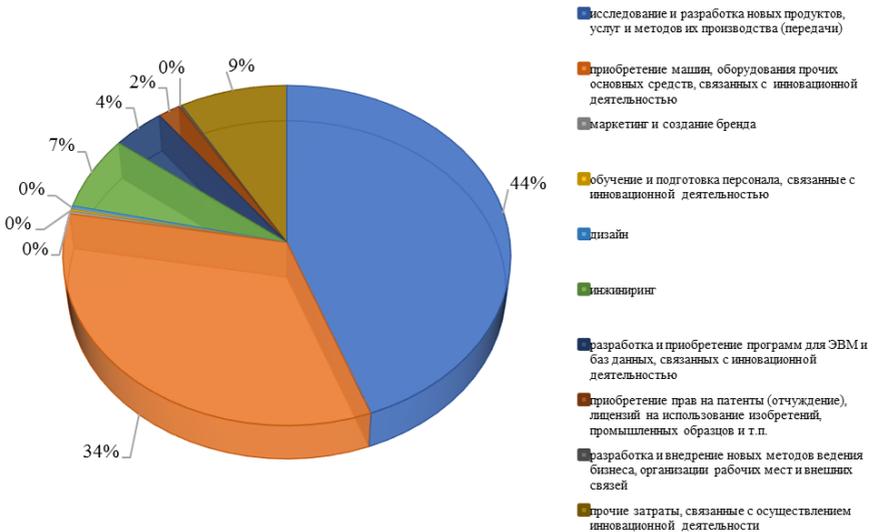


Figure 4. The structure of costs for innovative activities of organizations by types of innovative activities in 2020

Based on the data in figure 3 and figure 4, we can conclude that there were no significant changes in the structure of costs for innovation activities in the period 2019-2020.

Analyzing Figure 5, we see that expenditures on civilian science increased in 2020, but the value of expenditures on civilian science in relation to total expenditures from the federal budget decreased (from 2.69% to 2.41%), this fact is associated with an increase in funding for healthcare, support for small and medium-sized businesses, assistance to families with minor children and other support measures from the state during Covid-19.

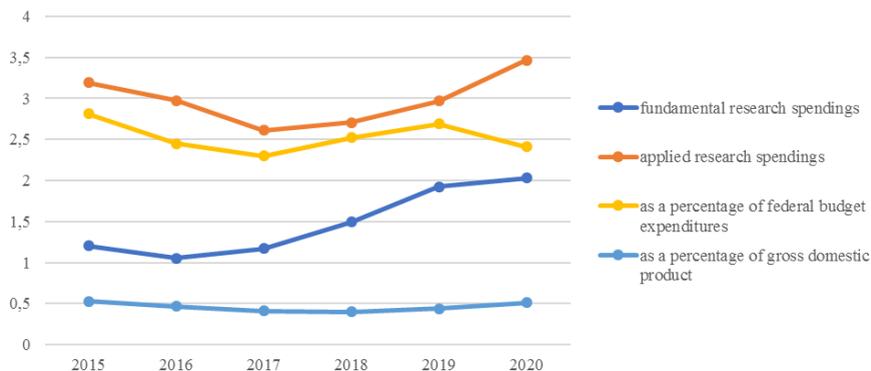


Figure 5. Dynamics of science financing from the federal budget

As a result of the analysis, the following can be distinguished:

1) In 2020, compared to 2019, the level of innovative activity of organizations engaged in activities in the field of information technology almost doubled (from 5.5 to 10.2), as well as organizations engaged in professional scientific and technical activities.

2) In 2020, organizations reduced the cost of innovative activities such as marketing and brand building, education and training of personnel related to innovation, design, engineering, planning, development and implementation of new business methods.

3) In 2020, the value of spending on civilian science in total spending from the federal budget decreased (from 2.69% to 2.41%).

In the short term, the lockdown did not have a large-scale impact on the development of innovation activity. This may be due to the fact that planning for innovative development is carried out several years in advance, and perhaps most of the projects that were implemented in 2020 were planned several years earlier. Tracking the real impact of the lockdown will only be possible in the period

2023-2024. But, despite the short period of time, we see that the introduction of the lockdown still led to negative consequences in the field of innovation in the Russian Federation. In addition to the negative aspects, positive ones can also be distinguished, for example, the growth of innovative activity of organizations engaged in activities in the field of information technology, as well as organizations engaged in professional scientific and technical activities.

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贸易和公共餐饮领域的进口替代作为确保区域层面经济安全的工具
**IMPORT SUBSTITUTION IN THE SPHERE OF TRADE AND PUBLIC
CATERING AS A TOOL FOR ECONOMIC SECURITY ENSURING ON
THE REGIONAL LEVEL**

Krut Anatoly Alexandrovich

lecturer

Academy of the Federal Penitentiary Service of Russia

注解。 本文介绍了在贸易和公共餐饮领域证实进口替代方向作为确保区域经济安全的工具的结果。 俄罗斯联邦生产总值结构中贸易和公共餐饮的份额已经进行了计算。 在对不友好国家的制裁政策收紧前后, 贸易领域高度依赖进口的风险、威胁和不利后果得到了证实。

关键词: 经济安全、制裁、贸易、公共餐饮。

Annotation. *The article presents the results of substantiating the directions of import substitution in the field of trade and public catering as a tool for ensuring regional economic security. Calculations of the shares of trade and public catering in the structure of gross value added produced in the Russian Federation have been carried out. The risks, threats and adverse consequences of high import dependence of the trade sphere in the conditions before and after the tightening of the sanctions policy of unfriendly states are substantiated.*

Keywords: *economic security, sanctions, trade, public catering.*

The activity of private business in the field of trade and catering should be defined as an important component of the modern market economy. Within the framework of these types of economic activity, a significant part of the gross value added is formed (Table 1). It should also take into account the fact that any failures and externalities that are observed within this type of economic activity are particularly sensitive from the point of view of ensuring social stability, as well as public order. The problems of the presence of certain product groups in retail chains also deserve special attention, while any supply disruptions or price imbalances can have a significant public response. [1; 2]

Table 1.

Gross value added in the sectors of the economy of the Russian Federation in 2014-2018, in 2016 prices [3]

	2014	2015	2016	2017	2018
Gross value added in the wholesale and retail trade, repair of motor vehicles and motorcycles, million rubles	12740378	11862435	11391106	11670953	11922641
Activities of hotels and catering establishments, million rubles	754409,8	734914,4	700979,2	722063,8	766661,5
Total gross value added for all industries, million rubles	78515041	77141743	77475287	78675201	80436919
The share of wholesale and retail trade, repair of motor vehicles and motorcycles in the total gross value added	16,23%	15,38%	14,70%	14,83%	14,82%
For hotels and catering establishments in the total gross value added	0,96%	0,95%	0,90%	0,92%	0,95%

In a situation where the state is practically not represented in the retail and catering sector in any way, the levers of influence on such problematic situations are extremely limited. The state has instruments for the implementation of regulatory functions, where the relevant body is the Federal Antimonopoly Service (hereinafter – FAS), which monitors the facts of abuse of a dominant market position.

Despite the significant set of regulatory tools that the FAS can use in this case, it should be noted that there are a number of significant limitations on the potential of administrative measures that can be taken by antimonopoly regulatory authorities:

- significant time lag between the measures taken and their results;
- complete lack of opportunities to influence foreign retail chains and networks of public catering establishments that have decided to cease their business activities in the Russian Federation;
- complete lack of opportunities to influence foreign retail chains and networks of public catering establishments that carry out hidden forms of stimulating import supplies of products that have an adequate replacement with Russian analogues and substitute goods;

- complete lack of opportunities to influence importers who have decided to unilaterally stop supplying products to the Russian market.

At the same time, outside the tools of state regulation and ensuring economic security, there remain issues of protecting the interests of domestic producers, which, among other things, carry out the production of import-substituting products.

Separately, it should be taken into account the fact that some features of the functioning of trade and catering enterprises are sensitive for the state from the point of view of ensuring social stability in society. World practice and historical experience show that some short-term problems and difficulties in the sale of certain consumer and industrial goods can be a trigger for destabilizing the situation in society. At the same time, often such difficulties can be created artificially, including with the participation of foreign agents. In our opinion, the simultaneous decision-making on the withdrawal from the Russian business of a number of foreign retail chains and catering chains had an initial goal - to achieve precisely destructive goals and in reality were not economically justified in any way.

In modern conditions, all of the above problematic issues are maximally actualized due to the fact that the sphere of trade in our country is largely represented by foreign trade networks that actually import their services. In addition to dominating the market of services of certain regions and territories, foreign retail chains also promote significant volumes of imported consumer goods (food and non-food products). These circumstances had a number of negative consequences, which increased many times after the strengthening of the sanctions policy of unfriendly countries and their economic aggression against the Russian Federation after the start of a special military operation on the territory of Ukraine on 02.24.2022 (Table 2).

Table 2.

Risks of threats and adverse consequences of high import dependence of the trade sphere in the conditions before and after the tightening of the sanctions politicians of unfriendly states

Before the active phase of economic aggression of unfriendly countries	After the active phase of economic aggression of unfriendly countries
Low level of reinvestment. Orientation to the export of capital. The volume of exported capital for many years of being on the Russian market has repeatedly exceeded the initial investment	
Promotion of imported goods in foreign retail chains. Abuse of market power, manifested in the creation of obviously unfavorable conditions for the admission of some domestic goods	
Low level of localization of production of goods sold under corporate brands of retail chains	

	The threat of closure of enterprises and mass dismissal of staff
	Deliberate creation of a commodity shortage
	Abuse of monopoly position in certain sectors of food and non-food trade
	Unjustified price increases, provocation of avalanche-like inflationary processes
	Pressure on the commercial rental market, the threat of closure of large commercial enterprises that continue to incur losses amid restrictions related to Covid-19

It should be noted that a number of foreign trade and catering enterprises have already announced the closure of their business and exit from the Russian Federation market. At the same time, a significant part of foreign enterprises remain loyal to the Russian market, despite the fact that they continue to feel significant pressure on their management in terms of making a decision to exit the Russian market. In our opinion, this kind of loyalty is extremely important for the Russian economy and the firm fulfillment of their social and business obligations by foreign enterprises deserves an appropriate assessment from the competent regulatory authorities.

At the same time, risks regarding the further withdrawal of foreign business from Russian retail and catering remain. At the same time, the unjustified public response of such processes is growing. We also note the increasing social burden on the labor market that has arisen due to the materialization of the risks of foreign enterprises leaving the market (Table 3).

Table 3.

The number of personnel of large foreign network structures (retail and catering) that have publicly announced their plans for further economic activity in the Russian Federation after the tightening of the sanctions politicians of unfriendly states

Network structures that announced the closure of business in Russia	Number of staff	Network structures that have announced the continuation of business in Russia	Number of staff
McDonalds	62000	Leroy Merlin Russia	42419
Pepsico	19000	Ashcan Retail Russia	33000
IKEA	15000	МЕТРО Cash and Cary Russia	20000
Yum! Brands	14500	Globus Россия	11000

Inditex S.A. (Zara Home, Massimo Dutti, Bershka, Oysho, Pull & Bear, Stradivarius)	8840	Castorama Russia	3000
Adidas	5539	Selgros Cash&Carry Russia /Global Foods	2000
Mothercare	4500	PRISMA	1200
OBI	4259		
H&M	3542		
Другие	30960		
Total	168140		112619

In our opinion, special attention should be paid to the fact that ensuring economic security within the framework of the studied types of economic activity is achieved precisely at the regional level, which is explained by the focus of state policy on the development of regional network structures capable of diversifying national retail and catering networks. That is why a significant role in the framework of our proposed system is played by regional management structures and their associations that perform import substitution functions.

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附加教育计划在“兽医”专业中对农产工业综合体经济人员配备的作用
**THE ROLE OF ADDITIONAL EDUCATIONAL PROGRAMS IN THE
SPECIALTY "VETERINARY" FOR THE STAFFING OF THE AGRO-
INDUSTRIAL COMPLEX ECONOMY**

Solodovnik Aleksandra Igorevna

Candidate of Economic Sciences, Chief Specialist,

Savkin Vladimir Ivanovich

Doctor of Economic Sciences, Professor,

Amelina Anastasiya Vladimirovna

Candidate of Economic Sciences, vice director

Orel State Agrarian University named after N.V. Parakhin

抽象的。本文讨论了继续教育和附加教育计划在规划教育轨迹和为农工综合体人员配备高级培训的框架中的作用问题。该研究证实了继续教育在信息数字农业发展背景下的相关性。作者提请注意“兽医学”专业附加教育计划中能力发展的问题和特点。能力是现代教育的主要优先事项之一，尤其是在区域和部门层面的劳动力市场竞争关系中。研究分析表明，继续教育有可能让人们为不断变化的劳动力市场做好准备。额外的教育有助于开发可持续经济发展领域的劳动力潜力。文章强调需要整合所有形式和水平的教育和培训，以促进终身学习。

关键词：终身教育，附加教育计划，农工综合体，专业教育，合格人才

Abstract. *The article discusses the issues of the role of continuing education and additional educational programs in the framework of planning an educational trajectory and advanced training for staffing the agro-industrial complex. The study confirms the relevance of continuous education in the context of the development of information-digital agriculture. The authors draw attention to the problems and features of the development of competencies in additional educational programs for the specialty "Veterinary Medicine". Competencies are one of the main priorities in modern education, especially in competitive relations in the labor market at the regional and sectoral levels. Research analysis shows that continuing education has the potential to prepare people for an ever-changing labor market. Additional education contributes to the development of labor potential in the field of sustainable economic development. The article highlights the need to integrate all forms and levels of education and training to promote lifelong learning.*

Keywords: *lifelong education, additional educational programs, agro-industrial complex, professional education, qualified personnel*

Introduction

In the information-digital economy, questions about the role and place of continuous and additional education in the formation of human capital based on the competence-based model of education throughout life become relevant. The practice of staffing organizations of the agro-industrial complex for the specialty "Veterinary" in higher educational institutions is characterized by the presence of basic professional educational programs of higher education and training programs for highly qualified personnel. Veterinary education in the context of the development of information-digital agriculture requires additional levels of training for professional activities, taking into account the practical orientation and features of the sub-sectors of the agro-industrial complex [5]. Additional education programs allow you to update and acquire new skills and competencies that allow you to perform labor functions in new business conditions, the development of scientific achievements in veterinary science. The role of additional educational programs is increasing due to the introduction of information and digital technologies and an increase in the productivity of the production process and labor [3]. New biotechnologies combine innovative digital technologies, the development and management of which requires staffing through training/retraining of specialists [2]. A feature of additional educational programs is the definition and use of the competence / part of the competences of professional standards.

Materials and Methods

For the purposes of the research were studied statistical reports and forecasts from the economic literature, Internet resources. The methodological basis of the study was the economic and statistical method, the principles of dialectics, comparative analysis, systemic and institutional approaches. The theoretical and informational base was the publications of domestic and foreign scientists on the effective functioning of agro-industrial production, the concept of lifelong education, the digital economy and other aspects of improving the efficiency of the national economy. The influence of such trends as the formation of an information-digital society, the development of information networks, the virtualization of companies, blockchain technologies, lead to changes in the system of economic relations. In particular: in the information economy, the production and dissemination of new knowledge and the practice of managing it is inseparable from the human and managerial component; changes in the level of employment in industries, as well as the complication of the multisectoral structure of the national economy and the relationship between its sectors; the competitiveness of economic entities and the national economy is increasingly dependent on scientific and innovative, per-

sonnel and managerial potential; the implementation of state programs for personnel management is aimed at securing university graduates in rural areas with the aim of innovative development of the agro-industrial complex; the development of economic integration is associated with the formation of a certain information network and its expansion, as well as the development of markets for agricultural producers through the Internet, etc.

Results

Under the influence of the rapid obsolescence of professional knowledge and the high dynamics of the creation and dissemination of intellectual creative knowledge, a competency-based model of continuous education is being formed. The new reality of the modern labor market is continuous continuous learning, creative work, self-realization in the context of increasing information mobility. The Russian labor market is characterized by inter-company mobility rather than intra-organizational career trajectory, so investment in human capital is less profitable. And continuing education is perceived as a function to supplement, update qualifications, or as a requirement in accordance with professional standards. One of the problems in modern veterinary medicine is resistance to microbes that are resistant to drugs that destroy them. The problem affects livestock and food security. Therefore, the need to remove attention to the issues of veterinary and sanitary examination of food raw materials, veterinary practice and animal husbandry has increased significantly. The solution of this problem is impossible without the training of specialists and the wide replication of experience in the containment of antimicrobial resistance. In the context of the formation of the information-digital economy, the educational sphere is subject to requirements for an individual learning path, flexible updating of human capital competencies [4]. Figure 1 shows the dynamics of the participation of the population in lifelong education.

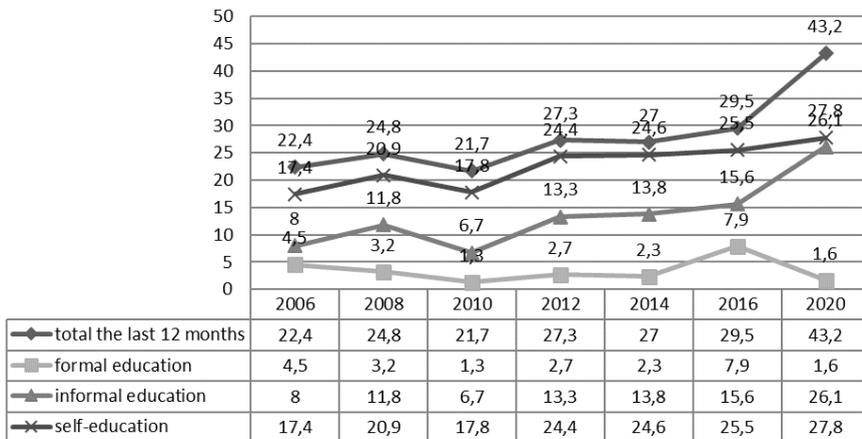


Figure 1. Participation of the population in lifelong education (as a percentage of the number of respondents aged 25-64)* [7, 8, 9]

* For 12 months, respondents could receive training both in the field of formal education and in additional education courses, as well as engage in self-education.

The purpose of developing a program of additional education in the specialty "Veterinary" is to increase the level of knowledge, skills and practical skills of specialists responsible for prescribing antimicrobial drugs for veterinary use, in the field of food quality control and veterinary and sanitary examination of food raw materials. The subjects of the educational program are groups of specialists - veterinarians, microbiologists, chemical engineers, specialists from testing laboratories and quality control centers, veterinary diagnostics laboratories. The scope of the program is animal husbandry, food production of animal origin, "smart agriculture", "digital agriculture", circular and green economy.

The assessment of the levels of formation of skills and competencies, their dynamics in the process of implementing an additional educational program correspond to organizational and pedagogical procedures [6].

The process of planning and implementing an additional educational program in the specialty "Veterinary" is an educational, design and operational activity that ensures the integration of an educational organization, labor resources and agricultural organizations. In the process of approbation, much attention is paid to the scientific content of the program, the study of the real livestock sector, feedback from both students and customers. The process of preparation and lifelong learning in relation to higher educational institutions should form a single educational space, including additional preschool, pre-university school, university, postgraduate education, including educational, general development programs, professional edu-

cation (bachelor's, specialist's, master's), postgraduate, doctoral studies, advanced training, retraining of personnel, international educational programs (Figure 2)

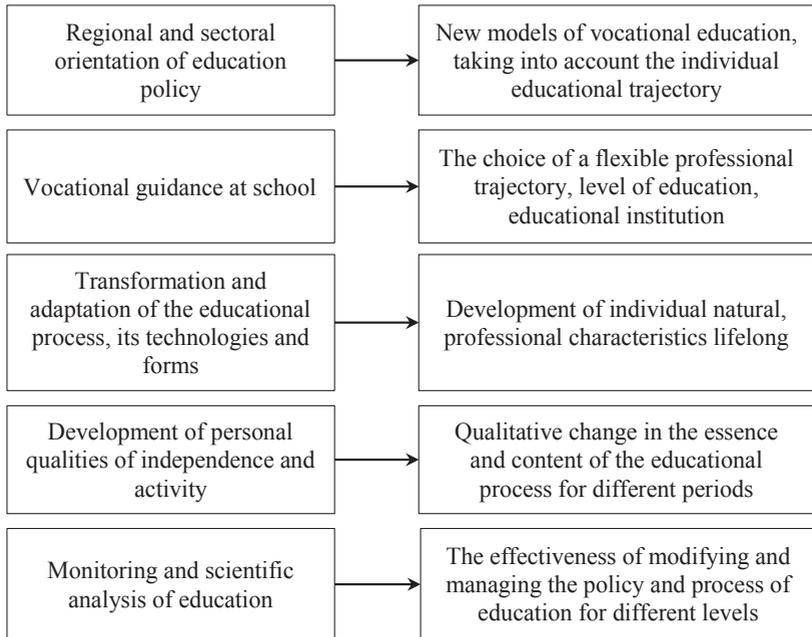


Figure 2. The system of a single educational space in the concept of lifelong education

Institutional national and international systems of quality assurance and accreditation of education should be restructured in the framework of lifelong learning, which will effectively navigate in various areas of flexible learning. Qualifications frameworks, such as those in occupational standards, have great potential and also enable trained workers to transfer their country's qualifications for employment abroad.

Discussion

In general, the design of additional education programs in the veterinary direction is not possible without taking into account the accumulated empirical experience in related programs [1]. Features of the education model in the information-digital and knowledge economy are manifested in the variety of resources used in training: the interaction of educational communities, scientific and educational knowledge, material base, organizational and managerial, educational, scientific, and human capital.

Continuous education allows revealing the priority of creating, disseminating and applying information and knowledge to improve and form competencies that will determine the competitiveness of human capital and organizations. Continuing education allows you to expand competencies and skills, form professional connections, develop social capital, develop a professional labor trajectory, and participate in new forms of employment.

Conclusion

Thus, the system of interaction between an educational organization that implements an additional educational program in the specialty "Veterinary Medicine", with agricultural organizations that send specialists in accordance with the needs, and / or with labor resources that are motivated to obtain high-quality qualification competencies and skills, is aimed at ensuring sustainable functioning and development of the livestock industry and the production of safe food raw materials in the agro-industrial complex of Russia. The influence of external and internal factors, such as professional standards, the creation of new drugs, demography, technologies in the production chain, digitalization of production, competition between manufacturers, the national food standardization system, and others, determine the possibility of updating the content, a high degree of variability, and the choice of forms of education. The role of additional veterinary education reflects the timeliness of creating an additional educational program in the specialty "Veterinary" as part of the response of the system of additional professional education to the trends in the effective use and development of human capital for the development of the agro-industrial complex and the economy as a whole.

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肌肉间协调性作为运动员跑步技术特征准确性的一个因素
**INTERMUSCULAR COORDINATION AS A FACTOR OF ACCURACY
OF THE CHARACTERISTICS OF THE ATHLETE'S RUNNING
TECHNIQUE**

Shimansky Alexander Andreevich

Undergraduate

Tsipin Leonid Lvovich

Doctor of Pedagogic Sciences, Full Professor

Medvedeva Elena Nikolaevna

Doctor of Pedagogic Sciences, Full Professor

*Lesgaft National State University of Physical Education, Sport and
Health, St. Petersburg*

抽象的。在分析高素质运动员在不同配速下跑台技术的过程中,该动作技术的节奏结构特点、肌间协调的表现以及它们在不同配速条件下的相互影响。揭示了心血管系统功能的不同强度。为了记录跑步步骤的参数,使用了肌电图和运动视频捕捉的方法。通过对运动学和肌电指标数理统计分析数据的归纳总结,得出了长距离冲刺跑速度下降的可能原因,以及改善田径跑节奏结构的方向。

关键词: 田径跑步, 运动技术, 运动学特性, 节奏结构, 肌肉电活动, 肌间协调, 效率。

Abstract. *In the process of analyzing the technique of running on a treadmill, performed by a highly qualified athlete at a different pace, the features of the rhythmic structure of the technique of movements, manifestations of intermuscular coordination, as well as their mutual influence under conditions of different intensity of the functioning of the cardiovascular system, were revealed. To register the parameters of the running step, the method of electromyography and video capture of movements was used. Based on the generalization of the data of mathematical and statistical analysis of kinematic and electromyographic indicators, a conclusion was made about the possible reasons for the decrease in running speed in a long sprint and the direction of improving the rhythmic structure of running in athletics.*

Keywords: *athletics running, movement technique, kinematic characteristics, rhythmic structure, muscle electrical activity, intermuscular coordination, efficiency.*

Introduction

Features of the rhythmic structure of competitive movements are the object of study in many sports. And although there are no direct studies that, from a biomechanical point of view, would link rhythm with the stability and reliability of movements, it is assumed that their effectiveness is largely determined by the rhythmic structure of motor actions [1]. For the successful formation of an effective running technique in athletics, a coach and an athlete need to deeply understand and master the tempo-rhythmic structure of movements, their spatial and temporal characteristics, the ratio of various components of the technique due to changes in the level of physical fitness, first of all, the hard-trained qualities of speed, coordination, speed-strength [2,3,4,5]. All this predetermines the result of specific muscular activity. In this regard, the study of intermuscular coordination and its influence on the kinematic structure of high-intensity track and field athletics is relevant for improving the training of athletes.

Research methods and organization

The study involved a highly qualified athlete (CMS), who ran at different speeds on a treadmill (Cosmos Venus, Germany) in intensity zones set using a heart monitor (HR: 120 beats/min; 140 beats/min; 160 beats/min; 180 beats/min).

The bioelectrical activity of the main muscle groups was recorded by bipolar surface electrodes with an active contact area of 2.5 cm² using a ME-6000 16-channel electroneuromyograph (Finland). Registration of electromyograms (EMG) was synchronized with the motion capture video system. The obtained data were processed using the "MegaWin" program. To register the kinematic characteristics of the movements of the lower extremities, a Qualisys 3D motion video capture system (Sweden) was used. Light-reflecting markers were attached on the skin to anthropometric points coinciding with the axes of movement in the main joints of the subject's body (shoulder, hip, knee, and ankle).

Research results and discussion

First of all, for analysis, the full cycle of the running exercise was divided into 2 steps, each of which consisted of: phase 1 - placing the left leg on the support and depreciation; phase 2 - active repulsion with the left foot; phase 3 - flight (unsupported phase). At the same time, to describe the rhythm, a three-beat measure was used, borrowed from the theory of music, which corresponded to successively located efforts in kinematic phases [1], and the boundaries of the measure in running coincided with the boundaries of the cycle.

In the process of analyzing the ratio of phase durations in running cycles - rhythm, it was found that in a highly skilled athlete, with a change in the pace of running, the rhythmic structure changes significantly ($p < 0.05$) (figure 1).

So if the rhythmic structure of running steps at low intensity (120 beats/min) was characterized by the ratio of the duration of the phases of the step of the left

leg "1-2 / 3-1/2", then at an intensity of 180 beats/min - "2/3-1 /3-1". Comparing the indicators, it was confirmed that an increase in running speed leads to a reduction in the setting and repulsion phases (by 0.07 s) and an increase in the duration of the unsupported phase (by 0.08 s).

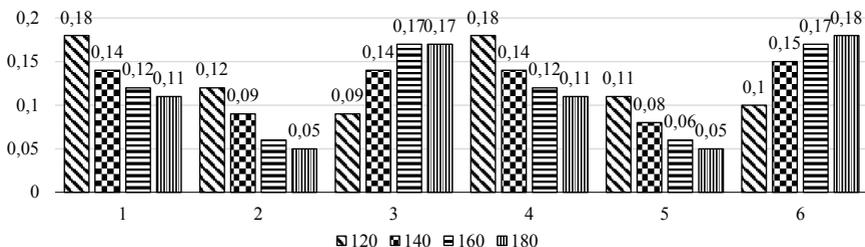


Figure 1. The duration of the phases of the running steps of a highly skilled sprinter in different zones of intensity (N=12; s)

Note. Running phases: 1 - placing the left leg on the support and depreciation; 2 - active repulsion with the left foot; 3 - flight; 4 - setting the right leg on a support and depreciation; 5 - active repulsion right; 6 - flight.

Given that with an increase in the pace of running, the rhythmic structure of the movement acquires the features of an integrative system due to the fact that the muscles simultaneously provide the solution of several tasks (develop traction, recuperate energy, increase the rigidity of the musculoskeletal system) [1], an analysis of the integrated bioelectrical activity (IBEA) of the athlete's muscles was carried out (figure 2).

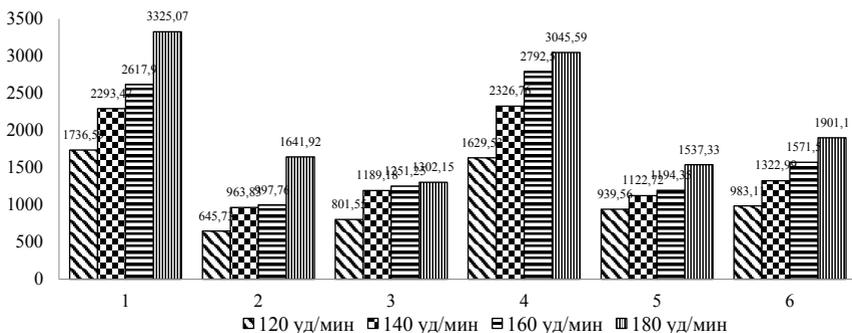


Figure 2. Integrated bioelectrical activity of the muscles of a highly qualified athlete in the phases of the running step in different zones of intensity (N=12; μV)

Note. Running phases: 1 - placing the left leg on the support and depreciation; 2 - active repulsion with the left foot; 3 - flight; 4 - setting the right leg on a support and depreciation; 5 - active repulsion right; 6 - flight.

Analyzing the dynamics of this indicator, the problem of assessing the adequacy of muscle activation in each intensity zone and phase of the running step was solved, taking into account changes in motor tasks. Thus, in 86.5% of the analyzed attempts, a highly qualified sprinter was characterized by the following ratio in the manifestation of IBEA in the phases of the steps of the full cycle of running: 1-3-2 and 4-6-5. Changes in the athlete's IBEA ratio occurred only when running at the maximum pace: this indicator was significantly higher during repulsion ($p < 0.05$) than in the unsupported phase of the running step.

From the analysis data, it followed that the increase in the pace of running was provided by an adequate increase in muscle activity. At the same time, the condition for maintaining the rhythmic structure of the running technique in different zones of intensity was the uniformity and stability of the phase structure of the IBEA muscles. This conclusion was confirmed by the results of correlation analysis: the largest number of muscles significant for the duration of running phases was involved in the zone of 180 bpm (25.0%).

In the practice of studying intermuscular coordination, the most accurate and independent indicator of the quality of movement performance is muscle reciprocity, which characterizes the consistency of their work in the "agonist-antagonist" system. An analysis of the average statistical indicators of muscle reciprocity showed that an increase in the pace of running is ensured by optimal activation of the antagonist muscles.

In the zone of low running intensity, the reciprocity of the pairs of muscles "straight thigh and biceps", as well as "anterior tibial and gastrocnemius", "gluteal and straight abdomen" in accordance with the motor task solved in the phase of placing the foot on the support and extending the leg, had the following values: providing a quick repulsion of an explosive nature. The greater the depreciation, which is based on the alternate work of the muscles, the longer the phase of setting and repulsion became. Therefore, upon contact with the support, the reciprocity of the pair of muscles "left anterior tibial - left medial gastrocnemius" was equal to 44% and provided insignificant shock absorption, and the pair of muscles "left rectus femoris - left biceps femoris" corresponded to 60%, providing rigidity of the system when setting the leg.

Comparison of the "profiles" of muscle reciprocity made it possible to establish that complete similarity in rhythm is characteristic of the muscles of the right leg. At the same time, a decrease in consistency in the electrical activation of the muscles of the right thigh occurred only when running at a maximum pace

(180 beats/min). Rhythm disturbance in the intermuscular coordination of the left leg was observed already in high-intensity running (160 beats/min). That is, the tempo-rhythmic structure of the running step with the right foot was more stable, which made it possible to solve the problem of increasing and maintaining the running speed by increasing the frequency of movements.

The analysis of correlation relationships made it possible to reveal the interdependence of muscle reciprocity and the rhythm of the running step (ratio of phase durations) in the process of increasing the intensity of the athlete's run. Regardless of the rate of running of a highly qualified athlete, this pattern was most pronounced in the unsupported phases of the cycle in the pair of muscles "the rectus muscle of the left thigh - the biceps muscle of the left thigh" (46.88%).

It was found that as the pace of running increased, due to the stabilization of reciprocity indicators, the number of significant correlations decreased (from 17 to 9). Thus, in running with average intensity (HR 140 beats/min), the reciprocity of the pairs of muscles "thigh straight - biceps femoris of the right leg" and "abdominal straight - gluteal muscle of the right side of the body" had the greatest influence on running speed. The inverse correlation relationship indicated the need to reduce the duration of the setting phase and pushing away with the left leg while increasing the reciprocity of the muscles of the right leg. And, conversely, a decrease in the reciprocity of the muscles of the right side of the body indicated the importance of amplitude movements in the step of the left leg. That is, during the entire running cycle, regardless of its intensity, the duration of the phases was provided by the intermuscular coordination of the athlete. Timely activation and relaxation of muscles creates the conditions for the effective solution of motor tasks, taking into account the structure of movement and the achievement of the highest running speed with optimal energy consumption.

Conclusion

Thus, during the entire running cycle, regardless of its intensity, the duration of the phases ensures the intermuscular coordination of the athlete. Timely activation and relaxation of muscles provides an effective solution of motor tasks, taking into account the structure of movement and the achievement of the highest running speed with optimal energy consumption.

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儿童附加教育教育计划设计中的远程学习技术

**DISTANCE LEARNING TECHNOLOGIES IN THE DESIGN OF THE
EDUCATIONAL PROGRAM OF ADDITIONAL EDUCATION FOR
CHILDREN**

Smurova Natalia Fedorovna

postgraduate

Nevinnomyssk State Humanitarian and Technical Institute

Deputy Director

"House of Children's Creativity" S. Kochubeyevskoye, Russia

Filimonyuk Lyudmila Andreevna

Doctor of Pedagogical Sciences, Full Professor

Nevinnomyssk State Humanitarian and Technical Institute,

North Caucasus Federal University

注解。 文章涉及在远程技术的帮助下组织附加教育机构儿童教育的问题, 教师方法培训问题, 激活父母在儿童附加教育中的作用以及主要问题 以及利用远程技术发展附加教育系统的前景。

关键词: 教育技术, 远程学习, 附加教育, 普通教育计划, 附加教育教师。

Annotation. *The article deals with the problems of organizing the education of children of the institution of additional education with the help of distance technologies, the problem of methodological training of teachers, the activation of the role of parents in the additional education of children and the main problems and prospects for the development of the system of additional education using distance technologies.*

Keywords: *educational technologies, distance learning, additional education, general education program, teacher of additional education.*

Informatization of society is an absolute factor in the development of the educational environment, in which distance learning becomes one of the structures of continuous knowledge formation without any restrictions, without taking into account the territorial location of the educational organization [5].

Additional education of children is actively mastering distance education technologies, which makes it possible to ensure the choice of the mode, the pace of mastering additional general development programs, to build individual educa-

tional trajectories (gifted children, children with disabilities).

Today, the emphasis is shifting from learning (the teacher teaches) to studying (the student studies) it is no longer a new educational paradigm: in the modern learning model, a teacher should act as a tutor-consultant, mediator-mediator or a link between the organizational and technological learning environment and the student. The peculiarity of the present time is that students receive a large amount of important knowledge for them outside the walls of an educational institution. And this is done outside of the organizational and activity structure that the educational institution offers for training [1].

Practice shows that key competencies are formed only in the experience of their own activities, therefore, the educational environment should be built in such a way that the child finds himself in situations that contribute to their formation. We are talking about both the content of training courses and the forms of organization of the educational process.

Sanitarova N.D. understands the design of an educational program by teachers of additional education as a collective innovative managerial and pedagogical activity to create interdisciplinary projects of educational activity of students (multidisciplinary and single-profile), ensuring their creative self-realization in the chosen direction or profile of additional education [4]. The result of such design is the advanced development of teachers' creative abilities, which is expressed in their professional maturity, which includes design and technological competence and characterizes their readiness to create psychological and pedagogical conditions for creative self-realization of students at the stage of implementation of such programs [6].

In MBU TO DDT with Kochubeyevsky designed and implemented a variety of additional general education programs in the areas of work of the educational institution: artistic, socio-humanitarian, physical culture and sports, scientific and technical, tourist and local history.

In the period from 2020 to 2022 academic years, there is a quantitative dynamics of additional general education programs in duration: one year, two to three years, three to five years.

The designed additional general education programs are aimed at developing children's cognitive interests, expanding horizons, revealing creative potential, mastering the skills of subject-practical activity, for a more in-depth study of the chosen field of activity by children, acquisition by students of a wide range of skills of a more complex level [2-3]. In DDT, program design is carried out by creative problem groups, which include teachers, methodologists.

The development of additional general education programs determines: the choice of methodological bases for the design of programs; the definition of value-semantic bases for the design; goal setting; the definition of a social order for the program; the determination of the effectiveness of the program at the end of its

implementation; the selection of content, methods, learning technologies; quality assessment.

Designing an additional general development program allows you to ensure the quality of the educational process of the institution.

In 2020, in connection with the quarantine in MBU BEFORE DDT, distance learning was organized. This form of training is not new, it was used in the institution sporadically. But the complete transition of all DDT educational activities to a distance learning format was defined as innovative.

The main objectives of distance learning in MBU BEFORE DDT are:

- providing access to education for students regardless of their location;
- the possibility of maintaining the contingent of students in an educational institution by providing educational services in the most convenient form (in the case of the introduction of certain restrictive measures).

Classes were held in various forms using electronic educational resources and online platforms. During the period of work, each teacher has compiled a curriculum, approved a schedule taking into account the capabilities of each student.

The sources of knowledge were information resources of the Internet, both specially prepared and already existing in the basic telecommunications environment (in the on-line system is a system of communication between the teacher and students in real time (webinars, online classes)), practical classes in all technological environments – electronic platforms, ZOOM application, messengers WhatsApp, Facebook, Viber.

45 teachers of the institution took part in the survey. The results of the teachers' survey "What remote tools do you use" are shown in Figure 1.

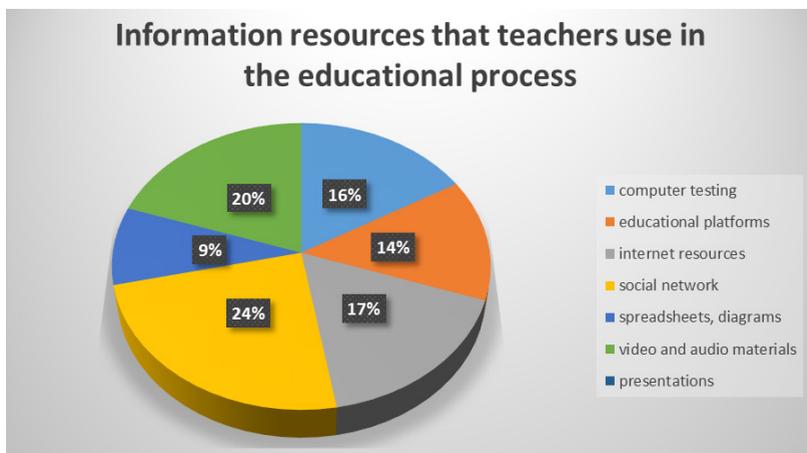


Figure 1. Results of a survey of teachers "What remote tools do you use"

Most of the teachers used messengers for training (Whatsapp, VKontakte. Odnoklassniki) and online workshops, various Internet resources were also popular. Video and audio materials.

Interactive interaction of teachers and students in the learning process provided children with the opportunity to work independently with information sources of the network, assessment of knowledge and skills acquired during training.

With the help of distance learning, the following tasks were solved: to form students' cognitive independence and activity; to create an effective educational space.

When organizing distance learning, we have identified the following opportunities:

- the possibility of continuing education in additional general educational general development programs with the introduction of quarantine;
- getting access to an extensive database;
- ensuring access to education for children who for some reason cannot attend the institution (children with disabilities).

The content of additional general education programs was adjusted taking into account the introduction of a distance learning regime (changes to the educational and thematic plan and the content of classes).

The teachers carried out the design of their further pedagogical activities taking into account the use of remote technologies, including the study of new educational resources for use in the classroom (platforms, websites, workshops, web classes). We also tested the work on platforms (we tried to work it out ourselves in practice).

The selection of the necessary materials for the organization of distance learning was carried out, which were included in the content of general education programs: online tasks, video lectures, presentations, master classes, viewing and participation in virtual exhibitions, electronic excursions, etc. The simplest and most understandable online tasks were created, systems for monitoring the activities of students and their development were developed general education programs: evaluation and diagnostic materials. Target groups were created in social networks, messengers for prompt feedback with students and their parents; remote counseling of target groups, individual counseling on all emerging issues of students and parents by phone, via e-mail; individual educational routes for gifted children and children with disabilities were developed - the creation of special pedagogical conditions for the possibility of the choice of methods, forms and methods of teaching, allowing to support various educational interests of students during training.

The methodologists of MBU BEFORE DDT developed methodological recommendations, teaching aids for the study of certain topics of additional general educational general development programs, online classes.

During the transition of the educational process of MBU TO DDT in the distance form, in 2020, mandatory monitoring of the involvement of each child in the learning process was developed.

Students and their parents sent reports on the completion of the task in a pre-set time by a personal message to the teacher's email address, to groups in social networks, messengers, WhatsApp, Viber, Skype chats for verification.

In case of difficulties in doing the work, students received an online consultation from a teacher, worked on mistakes.

Teachers regularly informed parents studying about the course of the educational process in the distance learning mode.

In the absence of technical capabilities – a computer or the Internet for the child, the training was organized in other accessible ways that do not violate sanitary norms and requirements. The assistant in supporting communication between students, teachers and parents, in this case, were the classroom teachers of the children.

Teachers in the process of remote work exchanged information among themselves on interesting forms of work that allowed them to activate not only students, but also their parents.

The teachers of the institution carried out work to create conditions for independent and research activities of students (development of creative tasks; projects, execution of works timed to all-Russian holidays and significant dates, organization of online exhibitions).

The use of distance learning during a difficult epidemiological situation and self-isolation in 2020 contributed to an increase in parents' interest in conducting classes and the child's participation in them by 40%.

The formed model of distance learning in DDT showed the following results:

- teachers have become more effective in using Internet resources for conducting classes in an online format, providing students with more opportunities for high-quality mastering of program material;
- teachers use various forms of training, conduct online master classes, and also attract students themselves to conduct master classes.

Table 1.

Analysis of the use of remote technologies in the implementation of additional general education programs in DDT for 3 years

A year of training with the use of UP-to-date technologies	2021	2020	2019
Number of students %	50- 80%	10-30%	15 - 20%

From the above table it can be seen that the largest number of associations in DDT are represented by artistic, physical culture, sports and socio-humanitarian orientation.

Table 2.

Analysis of the enrollment of students in training using distance learning technologies for the 2020-2021 academic year

The focus of the programs	Number of groups	Number of students
Artistic	120	1375
Physical culture and sports	13	150
Technical	4	24
Social and humanitarian	17	192
Tourist and local history	2	24
Social and humanitarian (ovz)	1	6
Artistic (ovz)	3	20
Total	160	1791

The largest number of MBU students BEFORE DDT are children of primary school age, which is associated with a social order (interest in additional education of parents of this age), on the one hand, and on the other - with the largest number of associations focused on this age.

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生物系统的遍历性问题

THE PROBLEM OF ERGODICITY OF BIOSYSTEMS

Filatov Mikhail Alexandrovich

*Doctor of Biological Sciences, Full Professor
Surgut State University*

Eskov Valery Matveevich

*Doctor of Physical and Mathematical Sciences,
Doctor of Biological Sciences, Full Professor
Head of the Department of Biophysics and
neurocybernetics*

*Federal Research Center Research Institute for System Research of the
Russian Academy of Sciences*

Shamov Kirill Alexandrovich

*Undergraduate
Surgut State University
Surgut, Russia*

抽象的。在过去的 150–200 年中，所有生物医学都根据确定性或随机方法进行了研究。这种方法的基础是因果关系的范式。如果我们证明过去对任何生物系统的未来状态没有影响，会发生什么？这就是 Eskov-Zinchenko 效应所证明的。同时证明了 W. Weaver 关于第三类系统的假设。在这种情况下，我们无法预测生物系统的未来，遍历性的特性就丢失了。生物系统参数的任何样本及其统计特征都变得独特。

关键词：随机，混沌，Eskov-Zinchenko 效应。

Abstract. *For the last 150-200 years, all biomedicine has been studied in terms of a deterministic or stochastic approach. The basis of this approach is the paradigm of cause-and-effect relationships. What will happen if we prove the absence of the influence of the past on the future state of any biosystem? This is what was demonstrated in the Eskov-Zinchenko effect. At the same time, W. Weaver's hypothesis about systems of the third type was proved. In this case, we cannot predict the future for biosystems and the property of ergodicity is lost. Any sample of parameters of biosystems and its statistical characteristics become unique.*

Keywords: *stochastics, chaos, Eskov-Zinchenko effect.*

Introduction

More than 70 years ago, one of the founders of information theory, W. Weaver [1], proposed to bring all biosystems beyond the limits of modern deterministic and stochastic science (DSS). He proposed to create a third science after (DSS) to describe systems of the third type (STT) - biosystems.

It is very strange, but no one has paid attention to the work of W. Weaver [1] for these 70 years, and there is a very specific explanation for this. To prove this conjecture, it was necessary to prove special properties (STT), which no one tried to do. However, further it would be necessary to create this new (third) science. There were no people willing to do this in the last 70 years.

Twenty years ago, a group of scientists from the city of Surgut (Russia) first started testing the hypothesis of W. Weaver (STT - not an object of DSS), and then began to create a new, third science in the form of the theory of chaos-selforganization (TCS) [2-9]. TCS is based on the proof of the loss of ergodicity of STT.

Obviously, the basis of DSM in biomedicine is the presence of cause-and-effect relationships for any biosystems. This means that any sample of any biosystem parameter $x_i(t)$ can be statistically repeated, that is, it can be predictable. What happens if any sample is unique, and its numerical characteristics over time are unstable? This is exactly what we proved 20 years ago, first in biomechanics, and then in all biology, medicine, psychology, ecology and other sciences about living systems [9-16].

1. Why are biosystems not a DSS object?

We emphasize once again: all modern science (DSS) is based on the dogma that the value of the past state of the biosystem vector $x=x(t)=(x_1, x_2, \dots, x_m)^T$ in the m-dimensional phase state space (PSS) gives complete information about the future state of the STT (biosystem). However, this is a fatal dogma about ergodicity in the dynamics of STT behavior [2-9].

Indeed, back in 1947, the outstanding biomechanic of the 20th century, N.A. Bernstein put forward the hypothesis of "repetition without repetition" in the organization of any movement. However, he did not provide any evidence of this (quantitative). He proved the reality of at least five different systems (systems A, B, C, D, E) in the organization of any movement.

N.A. Bernstein argued (in the monograph "On the construction of movements") that these five systems can be switched on and off chaotically in the organization of movements. Therefore, he spoke about the impossibility of arbitrarily repeating any movement. But he did not prove it quantitatively. It was only a hypothesis. It is strange that for 70 years no one has tested it (except us) in an experiment.

A year later, in 1948, W. Weaver publishes his outstanding article "Science and complexity", where he directly points out that biosystems are not an object of modern science [1]. In this article, W. Weaver takes all biosystems (systems of the

third type - STT) beyond the limits of modern deterministic and stochastic science (DSS). From requires the creation of a new (third) science to describe and study biosystems [1].

It is significant that, like N.A. Bernstein, W. Weaver did not provide any quantitative evidence for this hypothesis of his (STT is not a DSS object). These two hypotheses have remained unnoticed for more than 50 years. This is an amazing situation for science, because it was necessary to combine them together and test the stability of any sample of any biosystem parameter (STT) in an experiment [2-9].

It was necessary to repeat the same experiment many times with the same biosystem (in its unchanged state) and test the hypothesis of "repetition without repetition" and that STTs cannot be a DSS object. It is obvious that the proof of these hypotheses would destroy all modern biomedicine, psychology, ecology and other sciences about living systems [2-10].

All these sciences are based on the dogma that any selection of any parameter $x_1(t)$ of a biosystem can objectively describe the state of this biosystem. It is very surprising that in the 150-200 years of the existence of the life systems sciences, everyone was confident that the sample $x_1(t)$ provides objective information about these STTs. This was a huge mistake and an illusion by DSS.

In fact, when we measure the parameters $x_i(t)$ for STT over a time interval Δt , we know nothing about the state of the STT before this interval Δt_1 . We do not know anything about what happened to STT in the time interval Δt_1 and Δt_2 (on Δt_2 we register the second sample $x(t)$) and we do not know anything about what happens to STT after Δt_2 . We do not continuously monitor biosystems and this is a DSS error [9-16].

It turned out that even two neighboring samples $x(t)$, which were obtained in a row on the intervals Δt_1 and Δt_2 , have the probability of statistical coincidence $p_{i,j} \leq 0.05$ in biomechanics and $p_{i,j} \leq 0.05$ in cardiology, electromyography and in many other STT measurements. Biosystems (STT) cannot demonstrate the statistical stability of samples of their parameters $x(t)$ [9-16].

Twenty years ago, we began to test this thesis, first in biomechanics. When registering tremorograms (postural tremor of the fingers) - TMG in 5 seconds. It turned out that two adjacent TMG samples can statistically coincide with the frequency $p_{i,i+1}^* \leq 0.05$. This is a very small amount. As an example, we present a comparison of 15 TMG samples from one subject in tab. 1. In this table. 1, we introduce the Wilcoxon test p_{ij} in the statistical comparison of the i -th and j -th TMG samples.

Table 1.

The results of pairwise comparison according to the Wilcoxon test of TMG of one subject (GDV) with repeated measurements (in a row) in a short time ($T=5$ sec), the number of matches $k_i=6$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1		0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00		0.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.07	0.00	0.99	0.00		0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.28	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00		0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.09	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.01
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00		0.09	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.09		0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	

If we register 15 TMG samples in a row (for one person), and then build a matrix of paired comparison of samples of these TMG, then in such a matrix of 105 different comparison pairs there will be no more than $K \leq 5\%$ of pairs for which the Wilcoxon criterion $p_{ij} \geq 0.05$. In tab. 1 there are only $k_i=6$ such pairs.

This means that more than 95% of TMG sample comparison pairs fail to show statistical agreement. Their statistical characteristics (statistical mean $\langle x \rangle$, statistical variance (D_x^*), signal spectral density (SPS), autocorrelation (AC), etc.) do not match. This indicates a complete loss of ergodicity of the TMG samples. For example, we present a typical tab 1. in which the number k of pairs of TMG samples with $p_{ij} \geq 0.05$ is very small ($k=6$) and this proves the hypotheses of N.A. Bernstein and W.Weaver.

A sample of TMG randomly cannot be repeated statistically. We have proved this experimentally over the past 20 years for any parameters of the functions of the human body $x(t)$. The connection between the past and the future is broken for STT, and this is the basis of all modern DSS.

If the past does not predict the future, then any model (in the form of equations or statistical functions $f(x)$) has no information value. It describes the past for

S TT, the sample $x(t)$ is unique [2-10]. Obviously, it makes no sense to work with samples within the framework of statistics. This is the end of DSS for S TT, since it is no longer possible to describe unique systems in DSS.

2. The loss of ergodicity of S TT requires the creation of a new science.

Over the past 20 years, such statistical instability of S TT samples has been proven for many parameters of the human body. It turned out that the intervention of consciousness (in the organization of tapping - vertical oscillatory movements of the finger) increase the share of stochastics to 15% (and no more). We obtained the same numbers $k < 15$ for electromyograms (EMG), cardiointervals (CI) and for other 15 parameters of the heart, for tremorograms (TMG) and even for electroencephalograms (EEG). Although for EEG the number k can reach 30-35% of 105 pairs. In general, any S TT sample is statistically unstable. This completes the application of DSS for S TT [2-16].

Table 2.

Matrix of paired comparison of 15 samples of parameters of cardiointervals of one subject in repeated experiments ($k_2=9$) using the nonparametric Wilcoxon P test (critical level $P \geq 0.05$)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1		0,00	0,73	0,00	0,00	0,20	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,08	0,00
2	0,00		0,00	0,00	0,00	0,01	0,08	0,00	0,00	0,00	0,00	0,00	0,15	0,04	0,00
3	0,73	0,00		0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00
4	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5	0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
6	0,20	0,01	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,70	0,00
7	0,00	0,08	0,02	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00	0,91	0,00	0,00
8	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,02	0,00	0,00	0,00	0,00	0,00	0,00
9	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02		0,00	0,00	0,00	0,00	0,00	0,00
10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,00	0,00
11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,00	0,00	0,00	0,10
12	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,00	0,00	0,08
13	0,01	0,15	0,01	0,00	0,00	0,00	0,91	0,00	0,00	0,00	0,00	0,00		0,00	0,00
14	0,08	0,04	0,00	0,00	0,00	0,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00		0,00
15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,10	0,08	0,00	0,00	

As an example, we present tab. 2 for 15 CI samples from the same subject (in a calm physiological state). Note that we received several thousand such tables (as tab. 2 for CI) and observed the same pattern: $k_2 < 15\%$. This is called the Eskov-

Zinchenko effect (EZE) and it has now been proven for any parameters of the human body. The EZE is global and completes the application of DSS in the study of biosystems.

Clearly, other models and methods are needed to study STT. This is exactly what W.Weaver was talking about, but his theory was stubbornly ignored for 50 years. Only our scientific school proved EEZ and began to create a new science - the theory of chaos-self-organization (TCS). It is based on new concepts and new models. TCS introduces uncertainties of the 1st and 2nd types, an analogue of the Heisenberg uncertainty principle [2-9], the concept of a pseudo-attractor (PA). All this takes TCS (and STT) out of the DSS domain [9-16].

Discussion

The outstanding biomechanic N.A. Bernstein and the founder of information theory W.Weaver proposed brilliant hypotheses. However, for more than 50 years, all the scientists of the world ignored their work. It is now obvious that their proof required going beyond the limits of modern science (DSS) [2-16]. Twenty years ago, we began testing these hypotheses and proved EHZ. In this EEZ, there is a loss of ergodicity of the STT. This means that any sample of any biosystem parameter is unique. It does not provide information to predict the future state of the STT. This marks the end of DSS [2-9].

Further application of DSS methods and models is equivalent to the fact that we are trying to describe any distribution function $f(x)$ with one (arbitrary) point. This is an absurdity, and the whole of biomedicine is in this absurdity. Just as one point cannot describe the statistical distribution function (we need a sample - the area of points $x(t)$ in PSS), so one sample cannot describe any biosystem (STT). This shows the comparison of samples in the form of tab. 1 and tab 2. The share of stochastics for STT is usually less than 20% [9-16].

Statistics (DSS) cannot describe non-ergodic systems, because numerical characteristics $x(t)$ in the form of statistical average $\langle x \rangle$, statistical dispersion (D_x^*), signal spectral density (SSD), autocorrelation (AC), etc. change continuously and randomly. Statistics describe the past of STT and cannot describe what happened before Δt , between Δt_1 and Δt_2 , and after Δt_2 . Everything changes randomly.

Hence the conclusion follows that W. Weaver was right and STT requires the creation of a new (third) science after DSS to describe living systems. The EEA is global and cannot be described in different DSS.

Conclusions

The hypotheses of two scientists (N.A. Bernshtein W.Weaver) have now been proved by us in the form of EEZ. This means that STTs are not ergodic, they do not have statistical stability of samples $x(t)$ over time. This completes the application of DSS to describe STT.

There is an urgent need to create a new (third after DSS) science. After proving EEZ, we began to create such a science in the form of TCS. In this TCS, uncertainties of the 1st and 2nd types are proved, the concept of a pseudoattractor and a new understanding of the evolution of biosystems in TCS are introduced, new concepts of rest and motion for the vector $x(t)$ are introduced.

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治疗师实践中头部主要动脉的动脉粥样硬化和动脉僵硬
**ATHEROSCLEROSIS OF THE MAIN ARTERIES OF THE HEAD AND
ARTERIAL STIFFNESS IN THE PRACTICE OF A THERAPIST**

Sapunova Daria Alexandrovna

*Candidate of Medical Sciences, Associate Professor
Moscow State University of Medicine and Dentistry*

注解。 动脉僵硬度通过脉搏波速度 (PWV) 确定, 并被推荐作为检查动脉高血压患者的方法。 对更年期女性动脉僵硬度的研究在治疗师的实践中仍然具有相关性。 所提出的工作分析了人体测量数据、生化血液分析结果、颈动脉-股动脉 PWV 和头部主要动脉的内膜-中层复合体的厚度。 该研究显示, 当合并动脉高血压和冠心病时, 动脉僵硬度增加, 而在存在 2 型糖尿病的情况下, 该指标进一步增加。 在所有分析的患者组中, 确定颈总动脉内膜-中膜复合体厚度的平均值超过 0.9 mm。

关键词: 动脉僵硬度, 动脉高血压, 更年期

Annotation. *Arterial stiffness is determined through the pulse wave velocity (PWV) and is recommended as a method of examining patients with arterial hypertension. The study of arterial stiffness in women during menopause remains relevant in the practice of a therapist. The presented work analyzed anthropometric data, the results of biochemical blood analysis, carotid-femoral PWV and the thickness of the intima-media complex of the main arteries of the head. The study revealed an increase in arterial stiffness when joining arterial hypertension with coronary heart disease and a further increase in the indicator in the presence of type 2 diabetes. The excess of the average values of the thickness of the intima-media complex of the common carotid arteries was determined to be more than 0.9 mm in all analyzed groups of patients.*

Keywords: *arterial stiffness, arterial hypertension, menopause*

The increase in arterial stiffness reflects the processes of vascular remodeling and is considered among one of the important indicators of the progression of pathology of the cardiovascular system. At the moment, there is enough data on the peculiarities of the formation and course of diseases of the cardiovascular system in women. Female sex hormones have a cardioprotective effect, which extends to the main components of the formation of atherosclerosis, and the loss of their

activity due to menopause deprives the cardiovascular system of this protection [1,2].

In order to compare and assess the severity of lesions of the main and peripheral arteries in patients with various diseases of the cardiovascular system, 50 patients from the group with arterial hypertension (AH), 30 patients with the combined pathology of arterial hypertension and coronary heart disease (AH+CHD), and 15 patients with arterial hypertension, coronary heart disease and type 2 diabetes mellitus (AH+CHD+DM 2) were examined on the basis of the University Clinic. Clinical examination of menopausal patients included clarification of complaints, clarification of gynecological anamnesis (with the duration and nature of menopause), clinical examination with measurement of blood pressure, heart rate, height, weight, waist and hip volume, calculation of the ratio of waist to hip volume and body mass index (BMI). The patients underwent a biochemical blood test: the level of total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides, glucose, urea, creatinine and C-reactive protein was determined. To assess vascular stiffness, ultrasound Doppler examination of the main vessels of the head and measurement of the carotid-femoral pulse wave velocity (PWV c/f) were performed.

Table 1 presents data on anthropological indicators in patients with various diseases of the cardiovascular system (AH; AH+ CHD; AH+CHD+DM 2).

Table 1.

Anthropological data of menopausal patients with various diseases of the cardiovascular system

Indicator	Patients with AH	Patients with AH+CHD	Patients with AH+CHD+DM 2
Number of patients	50	30	15
Age (years)	53,30±7,23	57,6±6,47	55,40±9,31
Height (cm)	163,18±5,05*	161,33±5,25	163,93±5,48
Weight (kg)	76,32±13,62	74,90±11,98	82,67±18,98
BMI (kg/m ²)	28,33±4,53	28,21±4,17	30,37±5,89
Waist volume (cm)	86,84±12,37	88,14±12,21	95,53±12,23
Hip volume (cm)	108,19±10,17	106,33±11,68	109,60±11,34
Ratio of waist to hip volume	0,80±0,06	0,83±0,15**	0,87±0,06***

* - p<0,05 between a group of AH patients and a group of AH+CHD patients

** - p<0,05 between a group of AH+CHD patients and a group of AH+CHD DM 2 patients

*** - p<0,05 between a group of AH patients and a group of AH+CHD+DM 2 patients

The reliability is determined by the ratio of waist volume to hip volume, which tends to increase as the pathology of the cardiovascular system worsens and emphasizes the importance of visceral obesity in the formation of diseases such as coronary heart disease and type 2 diabetes mellitus.

The results of arterial stiffness obtained by determining the pulse wave velocity in the area from the carotid to the femoral artery (PWV c/f) are relevant.

Table 2.

The main indicators of hemodynamics and PWV c/f in patients with various diseases of the cardiovascular system

Indicator	Patients with AH	Patients with AH+CHD	Patients with AH+CHD+DM 2
Systolic blood pressure (mmhg)	142,30±16,17	145,17±15,51	154,00±23,84
Diastolic blood pressure (mmhg)	91,60±9,71	89,50±10,20	92,33±10,67
Heart rate (beats/min)	71,52±10,15	73,60±8,90	79,13±9,84
PWV c/f (m/s)	11,83±3,47	13,16±3,96	15,30±6,86

The growth of heart rate and blood pressure indicators is determined as ischemic heart disease and type 2 diabetes mellitus join arterial hypertension without significant differences.

The PWV c/f index also shows an increase as mutually aggravating diseases are added in the examined patients.

Table 3 shows the results of comparing patients according to the main indicators of biochemical blood analysis.

Table 3.

Indicators of biochemical blood analysis in women with AH, AH+CHD and AH+CHD+DM 2

Indicator	Patients with AH	Patients with AH+CHD	Patients with AH+CHD+DM 2
Total cholesterol (mmol/l)	5,61±1,04	5,80±0,85	5,52±1,42
Triglycerides (mmol/l)	1,39±0,77	1,19±0,78	1,41±0,69
Low-density lipoprotein cholesterol (mmol/l)	3,79±0,77	3,33±1,57	3,39±1,38
High-density lipoprotein cholesterol (mmol/l)	1,41±0,39	1,63±0,37	1,36±0,30

Glucose (mmol/l)	5,21±0,64	5,29±0,91	7,68±1,93***
Urea (mmol/l)	5,49±1,27	6,25±1,90	6,16±1,39
Creatinine (mmol/l)	80,22±16,05	88,73±20,19	85,60±17,07
C-reactive protein (u/l)	1,52±2,80	1,68±3,17	3,44±5,32

*** - $p < 0,05$ between a group of AH patients and a group of AH+CHD+DM 2 patients

No significant differences were obtained, except for the expected increase in glucose levels in the group of patients with concomitant type 2 diabetes mellitus.

Table 4 shows the results of ultrasound of the main arteries of the head of the common carotid artery in the examined patients by nosology groups (AH; AH+CHD; AH+CHD+DM 2).

Table 4.

The average thickness of the intima-media complex of the common carotid artery in patients with various diseases of the cardiovascular system

Indicator	AH		AH+CHD		AH+CHD+DM 2	
	right	left	right	left	right	left
Diameter (mm)	6,92±0,6	6,81±0,6	7,13±0,6	6,95±0,5	7,54±1,38	7,26±1,14
Intima-media complex (mm)	0,95±0,15	0,98±0,13	0,96±0,11	1,00±0,13	1,07±0,47	1,07±0,35

Despite the absence of significant differences, the increase in the average value of the thickness index of the intima-media complex is noteworthy: in all groups, this indicator exceeded the value of 0.9 mm; as the pathology of the cardiovascular system worsened, there was a tendency for this indicator to increase.

An increase in the intima-media complex in an average value of more than 0.9 mm in the group with arterial hypertension indicates an asymptomatic lesion of the common carotid artery as a target organ in arterial hypertension. With the addition of coronary heart disease and diabetes mellitus to hypertension, there is a parallel thickening of the intima-media complex up to 1.00 mm in the group with hypertension and coronary heart disease and up to 1.07 mm in concomitant type 2 diabetes mellitus.

Tables 5 and 6 show the average values of the thickness of the intima-media complex at the level of the right and left internal and external carotid arteries of the patients of the analyzed groups (AH; AH+CHD; AH+CHD+ DM 2).

Table 5.

The average thickness of the intima-media complex of the internal carotid artery in patients with various diseases of the cardiovascular system

Indicator	AH		AH+CHD		AH+CHD+DM 2	
	right	left	right	left	right	left
Diameter (mm)	4,65±0,6 *	4,71±0,5	5,01±0,5	4,94±0,6	5,06±0,7 ***	4,93±0,04
Intima-media complex (MM)	0,85±0,1	0,84±0,1	0,93±0,1	0,91±0,1	0,89±0,2	0,93±0,1

* - $p < 0,05$ between a group of AH patients and a group of AH+CHD patients

*** - $p < 0,05$ between a group of AH patients and a group of AH+CHD+DM 2 patients

Table 6.

The average thickness of the intima-media complex of the external carotid artery in patients with various diseases of the cardiovascular system

Indicator	AH		AH+CHD		AH+CHD+DM 2	
	right	left	right	left	right	left
Diameter (mm)	3,69±0,5	3,69±0,5	3,88±0,4	3,96±0,4	3,87±0,4	3,97±0,4
Intima-media complex (mm)	0,81±0,1	0,79±0,1	0,88±0,1	0,87±0,1	0,83±0,1	0,83±0,2

As a result of the survey, similar results were obtained in terms of the thickness of the intima-media complex in all three groups of women surveyed without significant differences.

The process of thickening in the intima-media complex in all three groups of patients showed a similar trend: the average values of the intima-media complex on both the right and left are almost identical.

Conclusions:

1. As ischemic heart disease and type 2 diabetes mellitus join arterial hypertension, arterial stiffness increases.

2. Analysis of the thickness of the intima-media complex revealed a lesion of the common carotid arteries to a greater extent than the external and internal carotid arteries. The excess of the average values of the thickness of the intima-media complex of the common carotid arteries was determined to be more than 0.9 mm in all analyzed groups.

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高中毕业生的心理健康：压力和自杀行为
**MENTAL HEALTH OF HIGH SCHOOL GRADUATES: STRESS AND
SUICIDAL BEHAVIOR**

Victoria V. Ruzhenkova

MD, Candidate of Medical Sciences, Associate Professor, Head of the Department

Belgorod State National Research University

Konstantin Yu. Retunsky

MD, Candidate of Medical Sciences, Professor

Belgorod State National Research University

抽象的。一半的高中生在通过考试之前经历了极高的情绪压力。在 21.6% 的高中生中检测到有临床意义的抑郁症，在 31.6% 中检测到焦虑症，在 19.1% 中检测到神经衰弱症。在 52.3% 的病例中发现了自杀行为 - 在男性和女性中同样常见。有必要制定和实施计划，以早期发现和预防在校学生的社会心理适应不良、边缘性精神障碍和自杀行为。

关键词：青少年，高中生，边缘性精神障碍，教育压力，自杀行为，心理预防。

Abstract. *Half of high school students experience an extremely high level of emotional stress before passing the exam. Clinically significant depression was detected in 21.6%, anxiety in 31.6% and neurasthenia in 19.1% of high school students. Suicidal behavior was found in 52.3% of cases - equally often in males and females. It is necessary to develop and implement programs for early detection and prevention of conditions of socio-psychological maladaptation, borderline mental disorders and suicidal behavior among school students.*

Keywords: *adolescents, high school students, borderline mental disorders, educational stress, suicidal behavior, psychophylaxis.*

According to the WHO [3], mental health disorders account for 16% of the global burden of disease and injury among people aged 10–19 years, and suicide is the third leading cause of death in the 15–19 age group [3,9]. For every suicide in this age group, there may be up to 100–200 suicide attempts [8]. In terms of the absolute number of suicides among adolescents, Russia ranks first in the world [2]. It is known that among persons with suicidal behavior, persons with mental pathology (from mild forms to severe conditions) predominate [9], and depres-

sive states occupy a leading place in genesis. At the same time, depressive states in adolescents have their own specifics: they are often poorly understood by the children themselves and can be expressed in an increase in aggressive behavior, stubbornness, oppositional behavior, withdrawal into oneself [7]. One of the factors contributing to the manifestation of borderline mental disorders is educational stress [5]. This raises the question of the important role of clinical psychologists and psychiatrists in the system of prevention and post-suicide [6]. However, at the moment, the problem of early detection and prevention of borderline mental disorders and suicidal behavior among children and adolescents has not yet been resolved.

In this regard, the purpose of this study was to analyze the prevalence and clinical and psychological characteristics of borderline mental disorders and suicidal behavior in adolescents in order to develop recommendations for primary psychoprophylaxis.

Participants and research methods

The study involved 455 students of 11 grades of a general school aged 16-18 (16.8 ± 0.5) years: 180 (39.6%) males and 275 (60.4%) females. The study was conducted 1-1.5 months before passing the exams. The main research methods were medical and sociological (anonymous questionnaire using the author's questionnaire in the format of a structured interview), psychometric (DASS-21 tests, SPIN test, Yale-Brown scale, author's structured questionnaire for diagnosing neurasthenia, test on educational stress Yu.V. Shcherbatykh) and statistical (methods of non-parametric statistics). The qualification of suicidal behavior was carried out in accordance with the classification developed by A.G. Ambrumova and V.A. Tikhonenko (1980).

Results and discussion

It was found that 34.3% of preschool and early school students, at the initiative of their parents, sought help from "folk healers" mainly with problems of mild mental disorders (fears, night screams, stuttering). In 11.9% of people for the period of the survey, a diagnosis of vegetative-vascular dystonia was established.

An extremely high level of emotional stress before passing the exam (80-100%) was experienced by 47.9% of students, medium (50-70%) - 29.0%, mild (10-40%) - 18.5% and a complete absence of unrest - 4.6%.

Factor analysis of the symptoms of educational stress revealed 2 significant factors (56.7% of the variance): "Confusion" (due to the high study load, inability to properly allocate time and affective disorders) and "Psychosomatic symptoms". The degree of severity of all symptoms of educational stress in females was statistically significantly higher than in males.

Clinically significant depression (DASS-21 test) was detected in 21.6% of the examined: more often ($\chi^2 = 16.222$ $p = 0.0006$ $OR = 2.9$ $95\% CI = 1.7-5.2$) in fe-

males (27.9%) than male (11.6%). The probability (OR) of detecting depression in females is almost 3 times higher than in males. Depression was more often ($\chi^2 = 6.522$ $p=0.011$ $OR=2.2$ $95\% CI=1.2-4.1$) registered among those living in rural areas - 35% and 19.5%, respectively. Comorbidity of depression with anxiety was 76.5% of cases.

Clinical level anxiety (DASS-21 test) was detected in 31.6% of students, statistically significant ($\chi^2 = 53.451$ $p=0.0005$ $OR=6.1$ $95\%CI=3.6-10.6$) more often in females (44.7%) than males (12.1%). The odds ratio indicates that the probability of detecting clinical level anxiety in girls is more than 6 times higher than in boys. The comorbidity of anxiety with depression was 52.1%. Anxiety more often ($\chi^2 = 16.500$ $p=0.0006$ $OR=2.4$ $95\% CI=1.5-3.6$) was recorded in the subjects who applied for help to "traditional healers" - 44.2% and 25.1% respectively/

Clinically significant symptoms of social phobia (SPIN test) were registered in 54 (11.9%) students: equally often in boys and girls. Social phobias were also equally common among those living in the village (15%) and the city (11.4%). The comorbidity of socio-phobia with depression was 72.2% and anxiety - 77.8% of cases. Those who turned to "folk healers" more often ($\chi^2 = 14.956$ $p=0.007$ $OR=2.7$ $95\% CI=1.6-4.6$) had psychologically understandable fears - respectively 26.9% and 12 % of cases, and the clinical level of social phobia is equally common (11.5% and 12%).

Significant symptoms of obsessive-compulsive disorder (Yale-Brown scale) were detected in 7.3% of the examined: more often ($\chi^2 = 12.476$ $p=0.001$ $OR=7.2$ $95\% CI=2.1-30.2$) in females (10.9%) than the male (1.7%). The odds ratio indicates that the probability of developing OCD in girls is more than 7 times higher than in boys. Also, OCD symptoms were more common ($\chi^2 = 4.912$ $p=0.027$ $OR=2.7$ $95\%CI=1.1-6.6$) in rural areas (15%) than in urban areas (6.1%). Clinically significant symptoms of OCD were more common in those who applied to "traditional healers" ($\chi^2 = 5.549$ $p=0.019$ $OR=2.5$ 5.0% of cases).

Clinically significant symptoms of neurasthenia (author's structured questionnaire) were detected in 19.1% of the examined. They were registered more often ($\chi^2 = 15.060$ $p=0.0007$ $OR=3.0$ $95\%CI=1.7-5.5$) in females (25.1%) than males (10%). The odds ratio showed that the probability of developing neurasthenia in girls is 3 times higher than in male boys. Symptoms of neurasthenia were more often ($\chi^2 = 13.578$ $p=0.0009$ $OR=2.5$ $95\%CI=1.5-4.1$) among visiting "traditional healers" - 28.8% and 14%, respectively, and also among living in the village - 40% than in the city - 15.9% ($\chi^2 = 8.387$ $p=0.005$ $OR=2.5$ $95\% CI=1.3-4.6$).

Suicidal behavior was revealed in 52.3% of high school students: suicidal thoughts - 22.6%, suicidal thoughts - 16.5%, suicidal intentions - 3.7% and suicidal attempts - 9.9%.

Internal forms of suicidal behavior occurred at the age of 4 to 17 (14.1±2.3)

years, in 65.2% of cases at the age of 13-15 years; for the period of the survey, they were in 6.6% of the respondents. Suicidal attempts were made in the age range of 9-17 (14.2±2.2) years.

Comparison of the frequency of suicidal behavior among young students with the results we obtained earlier [4] showed that there is a statistically significant increase from 32.5% in 2010 to 52.3% in 2019 ($\chi^2 = 33.722$ $p = 0.0005$). If in 2010 the ratio: internal forms of suicidal behavior / suicide attempts was 10:1, then in 2019 it was 4:1.

An analysis of gender differences showed that in 2010, internal forms of suicidal behavior were more common ($\chi^2 = 6.445$ $p = 0.011$) in females (36.2%) than males (25.1%), and suicidal attempts - equally often (3.2% and 3.3%). In 2019, internal forms of suicidal behavior are detected equally often among males and females (38.3% and 45.8%, respectively). There is an increase in the number of suicide attempts by actually 3 times ($\chi^2 = 18.359$ $p = 0.0005$) - up to 10% among boys and 9.8% among girls. Smoothing the frequency of internal forms of suicidal behavior contradicts the literature data [1,9] - it is believed that they are detected more often in females than males. However, this phenomenon may be associated with a certain transformation of social roles - the feminization of men and the masculinization of women due to the peculiarities of socio-economic development. For females, the pursuit of a career, material independence, social activity, and competition that stimulate heteroaggression have become relevant. For males, on the contrary - subordinate behavior, social passivity, hedonistic orientation, alcohol abuse. As a result, there is a smoothing of gender roles to the level of "unisex" with undifferentiated suicidal behavior (more often parasuicidal, not motivated by ideas about taking one's own life).

All types of suicidal behavior were equally common among those living in the village (55%) and in the city (52%), and suicidal attempts occurred in 5% of rural and 10.6% of urban residents.

Internal forms of suicidal behavior were more common ($\chi^2 = 7.414$ $p = 0.007$ $OR = 1.8$ $95\% CI = 1.2-2.6$) in persons who turned to "traditional healers" - 51.9% and 38.1, respectively % of cases.

Correlation analysis revealed significant weak direct correlations of suicidal behavior with depression ($r = 0.558$ $p = 0.000$), anxiety ($r = 0.351$ $p = 0.000$) and social phobia ($r = 0.376$ $p = 0.000$).

Verification of mental health self-assessment showed that 45.8% of females and 26.5% of males recognized the presence of psychological problems ($\chi^2 = 11.926$ $p = 0.001$ $OR = 2.3$ $95\% CI = 1.4-3.8$). The symptoms of a mental disorder in the aggregate were revealed in 11.1% of the examined.

For the early detection and prevention of conditions of socio-psychological maladaptation and suicidal behavior, it is necessary to develop and implement

stress management and time management programs aimed at informing about stress and teaching how to overcome it (methods of resolving conflicts, overcoming auto- and hetero-aggressive tendencies, relaxation methods, etc.), teaching time planning, methods of independent work with educational literature, informing about a healthy lifestyle, taking into account biorhythms, daily routine and eating habits, about destructive methods of dealing with stress (in the aspect of addiction prevention).

It is necessary to involve the work of school and clinical psychologists. In addition, it is advisable to work with school teachers and parents of students in terms of ergonomics of the educational process, optimization of the teaching load, and requirements for high school students.

Conclusion

Thus, it was found that 47.9% of students experience an extremely high level of emotional stress before passing the exam, which leads to severe neurasthenia in 19.1% of cases. Educational stress manifests itself mainly in the form of "confusion" (due to a high study load, inability to properly allocate time and affective disorders) and various psychosomatic symptoms. 21.6% of schoolchildren had clinically significant depression, 31.6% had anxiety. The probability of detecting borderline mental disorders in adolescents who seek help from traditional healers is more than 2 times higher than in those who do not. This may serve as a factor contributing to the early detection of borderline mental disorders.

Half - 52.3% of high school students are characterized by suicidal behavior (suicide attempts in 9.9% of cases) - equally common among males and females, which is associated with the transformation of social roles - the feminization of men and the masculinization of women due to their characteristics socio-economic development.

Early detection and prevention of conditions of socio-psychological maladjustment and suicidal behavior requires the involvement of school and clinical psychologists, the development and implementation of stress management and time management programs.

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“G-01” 溶液在移植黑色素瘤 (B-16) 的实验动物中诱导免疫反应
**IMMUNE RESPONSE INDUCTION BY "G-01" SOLUTION IN
LABORATORY ANIMALS WITH TRANSPLANTED MELANOMA (B-
16)**

Garaishin Rustam Mazitovich

*Candidate of Medical Sciences, Department Assistant
Bashkir State Medical University, Ufa.*

Kzyrgalin Shamil Rimovich

*Department Assistant
Bashkir State Medical University, Ufa.*

Kitapova Rashida Ravilevna

*Candidate of Pharmaceutical Sciences, Associate Professor
Bashkir State Medical University, Ufa.*

Kostromina Daria Aleksandrovna

*Oncologist
Republican Clinical Oncology Center, Ufa*

Garayshina Daniya Rustamovna

*Student
Bashkir State Medical University, Ufa.*

Zaleev Timur Rivalevich

*Student
Bashkir State Medical University, Ufa.*

抽象的。在移植的B-16黑色素瘤模型上显示了不同浓度G-01溶液的抗肿瘤活性。确立了将 G-01 溶液作为天然来源的预防剂在医学上的应用前景。

关键词: G-01, 移植瘤, 黑色素瘤 (B-16)

Abstract. *The antitumor activity of various concentrations of G-01 solution was shown on the model of a transplanted B-16 melanoma tumor. Established prospect of using G-01 solution in medicine as a prophylactic agent of natural origin.*

Keywords: *G-01, graft tumor, melanoma (B-16)*

The plasma membrane participates in intercellular contacts, perceives, amplifies and transmits signals from the external environment into the cell. The plasma

membrane is associated with many enzymes that catalyze biochemical reactions. Among the many enzymes of almost every metabolic pathway, key or regulatory enzymes are distinguished, the activity of which can vary depending on the need of the cell in the end product of the metabolic pathway. Regulatory enzymes are located, as a rule, at the beginning or at the branching point of the metabolic pathway. Carbohydrate components located on the surface of cells serve as a kind of marking in the development of an immune response [2,5]. Abnormalities in carbohydrate metabolism can be indicative of the body's immune system.

Since immunotherapeutic approaches to the prevention of oncological diseases are diverse and specific, our task was to develop a method of a universal immune response that has an effect on tumor cells through programmed cell death - apoptosis.

Purpose of the study

To study the properties of the immune response with G-01 solution using the example of melanoma (B-16).

Material and methods

The experiments were carried out on BALB mice of different sexes, obtained from the nursery of the village of Chishmy R.B. The melanoma tumor strain B-16 was purchased from the Laboratory of Combination Therapy of Tumors, the Bank of Tumor Strains of the N.N. Blokhin Russian Cancer Research Center RAMS.

The experiments were carried out on the offspring of heterosexual BALB/c of the age of 8 weeks. The offspring groups were not separated by sex. Spontaneous regressions were not observed in the control groups.

The animals were kept under standard conditions on a natural diet in accordance with the current standards for the maintenance of experimental animals. All manipulations on animals were performed in accordance with international ethical and scientific standards for planning and performing animal studies [4].

In the work, a 20% solution of G-01 was used, administered 0.5 ml subcutaneously 2 times a day for 2 days. The joint was sterilized under pressure.

Hexose monosaccharide was used as a means of influencing parental individuals. Working code: G-01.

Statistical processing

The biomedical data obtained during the study were processed using the Statistica 7 (Stat Soft) version 6.0 program. Comparison of the frequency characteristics of qualitative indicators was carried out using a non-parametric method - Fisher's exact test (for small groups). For multiple comparisons - with appropriate amendments. Confidence intervals for frequency scores were calculated using Fisher's exact test. To study the relationship between immunotherapy and the frequency of deaths in the comparison groups, the correlation coefficient was calculated for nominal variables, based on "Chi-square" statistics, applicable to contingency tables (2x2); and Pearson's feature contingency coefficient (C), which characterizes the relationship of nominal variables for multi-field contingency tables [1,3].

Research results

For the experiment, a preventive course of therapy was administered to Balb/c mice of different sexes and different weight categories. One month after the optimal therapy regimen, an attempt was made to inoculate melanoma subcutaneously in 10 mice of the main group. The control group consisted of 6 mice. After 3 weeks, an increase in formation was found in the right axillary region in 2 mice in the main group. Formation over the next 3 weeks regressed. In the control group, melanoma was transferred to 5 out of 6 mice, with subsequent development of the disease and death on average on the 60th day of the disease.

The following attempts to inoculate B-16 melanoma were carried out once a month, growth of formations was periodically manifested, followed by regression in the main group and 100% of cases of inoculation with subsequent death in the control group.

After 7 months in the main group, an increase in B-16 was detected in 1 pregnant mouse out of 10, after giving birth the mouse died. After 8 months in the main group, an increase in B-16 was detected in 4 out of 10 mice. Of these, 2 pregnant females and 2 males. In males, the formation regressed. The females died within a month.

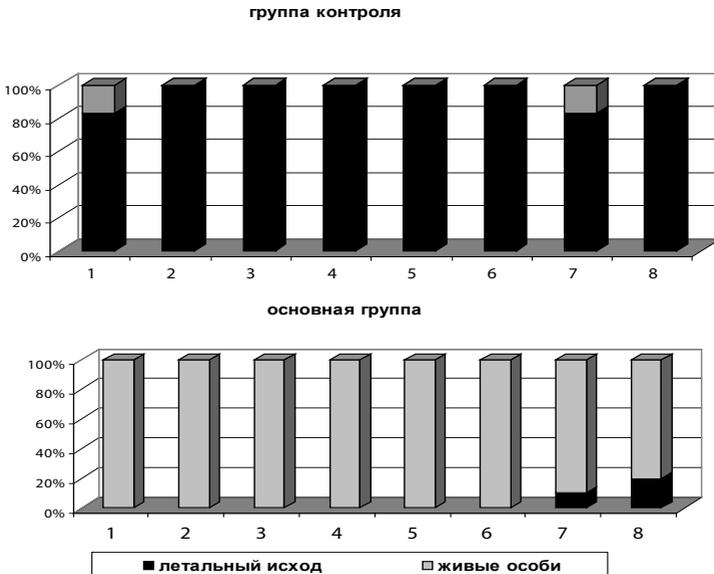


Figure 1. The frequency of deaths in the main and control groups, %
Note. on the abscissa axis – time of observation (months).

Considering that lethal cases occurred in the main group only 7 months after the start of immunocorrective therapy, the frequency of adverse outcomes in the compared groups was analyzed in general for 8 months of observation (tab. 1).

Table 1.

The frequency of deaths in the main and control groups of experimental animals during the observation period

Study group	Lethal outcome	No lethal outcome	Toatl
Main group	3 (3.75%)	77 (96.25%)	80 (100%)
Control group	46 (95.8%)	2 (4.2%)	48 (100%)

The frequency of lethal outcomes in groups of animals during the observation period was significantly higher in the control group compared to the main group ($\chi^2 = 103.8, p < 0.0005$).

The odds ratio (OR) of an unfavorable outcome in the main group to the odds of the control group was 0.0021 (0.21%), 95% CI [0.0006; 0.0131], indicating that the odds ratio for a poor outcome is higher in the control group.

An analysis of the correlation coefficient ϕ for nominal variables, based on the "Chi-square" statistic, and accordingly applicable to contingency tables (2x2), showed that

$$\phi = \sqrt{\frac{\chi^2}{n}} = \sqrt{\frac{103,8}{128}} = 0,9, (p < 0,001).$$

where n is the total sum of frequencies by cells (the number of animals taken for analysis during the observation period). The connection is considered established if the value of the coefficient is in the range from 0.5 to 1.0.

The calculated indicator characterizes a strong relationship between immunocorrection and the frequency of adverse outcomes.

For clarity, we examined the subcutaneous fat (fig. 2) of the right axillary region of 5 Balb/c mice of the main group 6 months after transplantation and 7 months after the induction of the immune response with G-01 solution.



Figure 2. Residual pigmentation in the area of subcutaneous injection of melanoma (B-16) 6 months after transplantation in the main group

According to the literature, the duration of immunity in mice, lasting 6 months, is approximately equal to 5-6 years of human life. We can assume that the induction of the immune response that we are carrying out in humans can last up to 5-6 years, which corresponds to immunity after vaccination against such infections as tetanus, hepatitis, etc.

The course of therapy with a solution of G-01 mice with transplanted melanoma

The therapy for Balb/c mice was started on the 6th day after subcutaneous inoculation of melanoma. The optimal treatment regimen was used. Two groups were analyzed: control and main. The tumor was transplanted in 100% of cases.

Mice died in both groups, no statistically significant differences were found between the groups.

Conclusions:

1. Nonspecific immune stimulation of the antitumor response is a prerequisite for antitumor immunity induced by G-01 solution.

2. Immune memory on the example of transplanted melanoma is valid for at least 6 months. In the following months, there is a gradual decrease in tolerance to the transplanted tumor.

3. Subcutaneously administered 20% solution of G-01, 0.5 ml, 2 times a day for 2 days on the 6th day after inoculation, does not affect melanoma.

Conclusion:

This method of inducing an immune response with G-01 solution can be used to prevent the development of a solid B-16 melanoma tumor. Solution G-01 eliminates the complications associated with the use of vaccines, the development of which is based on the properties of adaptive immunity-specificity. According to the literature, the duration of immunity in mice, lasting 6 months, is approximately equal to 5-6 years of human life. We can assume that the induction of the immune response that we are carrying out in humans can last up to 5-6 years, which corresponds to immunity after vaccination against such infections as tetanus, hepatitis, etc.

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天然物质 G-01 溶液对使用佐剂的肉瘤-M-1 实例的抗肿瘤活性
**ANTITUMOR ACTIVITY OF A SOLUTION OF NATURAL
SUBSTANCE G-01 ON THE EXAMPLE OF SARCOMA-M-1 USING AN
ADJUVANT**

Mirsaeva Faniya Zartdinovna

*Doctor of Medical Sciences, Full Professor
Bashkir State Medical University, Ufa.*

Garaishin Rustam Mazitovich

*Candidate of Medical Sciences, Department Assistant
Bashkir State Medical University, Ufa.*

Kzyrgalin Shamil Rimovich

*Department Assistant
Bashkir State Medical University, Ufa.*

Kitapova Rashida Ravilevna

*Candidate of Pharmaceutical Sciences, Associate Professor
Bashkir State Medical University, Ufa.*

Kostromina Daria Aleksandrovna

*Oncologist
Republican Clinical Oncology Center, Ufa.*

Garayshina Daniya Rustamovna

Bashkir State Medical University, Ufa.

抽象的。在移植瘤（肉瘤M-1）模型上，显示了不同浓度的G-01溶液在佐剂存在下的抗肿瘤活性。确立了将 G-01 溶液作为天然来源的预防剂在医学上的应用前景。

关键词：G-01，可移植肿瘤，肉瘤 M-1，佐剂

Abstract. *On the model of transplanted tumor (Sarcoma M-1), the antitumor activity of various concentrations of the G-01 solution with the presence of an adjuvant was shown. Established prospect of using G-01 solution in medicine as a prophylactic agent of natural origin.*

Keywords: *G-01, transplantable tumor, Sarcoma M-1, adjuvant*

Introduction

The main property of most adjuvants is the ability to adsorb its antigen on its

surface and keep it in the body for a long time, which increases the duration of its effect on the immune system, and also non-specifically enhances phagocytosis [1,7].

Based on the above, we assumed that the natural substance G-01 with an adjuvant can enhance adaptive immunity to prevent the development of a tumor process [2, 5, 6] and allow the use of G-01 solution in a smaller volume.

Purpose of the study

To study the properties of the G-01 solution with an adjuvant based on aluminum hydroxide with a single injection by changing the concentration of the solution.

Material and methods

The study was performed on the basis of the Research Institute of Oncology of the Bashkir State Medical University. The experiments were carried out on heterosexual outbred white albino rats of the "Wistar" line. The weight of the animals ranged from 200 to 250 grams, without division by sex. The Sarcoma M-1 tumor strain was purchased from the Combination Tumor Therapy Laboratory, the Bank of Tumor Strains of the N.N. Blokhin Russian Cancer Research Center RAMS. The animals were kept under standard conditions on a natural diet in accordance with the current standards for the maintenance of experimental animals. All manipulations on animals were performed in accordance with international ethical and scientific standards for planning and performing animal studies [3,4,8].

As a means of influencing animals, solutions of 5% and 15% monosaccharide-hexose were used. Working code: G-01. We used aluminum hydroxide as an adjuvant.

The adjuvant and the agent were diluted in proportions 1:1 and injected subcutaneously in an amount of 0.3 ml. In appearance, the solutions are a slightly cloudy liquid due to small particles of aluminum, partially precipitating.

Animals were divided into 3 groups: group 1 - 10 rats (received 15% solution of G-01 1/c., once). group 2 - 9 rats (received 5% solution of G-01 1/c., once). group 3 - 10 rats (control - not treated with G-01 solutions with adjuvant in various concentrations). The tumor in the control group was inoculated in 100% of cases.

The biomedical data obtained during the study were processed using the Statistica 7 (Stat Soft) version 6.0 program. Comparison of the frequency characteristics of qualitative indicators was carried out using a non-parametric method - Fisher's exact test (for small groups).

Results and discussion

1 month after the course of therapy with 5% and 15% solutions of G-01, adults were transplanted with Sarcoma M-1. In the control groups, the tumor took root in 100% of cases (fig. 1,2), the death of animals occurred within 4 months (fig. 3).

A 15% solution of G-01 with an adjuvant administered in an amount of 0.3 ml l/c had a pronounced antitumor effect. In the experimental group, consisting of 10 animals, after 2 weeks, tumor growth was detected in 1 individual, after another week, the tumor regressed in this individual.

In the experimental group, which received a 5% solution of G-01 with an adjuvant in the amount of 0.3 ml l/c, consisting of 9 individuals, tumor growth was detected in 4 out of 10 animals. 1.5 months after inoculation, all 4 individuals rejected the transplanted Sarcoma M -1 (fig. 4).



Figure 1. Animals aged 2.5 months, before inoculation with M-1 sarcoma



Figure 2. The control group of animals 3 weeks after transplantation of M-1 sarcoma. The tumor transplantation rate is 100%



Figure 3. Control on day 53 after inoculation of M-1 sarcoma. (All animal experiments were carried out in compliance with international and Russian ethical principles and bioethical norms)

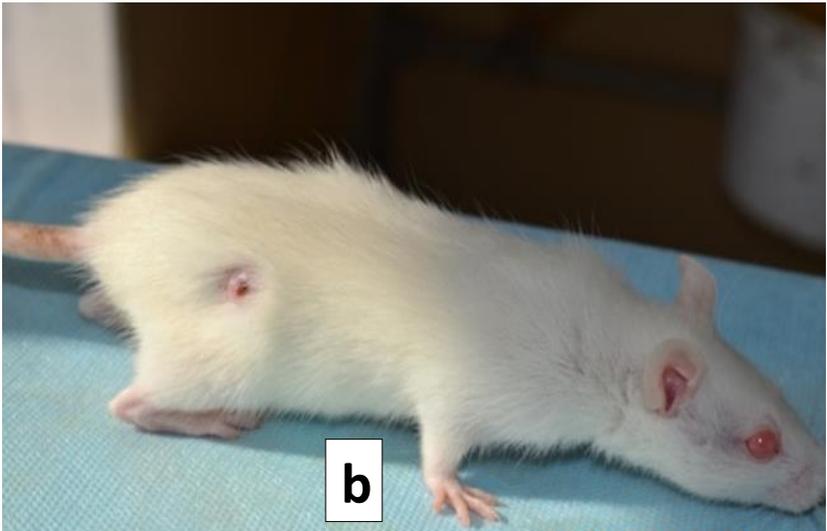
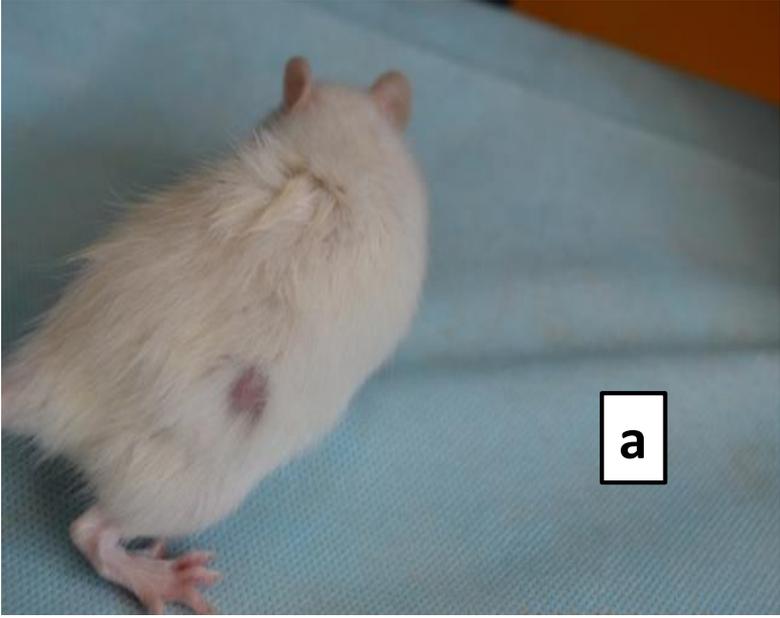




Figure 4. (a, b, c, d) 31-47 days after transplantation of M-1 sarcoma. (All animal experiments were carried out in compliance with international and Russian ethical principles and bioethical norms)

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从当地材料中获取耐腐蚀水泥混合物的方法
**WAYS FOR OBTAINING CORROSION-RESISTANT CEMENT
MIXTURES FROM LOCAL MATERIALS**

Umraliyev B.T.

Doctor of Technical Sciences, Expert of the Technical Assessment and Design Service of "KMG Engineering" LLP, Nur-Sultan, Kazakhstan

Nugiyev M.A.

Head of Technical Assessment and Design Service, "KMG Engineering" LLP, Nur-Sultan, Kazakhstan

Khassenov S.O.

Lead Engineer of the Technical Assessment and Design Service of "KMG Engineering" LLP, Nur-Sultan, Kazakhstan

抽象的。本文提供了有关本地生产材料的信息以及在腐蚀环境中使用它们进行有效水泥溶液回收的方法。

哈萨克斯坦共和国的能源安全只能通过确保整个石油和天然气综合体的可靠运行来实现。井的建设质量在这个问题中起着重要作用。分析表明，在建井过程中最常见的缺陷类型之一是：套管柱后面的水泥浆欠举，导致破坏了井壁的密封性；由于腐蚀性环境中的腐蚀过程而破坏密封。

如今，里海地区使用的胶结材料并不总能形成可靠的胶结环及其在腐蚀性环境中的必要耐久性。还需要注意的是，用于套管的回填料是从国外进口的。

里海低地是哈萨克斯坦最有发展前景的油气区，地质技术条件多样，井段划分为盐后、盐、盐下三个主要层段，而需要使用加重或轻质回填材料的异常高和异常低的地层压力。

关键词：耐腐蚀水泥混合物、当地材料、里海低地、水泥石、低碱性氢硅酸钙、氢碳铝酸钙、硅藻土、二氧化硅、硫化氢、二氧化碳、分解剂活化、贝壳岩石、白垩、灰炆、沙子。

Abstract. *In this article given information about local production materials and ways of using them for effective cement solutions recovery, on their base, in corrosion environment.*

The energy security of the Republic of Kazakhstan can only be achieved by ensuring the reliable functioning of the entire oil and gas complex. An important role in this issue is played by the quality of well construction. The analysis shows that one of the most common types of defects during well construction are: under-

lifting of cement slurries behind casing strings, leading to a violation of the tightness of the well lining; violation of sealing due to corrosion processes in aggressive environments.

Nowadays, cementing materials used in the Caspian region do not always provide the formation of a reliable cement ring and its necessary durability in an aggressive environment. It should also be noted that the backfill materials used for well casing are imported from abroad.

The Caspian lowland is the most promising oil and gas region of Kazakhstan and is characterized by a variety of geological and technical conditions, and three main intervals are distinguished in the well section: post-salt, saline and pre-salt complexes, while there are abnormally high and abnormally low formation pressures that require the use of weighted or lightweight backfill materials.

Keywords: *corrosion-resistant cement mixtures, local materials, Caspian lowland, cement stone, low-basic calcium hydro-silicates, calcium hydrocarboaluminates, thaumasite, silica, hydrogen sulfide, carbon dioxide, disintegrator activation, shell rock, chalk, ash, sands.*

The main reasons for poor-quality well casing are the non-compliance of cement materials with the geological and technical conditions of well construction and the insufficient durability of the resulting cement stone in aggressive environments.

From thermodynamic calculations [1], it was found that low-basic calcium hydrosilicates (LBCHS), calcium hydrocarboaluminates (CHCA) and thaumasite have the highest resistance. Carbon dioxide is an accompanying component that also causes corrosion damage. The mechanism of destruction of cement stone in hydrogen sulfide can be volumetric or layer-by-layer [2].

Based on research [1,2,3,4], we believe that the resistance of cement stone in hydrogen sulfide (H_2S), carbon dioxide (CO_2) and magesial media can be ensured by obtaining cement stone with an optimal or rational phase composition of hardening products and the best organization of the structure of the pore space.

It was previously noted that low-basic calcium hydrosilicates have the greatest resistance, but the probability of their formation at temperatures below $100\text{ }^\circ\text{C}$ is low. This is because silica has low solubility at these temperatures. Therefore, ash or burnt rocks are needed to implement this process. At the same time, N.Kh. Karimov [3] showed that disintegrator activation increases the chemical activity of low-active or practically inactive components, transferring them to the active state. The same effect can be obtained with the disintegrator treatment of silica. As a result, we can expect the formation of LBCHS at temperatures below $120\text{ }^\circ\text{C}$.

To obtain corrosion-resistant grouting materials, represented by calcium hydrocarboaluminates and thaumasite, it is necessary to introduce carbonate-con-

taining additives into Portland cement. The theoretical aspect of obtaining these hardening products is shown in fig.1. The role of calcium carbonate is reduced not only to the formation of new phases, but also to the catalytic effect in the production of LBCHS, as well as to improve the structure of the pore space of the cement stone. This is achieved by reducing the voltage, in addition, the resulting CHCA should provide some expansion effect. Finely dispersed carbonate fillers should ensure the sedimentation stability of cement slurries and, due to this, also improve the structure of the cement stone. The lower density of calcium carbonate than clinker can provide a lower density of cement slurries.



Примечание: ↑-увеличение количества; ↓-снижение количества; ↔ -остается неизменным

Figure 1. Scheme of mechano-chemical activation of Portland cement and carbonate chips during disintegration treatment

Research N.Kh. Karimova, Agzamova F.A., B.S. Izmukhambetova [1,2,3] carried out an analysis of local materials, which showed that slags can be effectively used to modify cements. To implement the provisions that have already been said, we have considered other industrial waste and local raw materials. As modifying additives, wastes from the production of building blocks from shell rock, chalk, ash, sands of the Caspian basin, in particular the Atyrau region (table 1).

The use of disintegrator technology in the modification of cements makes it possible to increase the strength of the base binder material and ensure its greater "additive capacity".

When developing a cement mixture with a silica-containing additive using disintegrator technology, it was shown that the rate of interaction of silica with calcium hydroxide increases sharply, approaching the rate of interaction of calcium oxide with amorphous silica.

Studies of changes in the pore space have shown that the composition and

technology of preparation of Portland cement-ash-lime cement have a significant impact on the structural characteristics of the cement stone. The characteristics of the porous structure of cement stone from Portland cement-ash-lime cement, obtained as a result of research, showed that the smallest porosity (20.4%) have samples prepared with a disintegrator processing mode of 12,000 rpm and hardened at normal temperature.

Table 1.
Chemical composition of materials

Material	Content (%)					
	SiO ₂	Fe ₂ O ₃	CaO/CaCO ₃	Al ₂ O ₃	MgO	p.p.p.
Carbonate rocks						
Shell rock (Mangistau)	3.27	0.28	-/93.51	0.32	0.45	other
Chalk (Inder, Kenbai)	2.54	0.16	-/95.44	0.48	0.36	other
Silica-containing materials						
Quartz sands (Inder)	92.25	0.04	0.23	0.45	0.02	other
CHP fly ash	56.0	4.58	3.64	26.7	1.44	11.12

With an increase in temperature, the porosity of these samples increased somewhat, but to a lesser extent than in samples of conventional preparation. The highest porosity has a sample of conventional preparation, hardened at a temperature of 75°C (31.04%).

As a result of the study of the structure of the pore space of the cement stone, it was found that the disintegration treatment of Portland cement-ash-lime cement makes it possible to obtain a cement stone with a very homogeneous structure, characterized by the vast majority of pores with a radius of 0.01 ... 0.05 microns. The structure of disintegrator-prepared stone, hardened at a temperature of 75 °C, is also characterized by one maximum in the region of intermediate porosity.

This allows us to conclude that Portland cement, modified with a lime-ash mixture and processed in a disintegrator, makes it possible to obtain a highly effective lightweight backfill material for well casing at normal and moderate temperatures.

The addition of a silica-containing additive reduces the strength of the cement stone, however, due to the disintegrator activation, the strength characteristics of the developed compositions increase.

The effect of the carbonate additive on structure formation is somewhat different; calcium carbonate has not only structure formation, but also has a catalytic effect on the formation of low-basic calcium hydrosilicates.

With an increase in the amount of shell rock additive to Portland cement in the initial periods of hardening, the strength of cement stone from PC decreases. The reason for this is the insufficiently strong coalescence of the shell rock with cement neoplasms in this period. The disintegrator activation of the mixture of cement-shell rock makes it possible to increase the strength of the cement stone based on them, both at normal and at a temperature of 75 °C, by almost 1.5-2 times, compared with similar compositions without activation.

X-ray diffraction studies have established that phases appear on the samples with the addition of shell rock, the diffraction peaks of which correspond to the parameters of interplanar distances CHCA. With an increase in the amount of shell rock additive and the degree of activation of the mixture on the disintegrator, the proportion of calcium hydrocarboaluminates in the total volume of cement stone increases, and at temperatures below 100 °C, thaumasite is formed. This reduces the amount of free lime in the composition of the cement stone. An increase in the proportion of tobermorite-like calcium hydrosilicates of the CSH(B) type is also observed.

The addition of shell rock and disintegrator activation increases the crystallinity of the structure of cement stone from PC. This is due to the introduction of calcite (CaCO_3) into the composition of the cement stone and the formation of calcium hydrocarboaluminates and thaumasite.

The shell rock leads to a decrease in microstresses in the crystallites that make up the cement stone at all temperatures. This contributes to the redistribution of microstresses throughout the cement stone sample, which subsequently increases the resistance of the cement stone in an aggressive environment.

Checking the corrosion resistance of cement compositions was carried out in laboratory conditions in contact with hydrogen sulfide gas.

Many experimental studies on the process of hydrogen sulfide corrosion do not take into account the actual conditions of cement stone hardening in well conditions. As is known, the test compositions are installed in a hydrogen sulfide environment only after molding and passing through a certain curing regime. In practice, hydrogen sulfide can come into contact with cement after the cement slurry is pumped into the well, and cement corrosion begins from the first minutes after it is transported to the annulus. This is mainly due to the physicochemical processes occurring in the cement.

Samples of cement stone with a shell rock content of 30% have a lower chemical activity in hydrogen sulfide compared to Portland cement. Compositions with the addition of shell rock 20% and 30% showed high corrosion resistance in gaseous hydrogen sulfide and hydrogen sulfide dissolved in water. Corrosion resistance of cement compositions with carbonate and silica-containing additives are given in table.2.

Samples of cement stone without additives and containing 10% shell rock in hydrogen sulfide gas collapsed as a result of an increase in volume, and samples from a mixture of PC: Shell rock - 70:30 had no signs of corrosion. The phase composition of cement stone with the addition of 10% shell rock is mainly represented by calcium sulfides (CaS) and iron (FeS) and other similar corrosion products, and with the addition of 30% shell rock it is represented by thaumasite.

Similar results in terms of corrosion resistance were shown by grouting compositions with the addition of silica-containing additives, the composition of which is mainly represented by low-basic calcium hydrosilicates such as tobermorite and xonotlite.

Table 2.
Corrosion resistance of cement compositions

Composition, %	W/C	Stable		With transient properties		Unstable	
		k_{bend}	k_{comp}	k_{bend}	k_{comp}	k_{bend}	k_{comp}
Cement	0.35	0.82	0.90	-	-	-	-
	0.45	-	-	0.70	0.86	-	-
	0.60	-	-	-	-	0.27	0.76
Cement: silica 60:40	0.45	-	-	0.77	-	-	-
	0.55	2.00	0.18	-	-	-	-
	0.70	-	-	-	-	0.70	0.54
Cement:Shell rock 80:20	0.45	-	-	-	-	0.46	0.55
Cement:Shell rock 70:30	0.45	1.08	1.17	-	-	-	-

Thus, it should be noted that the casing of wells in the Caspian depression is carried out in difficult geological and technical conditions with manifestations of aggressive components - hydrogen sulfide, carbon dioxide and salt aggression. Studies have shown the possibility of obtaining and using special grouting compositions based on local materials, namely chalk, shell rock, ash and other silica-containing materials for well casing in corrosive conditions and a temperature range from 20 °C to 120 °C.

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是否可以人工智能系统进行分类？

IS IT POSSIBLE TO CLASSIFY ARTIFICIAL INTELLIGENCE SYSTEMS?

Eskov Valery Valerievich

*Candidate of Medical Sciences, Associate Professor
Surgut State University*

Galkin Valery Alekseevich

*Doctor of Physico-mathematical Sciences, Full Professor, Director
Surgut branch of the Federal Scientific Center Scientific Research
Institute of System Analysis*

Gavrilenko Taras Vladimirovich

*Candidate of Technical Sciences, Associate Professor
Surgut State University
Surgut, Russia*

抽象的。人工智能在过去 20-30 年的积极发展需要一定的系统化和分类。本报告介绍了对此类系统进行分类的两种方法。在第一种情况下，我们谈论的是主观或客观地获得新信息（新知识）。在第二种情况下，我们谈论的是人工智能系统的运行原理。这些原则要么基于算法系统，要么基于以混沌模式运行的系统。在后一种情况下，我们谈论的是启发式人工智能系统。

关键词：人工智能，神经网络，启发式，Eskov-Zinchenko 效应。

Abstract. *The active development of artificial intelligence over the past 20-30 years requires a certain systematization and classification. This report presents two types of approaches to the classification of such systems. In the first case, we are talking about obtaining subjectively or objectively new information (new knowledge). In the second case, we are talking about the principles of operation of artificial intelligence systems. These principles are based either on algorithmic systems or systems operating in chaotic modes. In the latter case, we are talking about heuristic artificial intelligence systems.*

Keywords: *artificial intelligence, neural network, heuristics, Eskov-Zinchenko effect.*

Introduction

The development of general systems theory, cybernetics, and brain science is

leading us to a new understanding of artificial intelligence (AI) systems as well. In modern science, such AI systems (AIS) are interpreted very broadly. In the general case, they talk about systems that will replace a person in the field of intellectual activity (IP). It should be emphasized that the interpretation of ID itself also does not have precise definitions. In many sciences (psychology, Brain Research, mathematics, cybernetics, etc.), ID is interpreted in different ways. Hence the problem of a clear (strict) definition of AIS arises. With this in mind, we are now trying to give some systematization of AIS.

We emphasize that our attempt leads to the need to introduce two types of AIS work (outcomes of AIS activity). First, according to the new information received. Secondly, according to the signs of the work of AIS. The latter has a fundamental difference, since algorithmic AIS are widely used to date. However, biosystems cannot be the object of modern science (as W. Weaver spoke about in 1948 [1]).

1. Results of the work of AIS.

We note right away that AIS is usually understood as information systems that, as a result of receiving and processing information, create new knowledge. This new knowledge is further used to make decisions, create optimal control actions, etc.

As a result, in any case, we are talking about intellectual activity and obtaining new information. The very development of man and mankind is associated with the receipt (creation) of new information. However, this information should be shared. With individual training of a person (at school, institute, etc.), he receives subjective new (for him) information. At the same time, a person must receive signals from the external environment, process them and make optimal decisions.

All this is based on the intellectual activity of man and ensures his existence in the outside world. However, scientists and politicians can also create objectively new information. This knowledge is used by all mankind and it ensures the progress of all mankind. Objectively, new knowledge underlies the development of all mankind, they ensure the development of science.

Objectively new knowledge is the basis of all science, the entire development of mankind. Very often, such knowledge is associated with discoveries, the establishment of new laws of the behavior of matter, human communities. Without this new knowledge, there is no development of mankind. Such knowledge is often the result of the heuristic work of the brain of a genius or a talented person. Obviously, the replacement of a person in this type of activity (in the work of the heuristics of the brain) has not yet reached the required level within the framework of AIS. This is primarily due to the fact that heuristics are possible with a small amount of initial information, when the results are not very obvious or when they are difficult to obtain in a logical way.

In general, obtaining objectively new knowledge (new information) is the task of various sciences, which are based on a number of fundamental provisions. First of all, this concerns those processes, phenomena, events that have a causal relationship. This means that the past influences (determines) the future of the process or system.

It is on the reality of causal relationships that all modern deterministic and stochastic science (DSS) is based. At the same time, W. Weaver [1] clearly separated deterministic systems from stochastic ones back in 1948. He singled out two types of systems and two types of sciences (deterministic and stochastic sciences - DSS).

In determinism (for example, in the theory of dynamical systems - TDS), knowledge of the initial state $x(t_0)$ of the entire state vector of the system $x=x(t)=(x_1, x_2, \dots, x_m)^T$ in the m-dimensional phase state space (PSS) completely (and exactly) determines the final state of the system in the form $x(t)$. Here the past clearly defines the future ($x(t)$).

In stochastics, setting $x(t_0)$ cannot provide such a repetition of $x(t)$ and therefore we work with samples of such $x(t)$. In this case, the tests are repeated n times and a sample with n $x(t)$ values is obtained. However, two such samples (obtained in the intervals Δt_1 and Δt_2) do not exactly match and are analyzed statistically.

The loss of exact equality ($x(t_1) \neq x(t_2)$) is typical for stochastic processes and systems, and this already means the appearance of Complexity, Uncertainty and Unpredictability [2-9]. At the same time, in the entire DSS for these 150–200 years, no one asked the question about the state of the system under study before the Δt_1 interval, between the Δt_1 and Δt_2 intervals, and after the Δt_2 interval.

Moreover, no one even asked the question: do the samples $x(t)$ always coincide on the intervals Δt_1 and Δt_2 for the same biosystem, if nothing significant happens? Is the statistical stability of such samples preserved?

All these issues are of fundamental importance for biology, medicine, psychology, ecology, bioinformatics and other sciences of living systems. Otherwise, we cannot predict the future state of the biosystem $x(t)$ from the past $x(t)$. This is exactly what W. Weaver tried to say in 1948, but no one understood him, and therefore all AIS now work in the mode of cause-and-effect relationships, where there is a certain logic. AIS also replace a person in his intellectual activity, but they cannot replace the heuristic brain of a genius.

2. Second AIS classification.

So, according to the first classification, we are talking about AIS for obtaining subjectively new knowledge (replacing a person in management systems and making simple decisions) and for obtaining objectively new knowledge. A detailed analysis of this approach brings us to the second classification, which is based not on the result (of the work of the AIS), but on the principle of the work

of the AIS. In this case, we are talking about algorithmic AIS (working according to certain rules - algorithms) and non-algorithmic AIS.

The latest AIS quite often become models of the heuristic activity of the brain. In this case, all models, methods and theories of DSS can no longer provide a solution to the problem (obtaining new information) and other (new) AIS are required.

We emphasize that for all biosystems, any DSS methods and models can no longer be successfully applied. This is due to the Eskov-Zinchenko effect (EZE), which proved the absence of statistical stability of any samples of any parameters $x_i(t)$ of the human body. For example, if we register at least 300 cardiointervals (CI) in the same person in 5 minutes, then the next sample of CI (also in $\Delta t_2 = 5$ minutes) will coincide with the first sample (in $\Delta t_1 = 5$ minutes) with a frequency of $p_{i,j} + 1 \leq 0.2$. This is a very small value for DSS. For example, we present tab. 1, which contains a matrix of pairwise comparisons of 15 samples of CIs that were obtained in a row from the same subject. In this tab. 1, we introduce the Wilcoxon test p_{ij} in the statistical comparison of the i -th and j -th CT samples.

Non-parametric Wilcoxon Signed Ranks Test (p) for pairwise comparisons of 15 samples of CI parameters of the tested EIR in repeated experiments ($k_i = 9$)

1		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,9	0,0	0,0	0,0	0,0
3	0,0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
4	0,0	0,0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0	0,0
5	0,0	0,0	0,0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	0,0	0,0	0,0	0,0	0,0		0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0
7	0,0	0,0	0,0	0,0	0,0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
8	0,0	0,0	0,0	0,0	0,0	0,7	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0
9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0	0,0	0,0	0,9	0,2	0,0
10	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,6	0,0	0,0	0,0	0,0
11	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6		0,0	0,0	0,0	0,0
12	0,0	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0		0,0	0,0	0,0
13	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,9	0,0	0,0	0,0		0,4	0,0
14	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,4		0,0
15	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	

*Note: p – the achieved level of significance (the critical level is $p < 0.05$)

Characteristically, neural networks of the brain (NNB) work in this way. In table 2, we present a matrix of pairwise comparisons of 15 samples of electroencephalograms (EEG) of the same person (at rest, sitting). Obviously, the number $k_2 < 35\%$ (this is the number of EEG pairs for which the Wilcoxon test $p_{ij} \geq 0.05$, i.e. these two samples can statistically coincide [10-15].

Matrix of paired comparisons of EEG parameters of the same healthy person (15 EEG samples in a row) without influences (channel T6-Ref, number of matches $k_2 = 33$)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1		0.0	0.3	0.0	0.1	0.6	0.0	0.5	0.0	0.2	0.3	0.0	0.9	0.0	0.0
2	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
3	0.3	0.0		0.7	0.0	0.0	0.6	0.1	0.0	0.0	0.3	0.0	0.1	0.0	0.0
4	0.0	0.0	0.7		0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.1	0.0	0.0	0.0		0.0	0.0	0.4	0.3	0.6	0.0	0.0	0.2	0.0	0.0
6	0.6	0.0	0.0	0.0	0.0		0.2	0.8	0.0	0.2	0.5	0.0	0.6	0.0	0.0
7	0.0	0.0	0.6	0.8	0.0	0.2		0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
8	0.5	0.0	0.1	0.0	0.4	0.8	0.0		0.0	0.9	0.1	0.0	0.9	0.0	0.0
9	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
1	0.2	0.0	0.0	0.0	0.6	0.2	0.0	0.9	0.0		0.0	0.0	0.3	0.0	0.0
1	0.3	0.0	0.3	0.0	0.0	0.5	0.0	0.1	0.0	0.0		0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0		0.0	0.0	0.0
1	0.9	0.0	0.1	0.0	0.2	0.6	0.0	0.9	0.0	0.3	0.0	0.0		0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
1	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Both of these tables (as well as thousands of other tables that we have calculated over the past 20 years) prove the W.Weaver hypothesis (biosystems are not a DSS object) and EZE. This means that the past does not affect the future state of the biosystem. In other words, any model in DSS for a biosystem is a historical artifact. We cannot use any algorithms (based on TDS and stochastics) to describe biosystems. And this means that AIS based on algorithms cannot be used to create new knowledge, to study systems of the third type - CTT (according to W. Weaver [1]). There is an urgent need to create an AIS based on non-algorithmic processes and devices.

One of the promising directions in this is the use of artificial neural networks in two special modes (chaos and multiple repetitions - reverberations) in setting up the ANN. These two modes follow from Table 1 and tab. 2, which show the chaos of CI and EEG samples. At the same time, we repeatedly repeated the registration of samples of these parameters (CI and EEG). It turned out that if the initial weights w_{i0} of the diagonal features $x_i(t)$ for the STT are randomly set from the interval $w_{i0} \in (0,1)$ and then the ANN is tuned n times ($n \geq 100$), then the resulting samples of feature weights w_i (their mean values $\langle w_i \rangle$) can be ranked.

In this case, the problem of real separation of samples (and states) of biosystems is solved and order parameters (main diagnostic features) are found. This is the task of system synthesis. Algorithms do not work here (because of EZE), but we can talk about a model of the heuristic work of the brain.

Discussion

It is possible to classify artificial intelligence systems according to the information received (subjectively new or objectively new) and according to the principles of operation. Objectively new information can be obtained logically (in an algorithmic way). However, discoveries in science, its development, usually occur on the basis of heuristics. Only the brain of a talented person is capable of developing science and creating new knowledge.

Due to EZE, it turned out that all biosystems cannot be described and predicted within the framework of modern DSS. There are no algorithms that can describe statistically unstable systems. The loss of connection between the past and the future sharply limits the further application of DSS [9-15]. There is an urgent need to develop a new science based on non-algorithmic AIS. Such systems may include ANNs in special modes of chaos and multiple reverberations.

Conclusions

All artificial intelligence systems can be divided into systems for obtaining subjectively new knowledge and systems for obtaining objectively new knowledge. The latter ensure the development of all science. At the same time, it is possible to propose a classification of AIS according to the principles of operation. In this case, we are talking about algorithmic AIS (now used in control systems) and non-algorithmic AIS. The latest AIS can simulate the work of the human brain in heuristic mode. Here, artificial neural networks can be used in two special modes: chaos and multiple repetitions (reverberations) of ANN settings. In this case, the problems of system synthesis are solved.

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太阳能光热电池的电能和热能效率
**EFFICIENCY OF ELECTRIC AND THERMAL ENERGY OF SOLAR
PHOTO THERMAL BATTERY**

Tursunov Mukhamad Nishanovich

Doctor of Technical Sciences, Chief Researcher

Sabirov Khabibullo

Candidate of Technical Sciences, Senior Research Officer

Kholov Uygun Raufovich

Master's degree student, PhD student

Physics-Technical Institute

NGO "Physics-Sun", AS Uz

抽象的。使用晶体硅基光电电池 (PVB) 的主要问题之一是由于发电效率低 (18-20%) 和环境温度升高导致效率低下。本文的研究重点是通过减少 PVB 暴露于外部影响来提高 PVB 效率的措施。作为一种有效冷却光伏电池 (PVB) 的主动方法, 提出了一种新型结构光热电池 (PTB), 该电池通过将蜂窝聚碳酸酯集热器 (TC) 附着到基于晶体硅的 PVB 背面。实验比较了传统结构化 PVB 和 PTB 的参数, 并表明 PTB 可以比传统构造的 PVB 更有效地运行。特别是, 这些实验测试是在一年中最冷的月份, 在冬季寒冷中进行的。实验测试结果于 2022 年 1 月 20 日 21 日进行, 当时天气晴朗 (白天气温在 5-8 °C 左右)。已经表明, 当在 PVB 表面安装太阳能反射器 (横向反光平面, 反光系数 0.4-0.45) 时, 功率比普通 PTB 增加 27%。发现非反射器和反射器 PTB 的效率相差 22.5%。与在标准测试条件下获得的参数进行比较, 研究了考虑到极端条件、高温、污染程度和落在 PTB 表面的太阳辐射强度而准备的设备参数。

关键词: 光伏电池, 光热电池, 短路电流, 开路电压。

Abstract. *One of the main problems with the use of crystalline silicon-based photoelectric batteries (PVB) is the low efficiency due to the low power generation efficiency (18-20%) and rising ambient temperatures. The study in this article focuses on measures to improve the efficiency of PVBs by reducing their exposure to external influences. As an active method for efficient cooling of a photovoltaic battery (PVB), a new constructive photo thermal battery (PTB) was proposed by attaching a cellular polycarbonate thermal collector (TC) to the back surface of a PVB based on crystalline silicon. Experiments have compared the parameters of traditional structured PVBs and PTBs, and shown that PTBs can operate more*

efficiently than traditionally constructed PVBs. In particular, these experimental tests were performed in the coldest month of the year, in the winter chill. The experimental test results were conducted on January 20, 21, 2022, when the weather was clear (when the daytime air temperature was around 5-8 °C). It has been shown that the power increases by 27% from a normal PTB when solar reflectors (lateral light-reflecting planes, light-reflecting coefficient 0.4-0.45) are installed on the PVB surface. The efficiency of non-reflector and reflector PTBs was found to vary by 22.5%. The device parameters prepared to take into account the extreme conditions, high temperature, degree of contamination, and the intensity of solar radiation falling on the PTB surface were studied in comparison with the parameters obtained under standard test conditions.

Keywords: photovoltaic battery, photo thermal battery, short-circuit current, open circuit voltage.

Introduction

It is known that semiconductor solar cells, which are part of the PVB based on crystalline silicon, can increase the efficiency of using electricity by lowering the temperature. The aim of the study was to develop such an experimental device and at the same time study the advantages of PTB, made on the basis of heat sinks made of PVB of traditional design, and determine the possibility of their effective use in the winter months [1, 2].

In countries with a hot climate, including Uzbekistan, there are specific factors that distinguish the use of off-grid photovoltaic devices from use in other countries. One of such factors in our country is the change in the angle of incidence of the Sun on the Earth's surface relative to the intersection of the seasons. The efficiency of photovoltaic batteries decreases, especially in winter, when solar radiation falls at a very small angle to the Earth's surface. In summer, as a result of exposure to high temperatures, a decrease in the electrical energy efficiency of the PVB is observed, as well as a decrease in efficiency due to the presence of an increased content of dust particles in the atmospheric air. Various aerosol dust particles in the air cover the surface of the PVB, forming a layer that reflects solar radiation. And in this case, PVBs are one of the main factors that reduce the efficiency. The influence of ambient temperature and dust simultaneously affects the period from April to October. At this time of the year, there is a sharp decrease in the efficiency of the PVB due to the more arid climate of the southern regions, including recent dusty atmospheric processes [3].

Materials and methods

The cross section of the PTB, developed on the basis of scientific research, is shown in Figure 1.

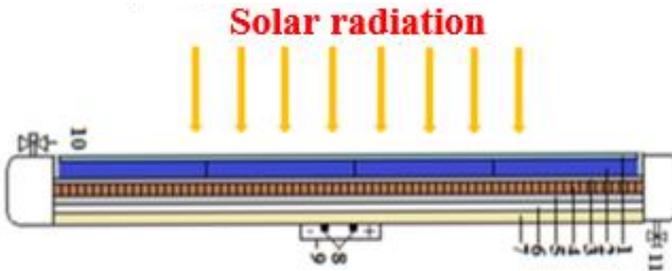


Figure 1. Cross section of the FTB. 1-protective glass, 2-solar panels, 3-layer EVA, 4-cellular polycarbonate, 5-layer insulation, 6-thermal (foam) layer, 7-back cover, 8-cell connection point, 9-pin box, 10 - cold water tap, 11 hot water tap

In our devices, the dimensions of the channels are $8 \times 10 \text{ mm}^2$ and the walls separating them are 1 mm. Cellular polycarbonate channels are arranged parallel to the PVB position. In the channels made of cellular polycarbonate installed on the rear surface of the PVB, which occupy the entire surface, water moves and absorbs heat. The heat collector is wrapped with a 3 mm thick insulating layer to prevent heat from spreading to the structural elements of the collector. Cellular polycarbonate, insulation and foam layer together with the back cover reduce heat loss several times. Some shortcomings of the previous heat collector design have been eliminated. In particular, the part connecting the polycarbonate channels of the water intake with pipes was sealed, water leakage was eliminated. For the inlet and outlet channels of cold water located outside the PVB, a polymer pipe with a diameter of 25 mm was used.

Materials and methods

Figure 2 below shows a graph of open circuit voltage as a function of time. As shown in the figure, the traditional open circuit voltage curves of the PVB and PTB change only after 10 hours depending on the intensity of the incident solar radiation. It can be seen from Figure 2 that the differences between traditional PVB and PTB with a change in voltage over time up to 10 hours are mainly related to PTB, there is no convective heat exchange with the environment, since the back and side surfaces of the photo radiator are covered with protective materials, so heat is not dissipated, but accumulated on its back surface. Since the rear surface of a normal PVB is open, the ambient air temperature during the day ranges from 1° to 8° , and the wind speed is from 3 to 7 m/s, its rear surface does not heat up as a result of exposure to low temperatures due to convective heat exchange with atmospheric air.

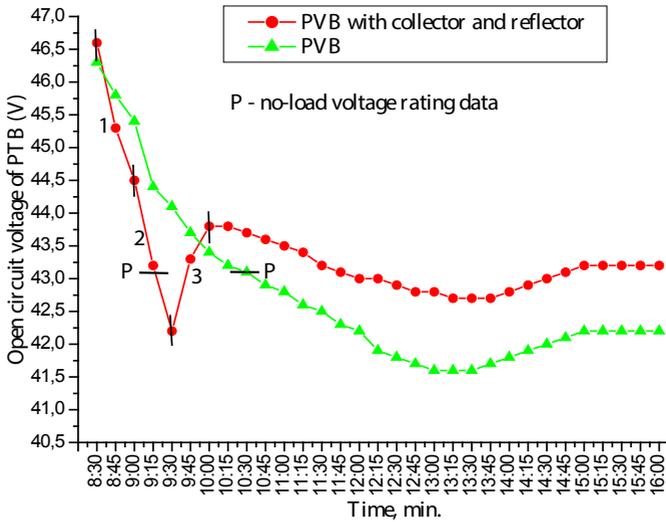


Figure 2. Open circuit voltage varies with time

In the photo thermal exchanger, on the contrary, in the 1st interval, the PTB operates in the mode of a photovoltaic battery and there is no convective heat transfer due to the fact that it is surrounded by layers protected from convective heat transfer. In interval 2, an increase in the intensity of solar radiation incident on the surface of the photocell when the side wings of the reflector are moved apart leads to additional heating of the rear surface. As a result, the open-circuit voltage continues to decrease, and during the transfer of water from the heat sink in interval 3, an increase in the open-circuit voltage is observed as the rear surface of the photocell cools, and the voltage value is higher than the voltage in the PVB passport. That is, this method can make the open-circuit voltage of the PVB more than the passport one.

In the process from 10 to 45 minutes, the dependence of the open circuit voltage on time in both photovoltaic and photovoltaic batteries is associated with an increase in atmospheric temperature and a change in the intensity of solar radiation for various reasons (see Fig. 3). Figure 2 shows that the time dependence of the voltage of a conventional photovoltaic battery changes mainly with a change in the intensity of solar radiation and atmospheric air temperature, and the PTB voltage differs by more than 2 V from the PVB voltage during the measurement period up to 16 hours after water. opens in its collector [4].

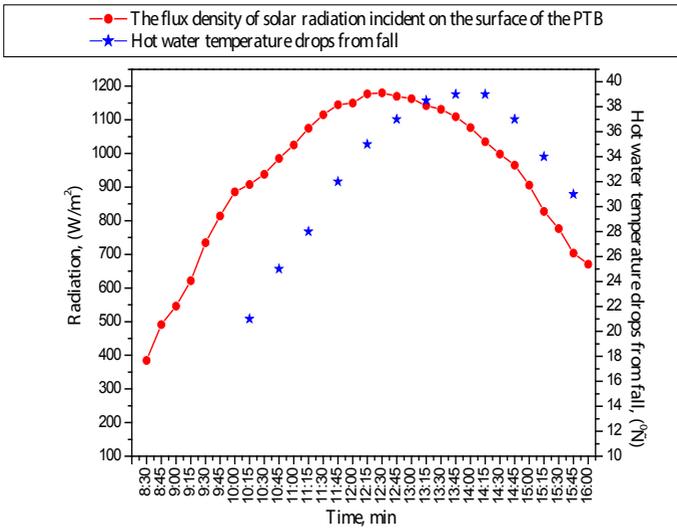


Figure 3. The time dependence of the solar radiation flux density and the temperature of the water leaving the collector

On fig. Figure 3 shows the time dependence of the intensity of the solar radiation flux and the temperature of the water at the outlet of the collector. A high value of the dependence of the intensity of the solar radiation flux on time corresponds to the period of the day from 12²⁰ to 12⁵⁰, the period of the passage of the zenith point by the Sun. Achieving the maximum value of water temperature depends on the process of heat exchange in solid and liquid bodies according to the laws of thermodynamics, which corresponds to a time of 13³⁰-14¹⁰ days. In winter, it is effective to use the PTB with a cooling system only on a clear sunny day. On the first day of research, the temperature rose to 40⁰ due to the fact that the water flow from the collector was 20 l/h. On the second day, a reflector was installed and the water consumption was doubled (40 l/h) and the water temperature was lowered to 36⁰. It turned out that from the reflective PTB on a sunny day you can get up to 36⁰ degrees of hot water, despite the low temperature (temperature equal to 5 °C).

On fig. 4 shows the time dependence of the short-circuit currents of photovoltaic and photovoltaic batteries. Under the conditions of AM-1.5, the power of the PVB (passport data is mainly 1000 W/m² and 25 °C) is 340 W and consists of 72 solar cells connected in series.

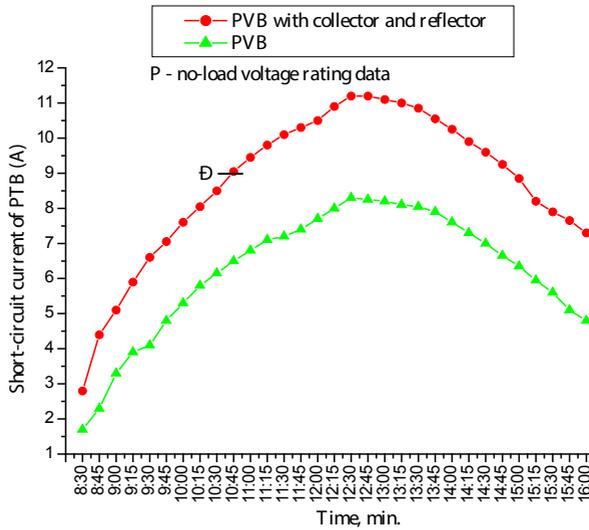


Figure 4. Time dependence of short-circuit currents of photoelectric and photoelectric batteries

It can be seen from the figure that the short-circuit current of the PTB reflector is large. In particular, from a comparison of Figures 3 and 4 at a solar radiation intensity of 1000 W/m^2 (Figure 3 at 10^{45}) the short circuit current is 9 A (Figure 4 at 10^{45}). This is an indicator in the PVB certification passport. That is, the result of the use of reflective planes (reflectors) on the sides of the PVB is an increase in the generated power. The main function of the reflector is to increase the flux density of solar radiation (especially in winter). The cost of manufacturing a reflector is 15 - 18% of the cost of a photocell [5]. However, the use of a reflector in combination with a PVB can increase power by up to 50% when a thermal collector is installed.

Conclusion

In rural areas of Uzbekistan, only 18 - 20% of the solar radiation falling on the surface of the PVT and absorbed by it is converted into electricity, and the rest is practically absorbed and converted into heat in the silicon semiconductor structure. solar element. With the efficient use of this heat, the newly developed photovoltaic devices based on PTB have the ability to receive both hot water and electricity for the domestic needs of the rural population. Based on the scientific and practical results obtained in January of the winter season, it can be concluded that with the help of devices based on photovoltaic batteries, it is possible to provide rural population with electricity and hot water all year round.

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人工智能领域的空间项目和俄罗斯在其中的地位
**SPACE PROJECTS IN THE FIELD OF ARTIFICIAL INTELLIGENCE
AND RUSSIA'S PLACE IN THEM**

Kharlanov Alexey Sergeevitch

Candidate of Technical Sciences, Candidate of Economic Sciences, Full Professor, Head Research Officer

Kharlamov Maxim Mikhaylovitch

Candidate of Economic Sciences, Head of the Research Center of

Dubinin Vladimir Ivanovich

Candidate of Technical Sciences, Associate Professor, Deputy Head of the Center for Scientific Work

Kryuchkov Boris Ivanovitch

Doctor of Technical Sciences, Full Professor, Laboratory Head

Yuri Gagarin Cosmonaut Training Center

抽象的。 本文描述了国内航天领域的现代方法和发展趋势，其中人工智能技术和数字化转型的使用将为改进设计过程和提供能够显著提高该国一些社会生产力的太空服务提供充满信心的动力。 经济过程。 它还考虑了俄罗斯航天工业数字化和人工智能系统实施领域的进一步服务市场，并将任务与其他世界航天机构进行了比较。

关键词：太空、俄罗斯航天工业、人工智能、数字化、制裁。

Abstract. *The article describes modern approaches and development trends in domestic cosmonautics, where the use of artificial intelligence technologies and digital transformation will give a confident impetus both to improve design processes and to provide space services that can significantly increase the productivity of some of the country's socio-economic processes. It also considers the market for further services in the field of digitalization and implementation of AI systems in the Russian space industry and compares the tasks with other world agencies.*

Keywords: *space, Russian space industry, artificial intelligence, digitalization, sanctions.*

The beginning of the Russian military operation in Ukraine and the ongoing stream of sanctions from the countries of the "golden billion" made many people talk about the upcoming retortions and reprisals, personnel and technological shortages in the Russian space industry. The existing space domination programs of various states are directly related to artificial intelligence (AI) systems, to the introduction of nature-like NBIC technologies, to ultra-fast supercomputing, and to the creation, analytics and use of databases in ultra-fast calculations used in dynamic models of a high degree of uncertainty. At the same time, world practice explores options for accelerated development, such as the synergy of scientific schools and navigation following the specific scientific results obtained in them, evaluating the predictive reliability of groundwork for technological breakthroughs and ready-made unique solutions in the field of entering new global technological structures. All countries that have built a digital infrastructure in the virtual space of their management business models have involved in this process the applied results of cooperation, project or holding clusters, start-ups, greenfields, most (more than 75%) of which are formed by the Big Five (Apple, Microsoft, Amazon, Facebook, and Alphabet (Google's parent company)), as dollar trillionaires and leading ICT software and network market integrators in Silicon Valley and China's 10 innovative industrial zones, using the power of the Internet itself, which played the role of coordinating information nodes in the digital network. China itself, according to the World Intellectual Property Agency, was rated by the "global innovation index" in 2020 as already occupying 14th place in the world from 35th place in 2013, with positive dynamics in the development of databases, cloud and ICT -services and AI systems. Among such creator zones, we can single out those that, over the 30-year history of the innovative technological leap, have created the relevant profiles of ICT goods and services, as well as developed the relevant scientific schools of world convergence, competencies and knowledge, namely in such centers as Shenzhen, Zhuhai, Shantou in Guangdong Province, and Xiamen in Fujian Province. At the same time, world statistics assess the participation of labor resources in the processes of computerization and robotics of transforming production processes as initially basically focused on the leading developments of the Soviet scientific school and its subsequent evolution through the "brain drain" of labor migrants organized by the West and their clustering on campuses and in creative industrial and scientific areas of academic campuses or unicorns responsible for the processes of ICT development and for the creation of systems of new generations of communication and data transmission, for the accumulated groundwork in the development of neural networks and deep machine learning. The depressing minimum number of relevant domestic necessary machine tools and devices, heavy-duty computers, devices for simulating real processes in various environments and in space, including the limited availability

of electronic panels-tablets for training Russian cosmonauts in Russia based on Apple and Samsung, leads the analyst to the idea that that our scientific school today is only being formed in the field of solving specific applied problems for certain projects or processes that can adequately and inexpensively compete with foreign manufacturers. The demonstrated approach itself, based on the wishes of a professionally created customer, in particular, an astronaut-researcher, forms not only the mental and thematic preferences of a civilized consumer of the behavioral economy of the present, but also visualizes its interface of requested tasks that can create both ecosystems of the future, and design and produce corresponding prototypes of unique devices that solve the problem of convergence of theoretical estimates with their practical results of execution in material form.

Most domestic space industry enterprises were founded in the middle of the last century. During this time, a huge amount of technical documentation, drawings, research papers, organizational documents, and so on have accumulated on the shelves of libraries and archives. There is a problem of accumulating, sorting, storing documentation, organizing search and quick access to the necessary information, limiting or sharing access to documentation with the ability to make changes in real time. The digitalization of production, which includes the creation of: unified geographically distributed digital libraries with access control, projects for product life cycle management, project management systems and hierarchies, and a formalized electronic document management system, can help in the issues raised.

All these products will allow young professionals to quickly adapt to enterprises, understand the logic of development, see the overall picture of work, as a whole, develop, edit and approve design documentation in real time, organize online meetings with a high degree of crypto protection of broadcast data.

Such a system should be built by creating a single information space and include a variety of information and analytical systems. Documents must be ranked, indexed, versioning must be tracked. Organized a simple and understandable search system throughout the database, with the ability to apply all sorts of filters and semantics. To obtain complete information about the object you are looking for: standards, 3D models, scientific research, test results, i.e. all related documents relevant to the request. The stages of building the system include digitizing documents, creating a digital archive, asking staff to create additional catalogs or digital workspaces to resolve work files. The next stage is the creation of a corporate intelligent search system based on artificial intelligence. The system must be self-learning so that the system helps to parse keywords, build a full-fledged index, then a semantic analysis is performed, during which the index is enriched with the value of the semantic class in order to ensure the search for the necessary documentation as quickly and accurately as possible. The system itself should

produce statistical data to analyze the number of developments, digitize documentation, count the number of units, issued technical documentation.

In continuation of the development of the project, it is necessary to consider the issues of connecting new sources of information, as well as enterprises of an integrated structure, which will require the creation of a closed system for transferring data between enterprises to exclude the possibility of unauthorized access to classified information.

The system will allow creating a unified knowledge base, will be able to unify the standards of the enterprise, provide a quick search for a huge amount of information, lead to a reduction in time spent on meetings and the development of technical documentation.

An example is the Earth remote sensing system.

At the first stage, the executive authorities send formatted applications for space imaging, at the second stage, space photography is carried out and thematic processing is carried out, integrated with information databases of the land cadastre, forestry, the Ministry of Emergency Situations, etc. As a result, digital products are obtained for various industries that solve various problems: water resources monitoring, waterlogging assessment, flood modulation, forest fires, illegal logging, criminal mining, emergency monitoring, pollution monitoring, illegal development of terrain and land squatting, crop monitoring and cleaning of agricultural land. All this information is transmitted to the Roscosmos geoportal, where customers can receive ordered images. This portal has already accumulated a huge database of digitized information.

An example of such projects is the Center for Collective Use of System Archives, Processing and Analysis of Satellite Observation Data of the Space Research Institute of the Russian Academy of Sciences for solving the problems of studying and monitoring the environment (CCU "IKI-Monitoring"), established in 2012.[1] Within the framework of the "IKI-Monitoring" Center, the following main tasks are solved: automated maintenance of super-large distributed archives of satellite data and the results of their processing, automated streaming data processing to obtain various information products necessary for scientific research, providing tools for processing and analyzing satellite data, providing software interfaces to various information systems for remote monitoring. [2] The archive base of the Center is more than 5 petabytes of information, about 4 terabytes of raw and processed information is received every day, about 150 geographically distributed servers with a total volume of 6 petabytes are used to provide the archive.[3] The sources of data are "Roshydromet", "Roskosmos", foreign companies, as well as the users of the system themselves, have the opportunity to replenish the information archives.

At the first level, the raw data from the spacecraft is unpacked, undergoes ra-

diometric and geometric corrections, then georeferencing takes place, where each pixel of information is assigned a set of geographic coordinates. Next comes a long set of operations, such as orthorectification. The second level is session fields of various physical characteristics and indexes translated into a cartographic projection. It can be different cartographic products, temperature, sowing indices, fires and much more. The archives store data of the first level, since there can be a huge number of level two products, depending on the tasks, and storage of which is not possible. Therefore, a system is being created that automatically, based on first-level information, depending on the user's request, is able to create thematic products and maps with the necessary set of parameters and indices. The third level is composite data based on the processing of information over a large time interval and having some statistics, or composite mosaics from several images of a given area of interest, taking into account the selection and rejection of the cloud zone. Based on the multispectral survey data, it is possible to predict the yield of sowing crops. Control issues are being resolved: comparison of the boundaries of the sowing field obtained by remote sensing with the state cadastral map, unaccounted agricultural lands and those plots that are not such are identified, areas of land misuse are determined. Using a combination of underlying surface data, weather conditions, and updated imagery, it is possible to model the spread of fires, aerosol emissions, and the spread of volcanic eruptions. The results of satellite imagery make it possible to identify the volume of increasing subsoil use, cutting down trees, organizing landfills, etc. [4, 5] Today, Roscosmos creates and pays great attention to the development of ground-based space infrastructure for receiving, processing, archiving, storage and distribution, as well as the provision of services and services based on them within the framework of the ETRIS remote sensing program. The system consists of a network of ground stations distributed over the territory of Russia, linked into a single network that allows receiving and processing information and transmitting data to the consumer with maximum efficiency. Since 2012, a significant archive of materials obtained by domestic spacecraft has been accumulated, based on these data, a continuous, seamless model of the Earth's surface is being created. For the further development of the project in 2017, "Roscosmos" launched the "Digital Earth" project, which is a completely new information and analytical system that allows access to space monitoring data. This project was organized as part of the implementation of the instructions of the President of Russia under the "Digital Economy" program. In the "Digital Earth" geoservices, with the help of artificial intelligence technologies, information from spacecraft is converted into understandable and convenient analytical reports on the state and development of objects, territories and natural resources. During the implementation, an automated data processing complex is created that combines several levels of data processing using neural network technologies and

artificial intelligence, capable of creating thematic products for a simple consumer, without the participation of narrowly focused specialists in this field. At the moment, the "Digital Earth" complex includes 7 geoservices and 27 monitoring products.[6] The development of these services will give an additional impetus to the development of modern technologies and the use of remote sensing data, which allow solving urgent problems in the interests of the socio-economic development of the Russian Federation, supporting the public administration system, and will also allow domestic companies to become one of the leading participants in the market for the provision of space products and services [7].

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基于聚己二酸对苯二甲酸丁二醇酯和聚丙交酯的可生物降解材料在紫外线照射下的强度性能研究

STUDY OF THE STRENGTH PROPERTIES OF A BIODEGRADABLE MATERIAL BASED ON POLYBUTYLENE-ADIPATE TEREPHTHALATE AND POLYLACTIDE WHEN EXPOSED TO ULTRAVIOLET RADIATION

Obydenova A.A.

Engineer

Myalenko D.M.

Candidate of Technical Sciences, Senior Research Officer

*All-Russian Scientific Research Institute of Dairy Industry
Moscow, Russia*

抽象的。世界上用于各种行业和包装的聚合物材料的数量以及它们的废物量每年都在增加。对此，有必要想办法解决这个环境问题。确保环境安全的方法之一是从完全可再生的植物材料中开发现代可生物降解的聚合物材料，其中一种是聚乳酸（PLA），以及基于它的组合物。外部物理因素，特别是紫外线照射（UV）对包装材料表面的影响会“启动”破坏性过程。本文介绍了紫外线辐射对基于聚己二酸对苯二甲酸丁二醇酯（PBAT）和聚丙交酯的可生物降解组合物的物理、机械、卫生和卫生以及感官特性的影响的数据。

关键词：生态学，可生物降解聚合物，降解，聚乳酸，材料强度，紫外线照射，聚己二酸对苯二甲酸丁二醇酯

Abstract. *The amount of polymer materials for various industries and packaging in the world is increasing every year, as well as the amount of their waste. In this regard, it is necessary to think about ways to solve this environmental problem. One of the ways to ensure environmental safety can be the development of modern biodegradable polymeric materials from completely renewable plant materials, one of which is polylactic acid (PLA), as well as compositions based on it. The influence of external physical factors, in particular ultraviolet irradiation (UV), on the surface of packaging materials can "start" destructive processes. This article presents data on the effect of UV radiation on the physical, mechanical, sanitary and hygienic and organoleptic characteristics of a biodegradable composition based on polybutylene adipate terephthalate (PBAT) and polylactide.*

Keywords: *ecology, biodegradable polymers, degradation, polylactic acid, material strength, UV irradiation, polybutylene adipate terephthalate*

Biodegradable materials are actively included in the daily life of mankind. Analogues of traditional polymers, which have the ability to degrade under environmental conditions to carbon dioxide and water, significantly reduce the burden on the ecosystem of our planet. Reducing the amount of polymeric waste in nature is an important vector in human life, so the introduction of biodegradable materials into industry in the future should replace the usual polymeric materials with environmentally friendly analogues [1-3].

The process of biodegradation of polymers in natural conditions depends on a number of factors, such as ultraviolet radiation, temperature, humidity, the number and activity of microorganisms, etc. For a number of biodegradable materials, special additives act as initiators of decomposition, which increase or accelerate the impact of natural factors [4]. However, a large number of biomaterials are based on natural polymers, such as starch, cellulose, chitin, etc., and therefore do not require additives that accelerate degradation.

According to experts for 2019, out of 2.11 tons of produced biomaterials, 13.9% was polylactic acid or PLA, and PBAT - 13.4%. PBAT is a completely degradable plastic and a promising replacement for polyethylene, as it has the necessary strength characteristics [5]. PLA is also a completely biodegradable polymer. Products made from PLA have high rigidity, transparency and gloss, so it is often used as a strength base for biodegradable compounds. [6]. Our studies have confirmed that the PBAT/PLA biocompound has the necessary strength and consumer qualities, as well as the maximum degree of degradation within six months.

Such materials are of great interest for the packaging industry of the food industry, including the dairy sector. The All-Russian Scientific Research Institute of the Dairy Industry ("ARSRIDI") is engaged in research on modern biodegradable materials that have potential applications as food packaging.

The purpose of this study is to compare the properties of a biologically pure polymer compound based on PBAT and PLA before and after a two-hour UV exposure. Irradiation was carried out in a setup with a constant combustion source with a wavelength of 247 nm. The appearance of the installation is shown in figure 1.



Figure 1. Schematic diagram of the installation for ultraviolet irradiation of polymeric materials.

Further analysis of the properties of the control and irradiated samples was carried out according to the following parameters: organoleptic characteristics of aqueous extracts in distilled water with an exposure period of 10 days; breaking stress at break, MPa; elongation at break, %; sanitary-hygienic study of the level of migration of substances into an extract based on distilled water.

The organoleptic evaluation of the control (sample № 1) and irradiated (sample № 2) samples was carried out according to instructions №880-71 of the Ministry of Health [7]. Evaluation of odor at different temperature conditions, taste, color, turbidity and sediment of distilled water after ten days of contact with the samples showed the absolute safety of the material. The results are shown in Fig. 2.

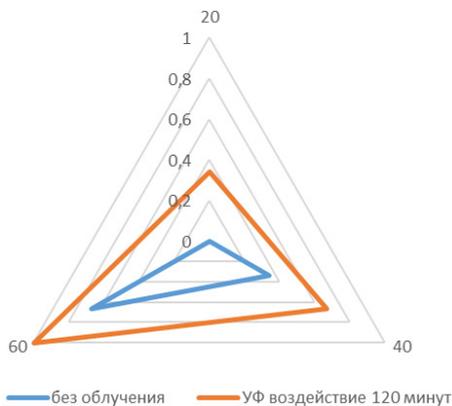


Figure 2. Organoleptic evaluation of biodegradable material based on PBAT and PLA after exposure for 10 days

In the extracts from the studied samples, there was no taste, turbidity of the precipitate, and color change. However, the extracts from the samples after UV treatment had a slight odor, not exceeding 1 point.

The evaluation of the physical and mechanical properties of the material under study was carried out in accordance with GOST 14236-81 [8]. The universal testing machine of the Japanese company SHIMADZU model EZ-LX was used as testing equipment (Fig. 3). The travel length of the traverse is 920 mm, the power of the installed force sensor is 2 kN. The test was carried out at a clamp travel speed of 500 mm/min.



Figure 3. Universal testing machine SHIMADZU with a fixed sample.

Table 1.
Results of strength tests of PBAT/PLA biocompound samples before and after two-hour UV irradiation

Sample name	Tensile strength, MPa	
	Longitudinal	Transverse
Sample №1	13,96	14,10
Sample №2	11,07	12,63

The results obtained show that after two hours of UV exposure, the material loses strength by 20.7% in the longitudinal direction and 10.4% in the transverse direction, respectively.

Sanitary and hygienic study of aqueous extracts in distilled water after contact with the material for 10 days was carried out in accordance with Appendix 1 of TR CU 005/2011 [9]. Determination of the allowable amount of migration of substances released from a polymeric material is an important indicator for assessing the safety of packaging intended for food contact. Studies of the migration of volatile organic compounds were carried out using a "KristalLux 4000m" gas chromatograph using a flame ionization detector and capillary columns: ZB-WAX 60m×0.53mm×1.00μm, phase composition polyethylene glycol 100% and ZB-624 60m×0.53mm×3.00μm, phase composition cyanopropylphenyl 6% dimethylpolysiloxane 94%.

The results of the study are shown in fig. 4 and 5.

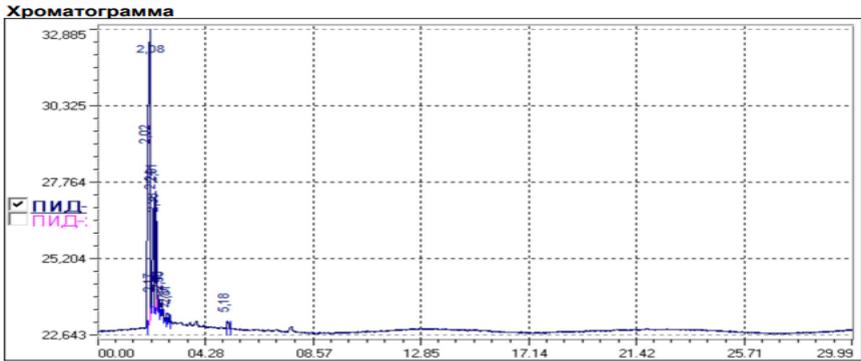


Figure 4. Chromatogram with the results of the analysis of extracts from distilled water after contact with Sample №1 for 10 days

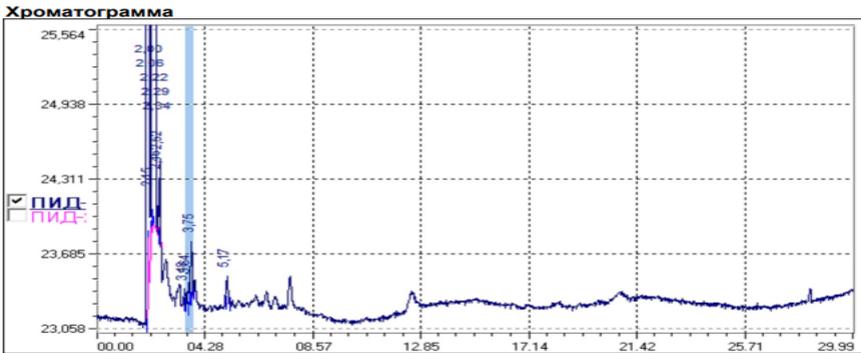


Figure 5. Chromatogram with the results of analysis of extracts from distilled water after contact with Sample №2 for 10 days

Conducted sanitary and hygienic studies show that exposure to UV radiation of a mercury bactericidal lamp of constant burning at a wavelength of 247 nm for 120 minutes does not adversely affect migration processes. The concentration of volatile organic compounds does not exceed the DCM established in the Technical Regulations of the Customs Union "On the safety of packaging" (TR CU 005/2011).

Thus, UV radiation affects the strength characteristics of biodegradable materials from PBAT and PLA. The data obtained in the framework of this work are the "basic reference point": samples of biodegradable materials based on PBAT and PLA are placed in compost storage in laboratory conditions to establish the effect of UV irradiation on the course of destructive processes in them.

The development of biopolymer materials and the increase in the scope of their use contributes to the improvement of the environmental situation of the future, as it reduces the amount of non-recyclable and non-degradable polymer waste.

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液环真空泵偏心率值对工作流体粘度依赖性的测定

**DETERMINATION OF THE DEPENDENCE OF THE VALUE OF
THE ECCENTRICITY OF LIQUID RING VACUUM PUMPS ON THE
VISCOSITY OF THE WORKING LIQUIDS**

Zorin Alexander Sergeevich

Candidate of Technical Sciences, director

LLC «Z-line»

Skomorokhova Anastasia Igorevna

Master's degree Student

Tambov State Technical University

Zorina Olga Alexandrovna

Postgraduate

Tambov State Technical University

Selivanova Polina Ivanovna

Engineer

JSC «Gazprom Gas Distribution of Tambov»

Vacuum pumps are machines that pump out air or gas from an apparatus with a pressure below atmospheric pressure and, compressing it, usually push it into an apparatus with atmospheric pressure or into the atmosphere [1].

The demand for these machines and the intensive growth of production is due to a number of their advantages. Liquid ring pumps are indispensable in the oil, gas and chemical industries for the compression of flammable and explosive gases [2, 3]. Recently, they have found application as chemical reactors for mass transfer processes between a compressible gas and a working fluid. Relatively high values of specific power necessitate the development of more economical liquid ring machines [4, 5].

A significant influence on the characteristics of a liquid ring vacuum pump, in particular on the shape of the liquid ring, is exerted by the viscosity of the working fluid. At the beginning of the suction area, the fluid velocity in the bladeless space depends little on the viscosity. When moving from the upper section to the lower one, this difference increases due to hydraulic losses, and in the lower section, compared to water, the velocity decreases. This results in a relative increase in the liquid ring of about 8% and a corresponding decrease in the amount of suction

gas. During compression, the velocity of a more viscous liquid decreases faster than that of water, both due to losses and due to a more intensive increase in gas pressure in the cells. After the injection window is opened, part of the liquid immediately goes into the discharge pipe, the liquid velocity increases and the liquid ring moves away from the edge of the window. The volume of dead space and leakage increase, the speed of action decreases [6].

Therefore, when designing machines designed to operate on fluids more viscous than water, it is necessary to increase the eccentricity.

Thus, the viscosity of the working fluid affects the loss of speed, the vacuum achieved and the efficiency of liquid ring vacuum pumps. To improve the efficiency of liquid ring machines, a method for calculating the eccentricity value is proposed.

There is a well-known formula that describes the radius of the inner surface of the liquid ring [7]. This expression has a physical meaning under the following assumption: the inner surface of the liquid ring within the boundaries of one cell is cylindrical.

$$r_{22} = r_2 \sqrt{\frac{v^2}{k_1^2} + \frac{2 \times \varepsilon \times \left(1 - v^2 + \frac{\left(\frac{R}{r_2} - 1 - \varepsilon \right) \times \zeta}{\psi} \right) \times \left((8,3696 - 0,465 \times \text{ctg}(\beta_2)) \times -0,451 - 3,59 \times \mu_{\text{жк}} \right)}{\varepsilon + \frac{R}{r_2} - 1}} + \left(\frac{2 \times \zeta \times \left(\frac{R}{r_2} - 1 - \varepsilon \right) \left(1 - v^2 + \frac{\left(\frac{R}{r_2} - 1 - \varepsilon \right) \times \zeta}{\psi} \right) \times \left((8,3696 - 0,465 \times \text{ctg}(\beta_2)) \times -0,451 - 3,59 \times \mu_{\text{жк}} \right)}{2 \times \zeta \times \left(\varepsilon + \frac{R}{r_2} - 1 \right)} - 0,5 \right) \quad (1)$$

where r_2 – outer radius of the impeller blades; $v = r_1/r_2$; where k_1 - speed coefficient, depending on the shape and number of blades of the impeller; $\zeta = b_0/b$; ψ – is the coefficient taking into account the reduction in the working volume due to the thickness of the blades; β_2 – outlet angle of inclination of the impeller blades; R – gas constant of the pumped gas; ε – relative eccentricity; $\mu_{\text{жк}}$ – viscosity of the working fluid.

The values \mathbf{y} , \mathbf{V} , k_1, \mathbf{n} , \square_2 , R are constant for a specific type of pump.

Thus, from formula (1) we obtain the functional dependence of the relative eccentricity on the viscosity of the working fluid:

$$\varepsilon = f(\mu_{жс}). \tag{2}$$

The value of the eccentricity is calculated by the formula:

$$e = \varepsilon \cdot r_2 \tag{3}$$

We get from the obtained formula (3) the required eccentricity for the operation of a liquid ring vacuum pump on more viscous liquids than water. The graph (Fig. 1) shows the dependence of the relative eccentricity on the viscosity of the liquid used as a working fluid for the VLRP-12 liquid ring vacuum pump.

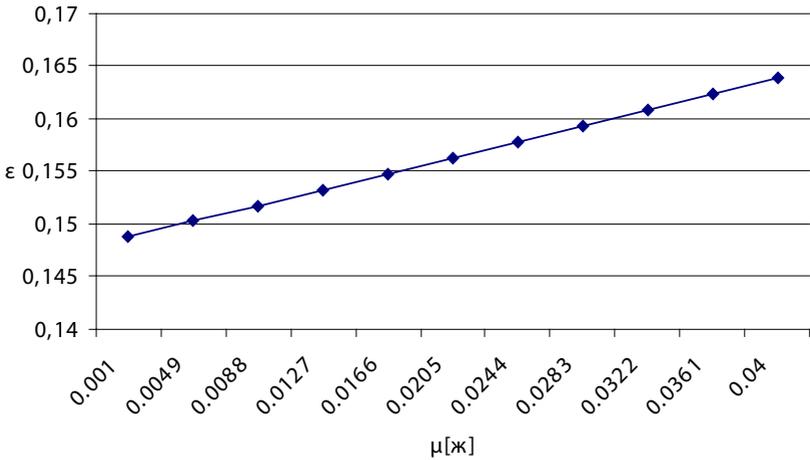


Figure 1. Graph of dependence of relative eccentricity on the viscosity of the working fluid for the liquid ring vacuum pump VLRP-12

It should be noted that the value of the viscosity of the working fluids used for the operation of the LRVP is in the range $\mu=0.001 \dots 0.08$ Pa·s.

Eccentricity regulation for existing designs is possible only when the liquid ring vacuum pump is operating on working fluids with a viscosity of $\mu = 0.001 \dots 0.04$ Pa·s, the limiting parameter is the gap between the impeller and the vacuum pump casing. Therefore, when designing vacuum pumps, it is necessary to calculate the pump geometry for operation on liquids of medium viscosity $\mu=0.04$ Pa·s.

Thus, the functional dependence (2) has been analytically obtained, the solution of which makes it possible to determine the value of the relative eccentricity necessary for the operation of the LRVP on working fluids of various viscosities while maintaining the nominal speed of action, the achieved vacuum and efficiency. Based on the analytical dependence, a LRVP design with adjustable eccentricity was proposed [8].

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使用发酵改变乳清的味道和感官指标
**CHANGING THE TASTE AND ORGANOLEPTIC INDICATORS OF
WHEY USING FERMENTATION**

Loginov Zakhar Alekseevich

ORCID ID: 0000-0002-5220-9047

Kalinovskaya Alexandra Igorevna

ORCID ID: 0000-0002-20597655

Ryndin Alexander Alekseevich

Candidate of Technical Sciences, Associate Professor

Moscow State University of Food Production

ORCID ID: 0000-0001-6861-9297

抽象的。乳清是乳制品生产的主要副产品，其处置问题非常严重。现有的乳清加工项目规模小，无法处理流量。饮料生产是一种快速、高质量且最重要的是价格低廉的解决方案。这项工作的目的是开发不具有牛奶或乳制品的味道和感官特性的基于乳清的饮料配方。根据 GOST 32892-2013 测量的 pH 值变化和根据 GOST 3626-73 在发酵过程中测量的固体量变化表明一些菌株发酵乳糖的能力。根据 GOST ISO 6658-2016 进行的感官分析显示了在发酵饮料生产中使用乳清的可能性。

关键词：乳清，柠檬水，发酵，矿物质成分。

Abstract. *Whey is the main by-product of dairy production and the problem of its disposal is very acute. Existing whey processing projects are small and cannot handle the flow. Beverage production is a fast, high-quality and most importantly inexpensive solution. The aim of this work was to develop whey-based drink formulations that do not have the taste and organoleptic properties of milk or dairy products. Changes in pH measured according to GOST 32892-2013 and changes in the amount of solids measured according to GOST 3626-73 during fermentation showed the ability of some strains to ferment lactose. Organoleptic analysis carried out according to GOST ISO 6658-2016 showed the possibility of using whey in the production of fermented drinks.*

Keywords: *whey, lemonade, fermentation, mineral composition.*

Whey processing is one of the most important tasks facing the dairy industry. At present, the problem of whey is very acute, since the volumes of whey signifi-

cantly exceed the volumes of manufactured products, and recycling methods have not been introduced at enterprises. A large number of factories pour it into drains, polluting treatment facilities. Based on this, we can say that the task of greening dairy production is one of the urgent tasks of the sustainable development of the food industry. Curd whey, cheese whey, as well as hard cleaning permeate were used as the object of the study. Each of the samples has a good mineral and vitamin composition, and also contains lactose fermented by some yeasts. In the context of increasing demand for functional drinks and an increase in the amount of whey discharge, a quick, high-quality, and most importantly not expensive solution was required. Whey was chosen as the main raw material not only because it needs to be disposed of, but also because of its beneficial properties. Milk whey contains vitamin B1 complex, folic acid, cobalamin, ascorbic acid, tocopherol, nicotinic acid, Ca, K, Mg, Na, P, Fe, I, Zn.

At the first stage, fermentation with the help of a number of microorganisms was chosen as the main technological step to remove lactose from the composition and obtain useful fermentation metabolites, as well as the biotransformation of sensory active whey components. We used 6 strains of yeast, the genus *Klyuveromyces lactis* intended for use in the cheese industry, as well as *Saccharomyces cerevisiae*, intended for use in champagne and still wines, as well as the alcohol industry. Yeast was added to caseous whey with a solids content of 4.5% and fermented for 7 days at a temperature of 22 degrees and fermentation for 7 days at a temperature of 8 degrees. In fermented whey, pH was determined according to GOST 32892-2013, dry matter content according to GOST 3626-73, as well as organoleptic analysis according to GOST ISO 6658-2016, the data obtained are presented in table 1.

Table 1.
Ability of strains to ferment lactose and organoleptic and physicochemical evaluation.

Strain	Fermentation activity	Organoleptic	pH	Dry matter
<i>Klyuveromyces lactis</i>	Active	Sweet, fruity, low curd	4,3	2,5
<i>Saccharomyces cerevisiae</i> (Champagnes BC S 103)	Active	Pleasant, sweet and sour	4,4	2
<i>Saccharomyces cerevisiae</i> (White classic)	Weakly active	Pleasant, sour-milk	4,5	3
<i>Saccharomyces cerevisiae</i> (Fruits)	medium active	Cheesy, strongly acidic	4	3,2
<i>Saccharomyces cerevisiae</i> (VR 44)	Active	Weakly kefir	4,3	2

Saccharomyces cerevisiae (Alcoholic)	Inactive	Strongly acidic, with a high admixture of esters	4,3	4,5
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It can be seen from the data presented in the table that most of the selected microorganisms are able to assimilate lactose. The highest fermenting ability was noted in strains number 1, number 2, number 4 and number 5.

Comparison of the fermentation ability and sensory indicators allowed us to select 4 strains that transformed the smell of whey. The aromatic profiles of the samples obtained are shown in Figure 1.

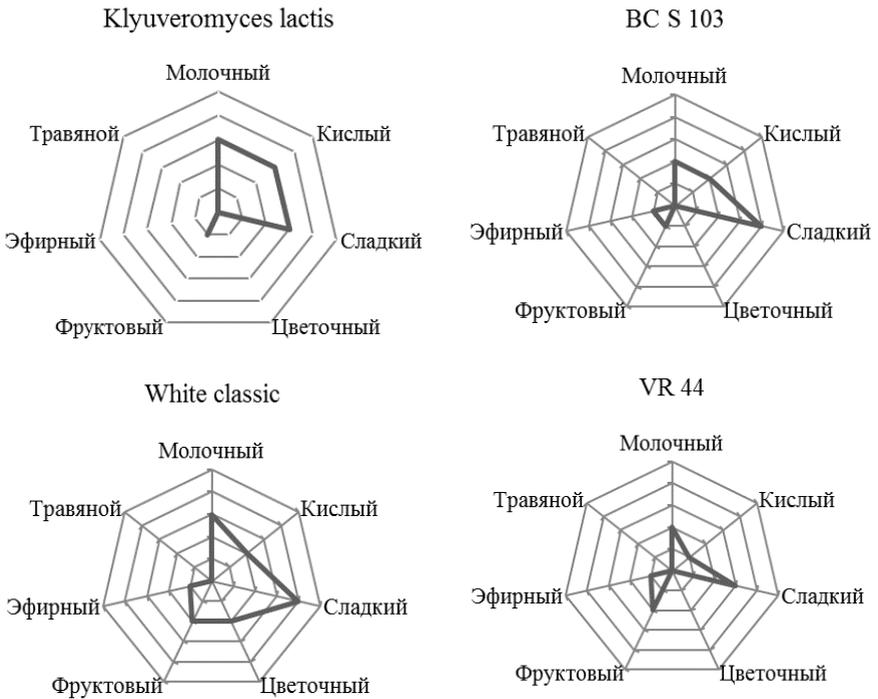


Figure 1. Profilographs of the flavor profile of fermented whey

As can be seen from the figure, the yeast not only removed most of the milk component from the aroma, but also enriched the fermented product with the aromas of fermentation products. Sample 1 performed well in sweet and fruity tones, sample 2 in sweet, fruity and ethereal tones, sample 3 in sweet and fruity, and sample 4 in sweet, floral and fruity tones.

The results obtained showed that fermentation with used yeast cultures can be an effective technique for preparing whey for further use.

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酒香酵母属在发酵饮料技术中的应用
**THE USE OF YEAST OF THE GENUS *BRETTANOMYCES* IN THE
TECHNOLOGY OF FERMENTED DRINKS**

Mukhamedzhanova Tatyana Georgievna

Candidate of Technical Sciences, Associate Professor

Barkanov Alexandr Vladimirovich

ORCID ID: 0000-0001-9929-6646

Makovkina Maria Vitalievna

Master's degree Student

Moscow State University of Food Production

抽象的。酒香酵母属的酵母传统上被认为是酿酒行业的害虫。然而，最近出现了关于酒香酵母属酵母转化啤酒花衍生的单萜醇以及同化硝酸盐的能力的数据。在这项工作的框架内，开展了从自然物体中寻找、分离和分析酒香酵母属酵母技术特征的研究。此外，以格瓦斯麦芽汁样品为例，评估了酒香酵母属酵母对发酵饮料感官特性的影响。

关键词：酒香酵母，克瓦斯，萜烯醇的生物转化，啤酒花微生物群

Abstract. *Yeasts of the genus *Brettanomyces* have traditionally been considered pests in the brewing industry. However, data have recently appeared on the ability of yeasts of the genus *Brettanomyces* to transform hop-derived monoterpene alcohols, as well as to assimilate nitrates. Within the framework of this work, research was carried out on the search, isolation and analysis of the technical characteristics of yeasts of the genus *Brettanomyces* from natural objects. Also, an assessment was made of the influence of yeast of the genus *Brettanomyces* on the organoleptic characteristics of fermented drinks using the example of kvass wort samples.*

Keywords: *Brettanomyces, kvass, biotransformation of terpene alcohols, hop microbiota*

Yeast of the genus *Brettanomyces* has traditionally been considered pests of brewing [1]. One of the features of this yeast is the release of fatty acids into the fermentation medium, which induce oxidation and reduce the taste stability of drinks [4]. However, data have recently appeared on the ability of yeasts of the

genus *Brettanomyces* to transform hop monoterpene alcohols [2, 3]. Under the action of yeast enzymes of the genus *Brettanomyces*, terpenes are oxidized to form derivatives with new aromatics that are not characteristic of the original hop. The scheme of transformation of hop oil terpenes under the action of these yeasts is shown in the figure.

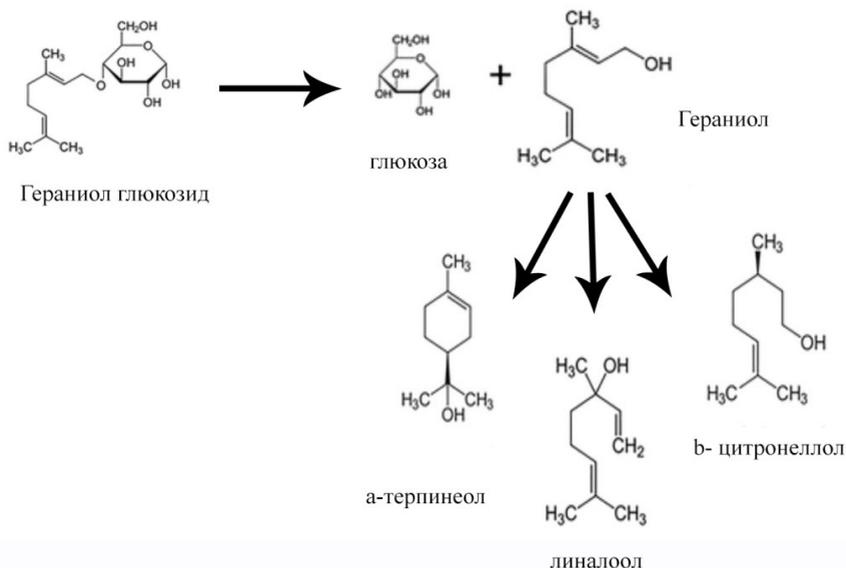


Figure 1. Biotransformation of monoterpene alcohols under the action of yeast enzymes of the genus *Brettanomyces*

It can be seen from the presented scheme that the original terpene alcohols (in this case, geraniol), which do not clearly manifest themselves in the flavor of the raw material, change the structure of the molecule, which leads to the development of a new aroma. These transformations make it possible to create new flavors in drinks from floral (α -terpineol) to citrus nuances (β -citronellol).[3] This discovered ability of yeast of the genus *Brettanomyces* is now beginning to be used in craft breweries in Western countries.

Another interesting property of yeast of the genus *Brettanomyces* is their ability to assimilate nitrates, which is important in terms of food safety.

Information sources provide data on the isolation of yeast of the genus *Brettanomyces* from natural objects and from beer obtained by spontaneous fermentation [2].

The purpose of this study was the search, isolation and study of yeasts of the genus *Brettanomyces* from natural objects.

Hops growing in the Ryazanskaya Meshchera and a consortium of microorganisms *Medusomyces gisevii* were used as objects of study [5].

Washing with sterile water was used to identify and quantify hop microorganisms. Inoculations were made from a suspension in a loop on dense nutrient media: Sabouraud medium, wort agar (from unhopped wort), dry nutrient agar to detect bacteria. Incubation was carried out at a temperature of 25 C° for 2-5 days. Sowing with a loop on a dense nutrient medium allowed us to obtain isolated colonies of yeast and bacteria. The isolated microorganisms were identified by PCR. Fermentation activity was determined by the final degree of fermentation (FDF) [6].

At the first stage of the study, the study of the microbiota of hop cones was carried out. The results showed the presence of bacteria and filamentous fungi in them. A photograph of isolated microorganisms is shown in Figure 2.



Figure 2. *Microbiota of hop cones*

Analysis of the conducted crops showed the absence of yeast on hop cones, which may be due to unfavorable conditions for drying and storing hops.

Yeasts were isolated from the *Medusomyces gisevii* consortium by inoculation on an agar selective medium containing bacteriocins, which corresponded in morphological characteristics to yeasts of the genus *Brettanomyces* [7]. A photo of the isolated yeast culture is shown in Figure 3.

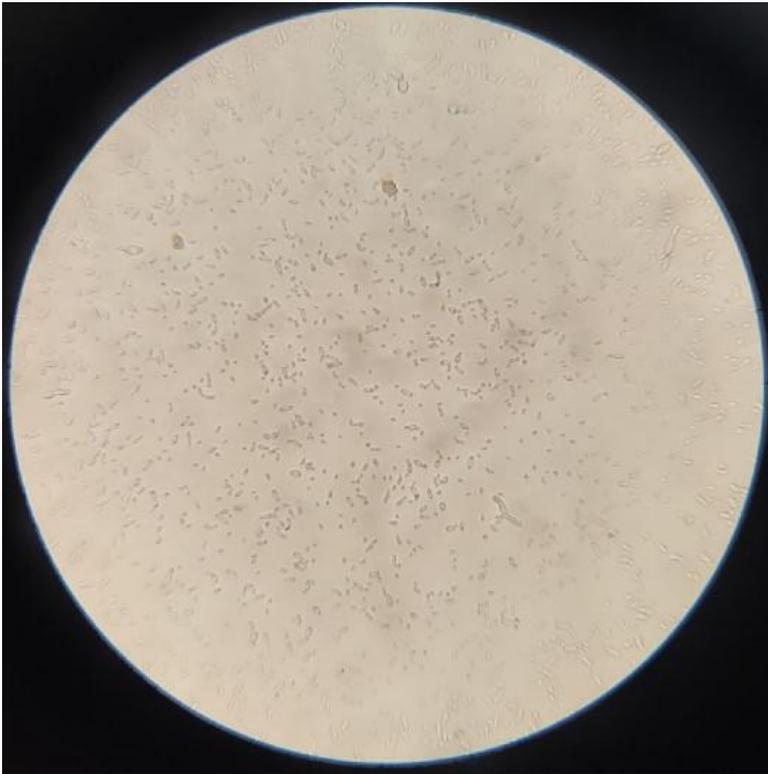


Figure 3. Microscopy of the isolated yeast with a 40X aperture

At the next stage of the work, yeasts were isolated as a pure culture and studied by PCR molecular biology methods. PCR results identified the isolated yeast as *Brettanomyces*.

The study of the fermentation activity of the isolated yeast in comparison with the yeast of the genus *Saccharomyces cerevisiae* (shown in Figure 4) showed that the yeast of the genus *Brettanomyces* has a lower fermentation activity, which is consistent with the publication data [8].

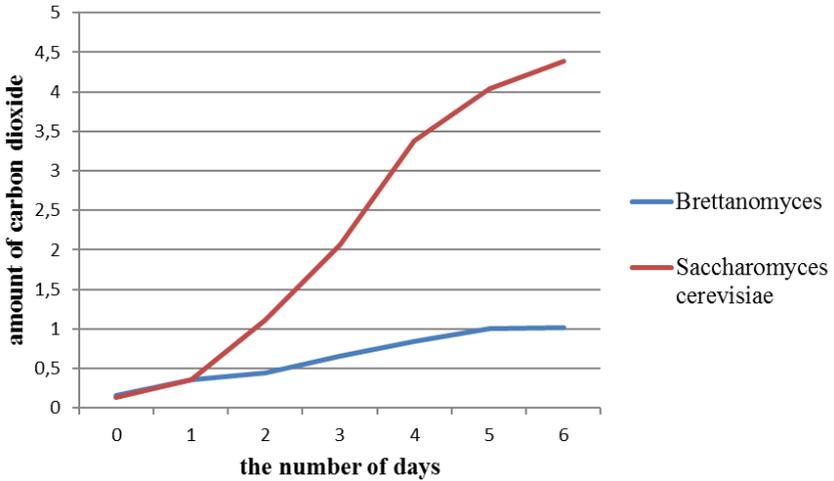


Figure 4. The amount of carbon dioxide formed during the fermentation of 100 ml of wort with a mass fraction of solids of 13% for 7 days

It is known from literary sources that yeasts of the genus *Brettanomyces* are able to ferment lactose. Since the fermentation of lactose contained in whey will allow the use of these yeasts in the technology of lactose-free drinks, the ability of yeasts of the genus *Brettanomyces* to assimilate whey lactose was studied.

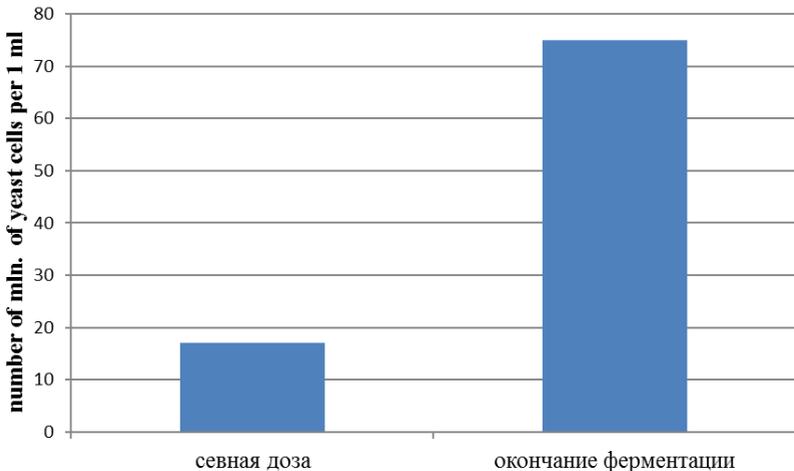


Figure 5. Accumulation of isolated yeast biomass on whey

Figure 5 provides data on the accumulation of biomass of yeast of the genus *Brettanomyces* during cultivation on whey. As can be seen in the figure, isolated yeasts are able to consume lactose, which corresponds to the literature data [9] and makes them promising for use in obtaining lactose-free drinks based on whey.

The effect of yeast of the genus *Brettanomyces* on the organoleptic characteristics of fermented drinks was studied on samples of kvass wort prepared according to the standard method [10]. Yeast of the genus *Brettanomyces* was added to the must in the amount of $16 \times 10^6 / \text{cm}^3$, fermentation was carried out for 72 hours at a temperature of 22 °C. The results of the organoleptic analysis of the resulting kvass are shown in Figure 6 [11].

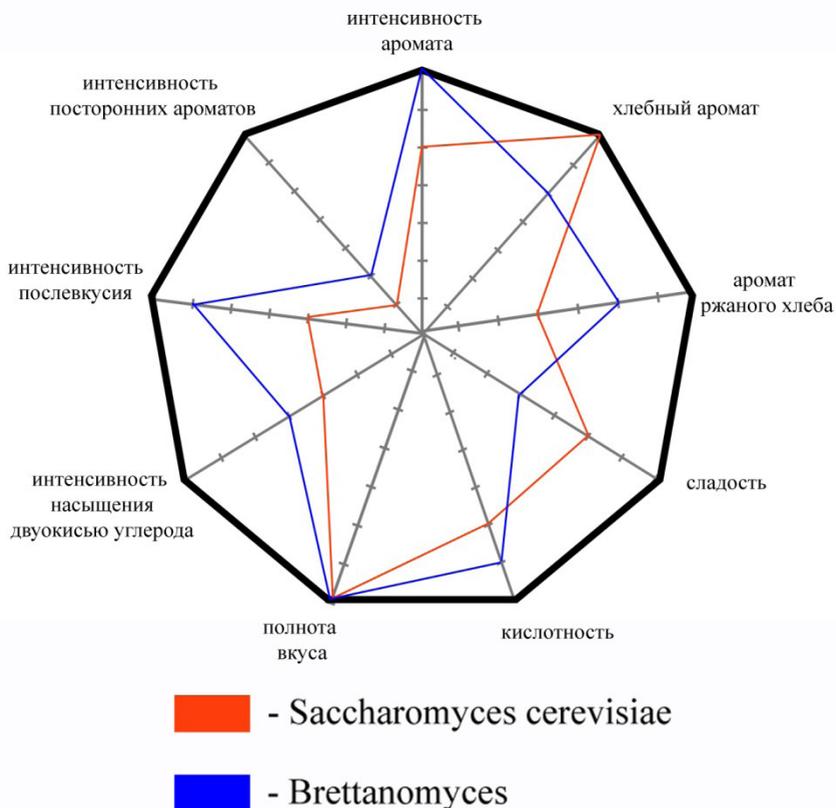


Figure 6. Radar chart of the flavor profile of kvass

As can be seen from the figure, the use of yeast of the genus *Brettanomyces* improved the sensory profile of kvass, the intensity of the aroma increased in it, and fruit and flower tones appeared.

Thus, the obtained data show that this yeast belongs to the genus *Brettanomyces*, it is able to ferment lactose and improve the sensory profile of beverages, which increases the possibilities of beverage manufacturers and allows to increase the range of products.

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基于后发酵古软茶的香膏配方及制法的开发

**DEVELOPMENT OF A RECIPE AND A METHOD FOR OBTAINING A
BALM BASED ON POST-FERMENTED FURUAN TEA**

Serykh Ivan Nikolaevich

Postgraduate

ORCID ID: 0000-0002-2690-4783

Bustamante Vanessa Fernandez

Master's degree Student

Adamovich Georgy Ivanovich

Moscow State University of Food Production

抽象的。 本文研究了原始和后发酵茶的酚类化合物、萃取率、颜色和 pH 值。此外，还对配方的成分进行了分析和选择，并进一步改变了配方。 在一份饮料和足够的生物活性物质消耗水平之间进行了比较分析。

关键词: 香脂、后发酵茶、功能饮料

Abstract. *The article investigates phenolic compounds, extractiveness, color and pH of the original and post-fermented tea. Also, the analysis and selection of the components of the recipe was carried out, with a further change in the recipe. A comparative analysis was carried out between one serving of the drink and an adequate level of consumption for the amount of biologically active substances.*

Keywords: *Balm, post-fermented tea, functional drinks*

Balm is a strong alcoholic drink (from 40 to 45% alcohol by volume), which has a unique "balsamic" bouquet, which includes many different flavors (herbs, seeds, roots and oils). The product is obtained by infusing various herbal medicinal and technical raw materials, mainly herbs, roots and beekeeping products. Initially, the first balms were medicines and were sold in pharmacies in small volumes. The first balms appeared in Russia in the middle of the 18th century. The Riga pharmacist Abraham Kunze reproduced old recipes for herbal tinctures, combining them into a single drink - "balm". The drink in 1752 was approved by Catherine II and was sent for industrial production (under the name "Riga Black Balsam"). In 1807, the Karlovy Vary pharmacist Josef Vitus Becher invented his own drink, which was used as a gastric medicine and in 1841 went into industrial production under the name Becherovka. [1]

Currently, a new promising direction of functional alcoholic and non-alcoholic drinks is emerging, corresponding to the desire of most people to lead a healthy lifestyle. Therefore, the development of new formulations of balms with a high content of biologically active substances is an urgent task.

The purpose of this work was to develop a recipe and a method for obtaining a balm based on post-fermented Furuan tea.

The objects of study are Furuan tea, which is characterized by a high content of antioxidants and has many other properties. Mushroom *Eurotium cristatum*. The fungus is not toxigenic, does not synthesize mycotoxins, when cultivated on tea, it enriches the medium with metabolites with various functional properties (hepato-protective effect, high antioxidant activity, cardioprotective effect)

The total phenol content was determined using the Folin-Ciocalteu reagent. The extractivity was determined by the pycnometric method. pH was determined using a pH meter. [2]

At the first stage of the work, phenolic compounds, extractivity, color and pH in the initial and post-fermented tea were studied. The research data can be seen in Table 1.

Table 1.
Physical and chemical indicators

Indicators	Original tea	Post-fermented tea
Extractivity, %	0,141	1,526
pH	6,4	7,3
Phenolic compounds, mg/cm ³	3	2.25
Colour	Amber	dark green



Figure 1. *The color of the infusion of the original tea and post-fermented*

Analysis of tea showed that as a result of microbial post-fermentation, the indicators changed significantly. Thus, the content of solids in the infusion increased 10 times, and the pH changed slightly from 6.4 to 7.3. Figure 1 shows the appearance of infusions.

At the next stage, plants with a high content of phenols were selected for the balm formulation. The characteristics of the selected plants are shown in Table 2. [4,5]

Table 2.
Recipe components

№	Raw material	Biologically active substances	Properties	Organoleptic
1	Rose hip	Flavonoids, vitamin C, organic acids	Tonic, immunomodulatory, anti-inflammatory, cardioprotective	taste and aroma are pronounced with a characteristic sourness
2	Yarrow	Phenolic compounds, vitamin C, essential oils	Anti-inflammatory, antitumor	herbaceous aroma; the taste is bitter
3	Oregano	Phenolic compounds, vitamin C, phytoncides	Soothing, choleric, anti-allergic	sweet taste and aroma
4	Chamomile	Phenolic substances, essential oils, coumarins	Soothing, anti-inflammatory, cardioprotective	herbaceous aroma; the taste is bitter
5	Licorice	Phenolic substances, flavonoids, saponin	Calming, anti-tumor	taste and aroma are pronounced with a characteristic sweetness
6	Ginseng	Saponins, vitamins, essential oils	Anti-inflammatory, antioxidant	taste and aroma expressed in sweetness, fruity and floral
7	Thyme	Phenolic acids, flavonoids, essential oils	Calming, immunomodulatory	taste and aroma are pronounced with characteristic bitterness
8	Lemongrass	Phenolic compounds, vitamin C, essential oils	Tonic, general tonic, antioxidant	taste and aroma are pronounced with characteristic bitterness, fruity

9	Rhodiola rosea	Phenolic alcohols, phenolic acids, essential oils	Stimulant, immunomodulatory	taste and aroma are pronounced with a characteristic sweetness and floral
10	Fermented tea	Phenolic compounds	Antioxidant, cardioprotective, immunomodulatory	The taste is pronounced, sour, the aroma is characteristic floral, fruity.

The analysis of the data in the table showed that some of the plants have the opposite functional orientation, so the following components were chosen for the tonic balm: wild rose, yarrow, lemongrass, Rhodiola rosea and fermented tea.

Based on the organoleptic characteristics and compatibility of the components, a recipe was developed and its flavor profile was characterized. The results are shown in Figure 2.



Figure 2. Organoleptic properties of the drink

As can be seen from the profilogram, the drink turned out to be characteristic, with a harmonious combination of sweet and sour taste, fruity-floral aroma and pleasant mild bitterness.

To assess the content of functional components in the drink, a comparative analysis of the formulation components for the content of biologically active substances in one serving was carried out and this amount was compared with an adequate level of consumption. This characteristic is shown in Table 3[2,3,6,7,9,10]

Table 3.
The amount of biologically active substances

Component	Amount in the drink, g		Flavonoids, mg		Minerals, mg per 50 cm ³				Vitamins, mg per 50 cm ³		
	Per 1 dm ³	Per 50 sm ³	Per 1 dm ³	Per 50 sm ³	Ca	Na	K	Mg	«A»	«C»	«E»
Rose hip	10	0,5	150	7,5	0,14	0,5	0,12	1,0	0,22	3,3	0,17
Yarrow	10	0,5	10	0,5	5,4	0,2	15,4	1,3	-	-	-
Lemon-grass	5	0,25	7,5	0,4	2,5	3,1	8,5	1	-	2,9	0,15
Rhodiola rosea	5	0,25	7,5	0,4	2,7	-	1,4	0,4	0,04	-	-
fermented tea	20	1	6	0,3	5	0,8	12,4	4,2	0,05	0,1	-
Total:	50	2,5	181	9,1	24,8	4,6	37,8	7,2	0,31	6,3	0,32
Adequate level of consumption			85		1250	900	2500	400	1	70	15

Analysis of the data in the table showed that in one serving of 50 cm³ of the drink, the content of biologically active substances does not exceed 30% of the adequate consumption rate.

Thus, the above data showed that Furuan tea can be successfully used in beverages as a base because of its functionality and as an organoleptic component.

Currently, tea is used to produce liqueurs and tea wine, but the functionality of these drinks is due only to the biological activity of the substances in Furuan tea. In Russia, there are many plants related to medicinal and technical raw materials and used in pharmaceuticals and beverages. The combination of the properties of Furuan tea and medicinal plants growing in Russia in one drink made it possible to obtain a drink with a high content of biologically active substances and pleasant organoleptics.

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确保我国道路上儿童安全的措施
**MEASURES TO ENSURE THE SAFETY OF CHILDREN ON THE
ROADS IN OUR COUNTRY**

Starkova Ksenia Dmitrievna

Master

Burmistrova Olga Nikolaevna

Doctor of Technical Sciences, Full Professor

Burgonutdinov Albert Masugutovich

Doctor of Technical Sciences, Full Professor

Perm National Research Polytechnic University

抽象的。 所选主题的相关性是由于需要确保安全,在路上保护儿童的生命和健康。

关键词: 安全、速度、道路、儿童、交通规则。

Abstract. *The relevance of the chosen topic is due to the need to ensure safety, preserve the life and health of children while on the road.*

Keywords: *Safety, speed, road, children, traffic rules.*

Safer roads for everyone means safer roads for children. To improve the safety of children on the roads, a number of measures need to be taken, which include enacting laws on key risks such as speeding, drunk driving, use of helmets, seat belts and child restraints, and enforcing existing laws; road construction and the obligation of manufacturers to produce vehicles with appropriate safety features; availability of systems for providing emergency first aid to the wounded. Additional actions specifically targeted at children can help to better protect them when they travel on the roads. These measures are recommended based on the analysis of the measures taken by the World Health Organization in Europe.

Maximum speed control. Speed is a contributing factor in about one third of all road traffic fatalities. Long, straight roads that pass schools, residences and businesses, allowing high speed driving, put children at significant risk. It is possible to regulate the speed limit by:

- setting and enforcing speed limits appropriate to the purpose of each road;
- establishing and enforcing a maximum speed limit of 20 kilometers per hour on roads with a high density of pedestrians;

- enforcement of speed limits through the use of automatic speed cameras;
- building or modifying roads to include speed limiting features. Such as traffic lights, roundabouts and speed bumps.

Reducing vehicle speed is of paramount importance for the protection of children on the roads.

Use of helmets for cyclists and motorcyclists. For children, wearing a helmet is the single most effective strategy for reducing the risk of head injury while riding a bicycle or motorcycle (Figures 1 and 2).



Figure 1. Children using a helmet while cycling



Figure 2. Use of a helmet and child seat when transporting children on a motorcycle

For cyclists of all ages, proper helmet use reduces the risk of head injury by 69%, and for motorcyclists of all ages, proper helmet use reduces the risk of death by 40% and the risk of serious head injury by more than 70%. Ensuring the use of helmets can help:

- introducing and enforcing motorcycle helmet laws, specifying the type of motorcycle helmets by age group;
- the introduction of internationally recognized standards for the production of motorcycle helmets, guaranteeing their suitability for children;
- ensuring that motorcycle helmets are available and accessible to those who need them;
- Supporting child-friendly community initiatives by teaching parents how to use motorcycle and bicycle helmets and providing free or discounted helmets to children.

Child protection in the vehicle. A range of child restraints are available to protect children in the vehicle. These include child car seats (Fig. 3), boosters and seat belts, and their use depends on the age, weight and height of the child..



Figure 3. Child in a child car seat

Compared to using seat belts alone, booster seats are estimated to reduce by 59% the risk of children between the ages of four and seven being seriously injured in a road traffic crash. The following strategies can increase the use of child restraints and their proper use:

- Enacting and enforcing child restraint laws for all private vehicles;
- introduction of internationally recognized standards for the production of child restraints;
- ensuring that child restraints are available and accessible to those who need them;
- Require vehicle manufacturers to have plug-in car seat anchorages in all private vehicles, such as anchorage systems that lock child restraints in place;
- Teaching families how to use restraints.

Increasing children's ability to see and be seen. The ability to see and be seen is a fundamental prerequisite for the safety of all people traveling on the roads, but is especially important for children because of their particular vulnerability. The following strategies can be used to improve visibility:

- wearing white or light-colored clothing;
- use of reflective stripes on clothing or items such as backpacks (Fig. 4);
- Formation of "pleasure buses", activities through which adult volunteers accompany groups of children in reflective vests along established routes (Fig. 5);
- appointment of guards in reflective vests around schools;
- use of bicycle headlights and front, rear and wheel reflectors;
- use of daytime running lights on motorcycles and vehicles;
- ensure that the streets are as wide as possible;
- strengthening of street lighting.



Figure 4. Reflective elements on clothing and backpacks



Figure 5. Accompanying children by volunteers

Improvement of road infrastructure. Historically, roads have been built primarily for vehicles, with little regard for the needs of the communities they pass through. Building new and modifying existing road infrastructure in a safe manner will improve living conditions and reduce the risks for children as a result of road traffic accidents. Measures to improve road infrastructure include:

- introduction of technical measures such as traffic lights, roundabouts, speed bumps, pedestrian crossings, overpasses, median lanes and street lighting on busy roads;
- Separation of different modes of transport and road users by means of such devices as elevated sidewalks for pedestrians, dedicated lanes for pedestrians and cyclists and median barriers to separate the flow of vehicles moving in different directions;
- creating car-free zones to improve pedestrian safety;
- introduction of safety zones in schools, including a set of measures to reduce speed, car-free zones, safe pick-up and drop-off areas, and road barriers;
- increased crossing times at signalized intersections near schools;
- allocation of playgrounds away from the road;
- investment in safe public transport.

Adaptation of car design. Optimal vehicle designs and standards can help keep children safe both inside and outside the vehicle, including on bicycles and

motorcycles. Many vehicle safety measures protect all road users, but some are designed specifically for children or may reduce risks for children more than adults. These measures include:

- mandatory installation of energy-absorbing crumple zones to protect passengers inside the vehicle in the event of a traffic accident;
- equipping cars with cameras and sound alarms capable of detecting pedestrians (Fig. 6);
- installation of alcohol blocking systems on cars.

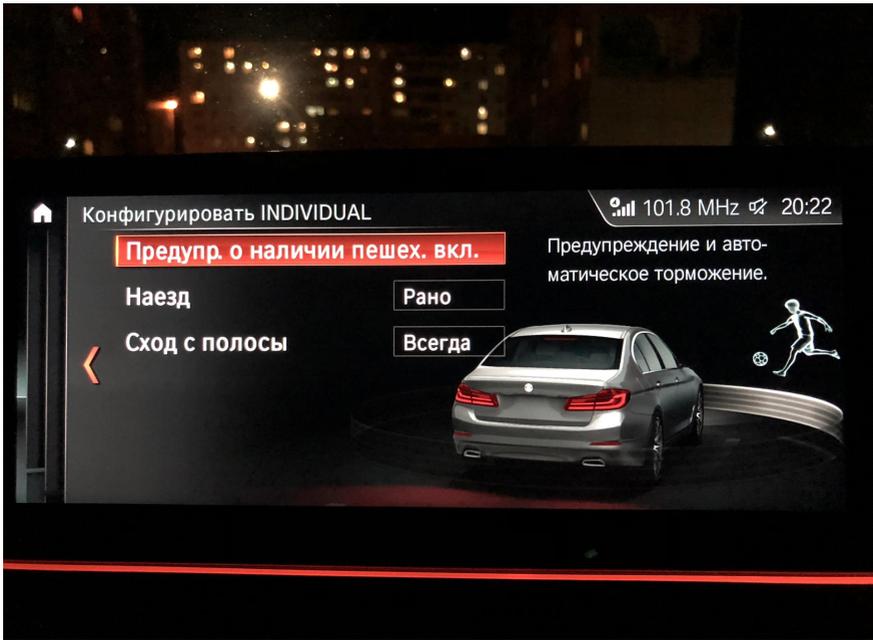


Figure 6. Pedestrian warning function, with braking function

Watching children on the roads. Young children have limited ability to assess risk. Thus, parents and other caregivers can play an important role in helping the children in their care interpret what is happening around them. Their supervisory role is particularly helpful in keeping children safe in difficult road conditions. Surveillance alone cannot replace the measures described above, but it can complement and enhance these measures. Supervision may include, for example, ensuring that children use helmets, car seats and seat belts and follow the rules set for school safety zones. Supervision, combined with other measures, will help reduce the chance of a child being involved in a traffic accident.

Also, educational programs in kindergartens (Fig. 7), schools and other institutions on the behavior of a child on the road will help newly minted pedestrians understand how to behave on the road, what actions are allowed and which are absolutely not.



Figure 7. Educational activities on traffic rules in kindergarten

Main conclusions

Improvement of technologies and high-quality arrangement of the carriageway, organization of traffic minimize the number of accidents.

Eliminate the risk on the road with children. They need special assistance in detecting movement and estimating the speed and distance to oncoming traffic.

As they grow and develop, and with the help of adults, children become more aware of how they can manage their own safety and become more aware road users.

A good example is one of the key aspects in keeping the life and health of a child on the road, developing his awareness of the road and traffic.

The result of the analysis of the causes of accidents at the intersection and the modeling of an improved intersection by arranging the necessary and additional technical devices and measures confirms their necessity, and therefore increases the safety of pedestrians, including children, at the site under consideration.

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镍晶格曲率的多尺度

MULTISCALING OF LATTICE CURVATURE OF THE NICKEL

Korotkevich Sergey Vasilievich

*Ph. D., Deputy Head of the Telecommunications Service
Republican Unitary Enterprise “Gomelenergo”,
Gomel, Belarus*

抽象的。显示了镍晶格局部曲率在所有结构尺度变形水平下的尺度不变性的基本作用。

关键词: 结构; 位错结构; 铁磁共振; 电子显微镜研究; 多尺度, 摩擦载荷。

Abstract. *The fundamental role of the scale invariance of the local curvature of the nickel crystal lattice at all structural-scale levels of deformation is shown.*

Keywords: *structures; dislocation structure; ferromagnetic resonance; electron-microscopic researches; multiscaling, friction loading.*

My Grandfather Krichevtsov Sergey Dmitrievich, Senior Sergeant, 3rd Brigade, 23rd Tank Corps is Dedicated

Introduction

The complexity of research on the creation of materials with new physical and chemical properties is determined by the lack of scientifically grounded fundamental principles that can be applied at the junction of different sciences (physics, mathematics, chemistry, mechanics, materials science, etc.). Such a principle linking the symmetry of the properties of space and time with the properties of materials is the principle of least action. The latter determines the search and establishment of basic, fundamental structural regularities [1] or invariants acting at all structural-scale levels of deformation. Four invariants are described in [2].

Experimental Details

Polycrystalline nickel of 99.99% purity, armco-iron, bearing steel, bronze, and cast iron were investigated. The nickel samples in the form of thin disks were polished electrolytically and annealed in a vacuum of 0.133 mPa at 973 K. The friction test of Ni – Mo pair was carried out on the machine AE-5 according to the finger-disk scheme with precise setting of the contact area at a specific load of \approx

84 kPa and linear speed of ≈ 0.5 m/s. Electron microscopic studies of nickel were carried out on a microscope EVM-100AK and Hitachi-H800 by the method of thin foils on "lumen". The resolution of the Hitachi-H-800 is ≈ 0.1 nm. The technique of preparation of nickel samples for transmission electron microscopy is given in work [3].

Results and Discussion

In the case of the combination of continuous and discrete discontinuities presented in Fig. 1, b, the components of the curvature tensor are defined by the expression [4]:

$$\chi_{ij} = \Delta\omega_i / \Delta x_j, \tag{1}$$

where $\Delta\omega$ means the averaging of the disorientation angle for characteristic region Δx .

The lower index ω_i corresponds to the projection of the angle on the corresponding vector on the x_j axis.

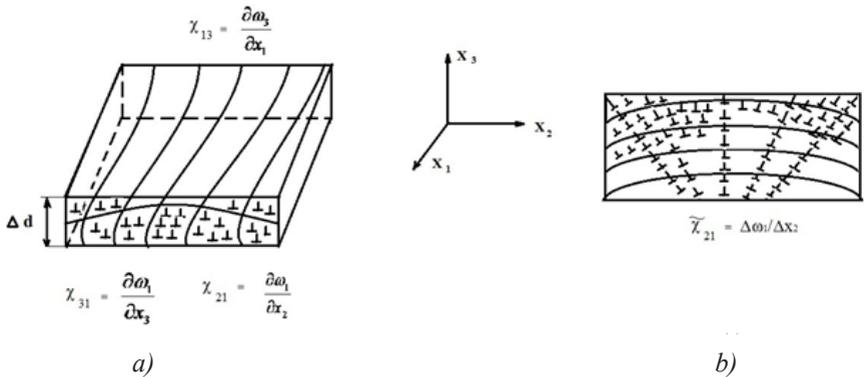


Figure 1. The schemes of structural states with high local gradients of crystal lattice orientation: a) substructure with high continuous disorientations; b) substructure with continuous and discrete disorientations

As a result of a long triboloading of the nickel surface ($\approx 150 \cdot 10^3$ s) in the presence of surface-active substances contained in the plastic lubricant CYATIM-201 the formation of a defective structure whose size varies from 30 μm to 3 nm (Fig. 2).

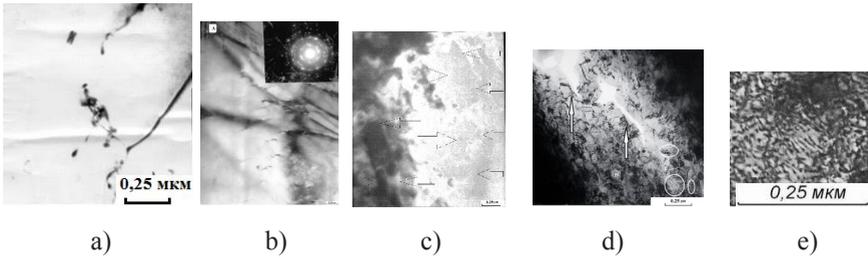


Figure 2. Kinetics of the nickel surface structure under triboloading: a) – initial structure of annealed nickel; b) – structure corresponding to the minimum oscillation dependence of the ferromagnetic resonance line broadening; c) – forming the curvature of the sliding bands; d) – subgranular microstructure; e) – nanocrystalline structure

The grain size of the nickel annealed before tribon loading was $\approx 30 \mu\text{m}$. Sub-microcrystalline (SMC) and nanocrystalline structural states (NC) have a closed form and are formed in areas with strongly disoriented crystal sections. The kinetics of defect structure formation can be simplified as a circle of decreasing diameter size (Fig. 3).

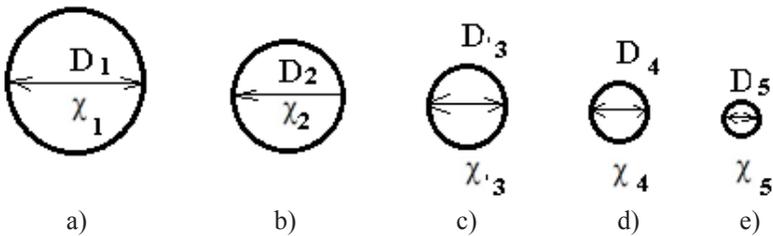


Figure 3. Scheme of the formation of structural defects at different structural-scale levels of deformation: a) initial structure; b)-e) evolution of the structure under the action of external influences (triboloading), namely: b) formation of microstructure; c) submicro-; d) nanoscale structural states; e) nanocrystalline structural states

Table 1.

The summarizes parameters describing the structural states shown in Fig. 1

Size of structural elements (diameter (D)), 10 ⁻⁶ m	Angle (Δω), degree	Local curvature of the nickel crystal lattice (χ), degrees/10 ⁻⁶ m
30	360 ⁰	12
3	360 ⁰	120
0.3	360 ⁰	1200
0.03	360 ⁰	12000
0.003	360 ⁰	120000

The local curvature of the nickel crystal lattice increases by an order of magnitude when the size of the structural element decreases by an order of magnitude (table 1). The expression is executed:

$$\chi_{ij}(10^{-n} \cdot x_1; 10^{-n} \cdot x_2; 10^{-n} \cdot x_3) = 10^n \chi_{ij}^0(x_1, x_2, x_3), \quad (2)$$

where x_1 , x_2 and x_3 are space coordinates, and χ_{ij} is the tensor of local curvature of the nickel crystal lattice, $n = 0, 1, 2, 3, 4$, χ_{ij}^0 is the tensor of local curvature of the nickel crystal lattice corresponding to the initial structure. The local curvature of the crystal lattice, takes place at all structural levels of deformation, from the nano- to the macro-level of scale deformation, which indicates its fundamental importance in the formation and evolution of structures.

Thus, the existence of another invariant, namely, the scale invariance of the local curvature of the nickel crystal lattice, has been proved [5]. The latter once again confirms that the kinetics of formation and evolution of structures at all structural-scale levels of deformation, as well as the relaxation of energy stored in the material, including its destruction, proceeds in accordance with the principle of least action [6, 7].

The increase in the number of slip bands determines the formation of elastic stress fields (σ) of compression and tension of the metal [3]. The oscillating distribution of the stress fields leads to a shift and simultaneous rotation of the grains at the micro- and mesoscale level of deformation, which causes a local gradient of orientation of the structural elements in the crystal lattice with a pronounced corrugation of the nickel surface layer (Fig. 4).

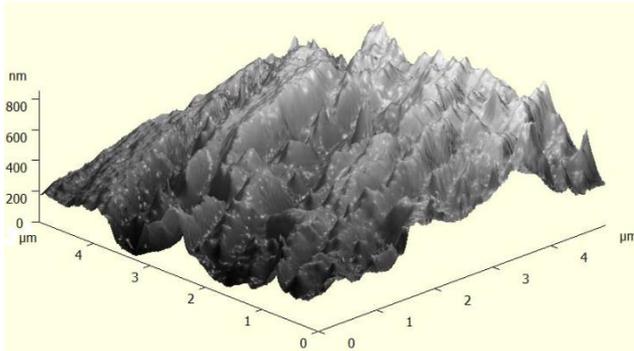


Figure 4. AFM images of the nickel surface ($t \approx 108 \cdot 10^3$ s)

The formation of crystal lattice curvature zones at the microlevel is shown by the example of the formation of packing defects in Fig. 2, c. These new structural states in the inter-nodes (Fig. 5) form the local curvature of the crystal lattice [8].

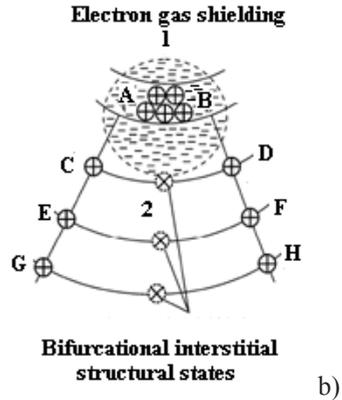
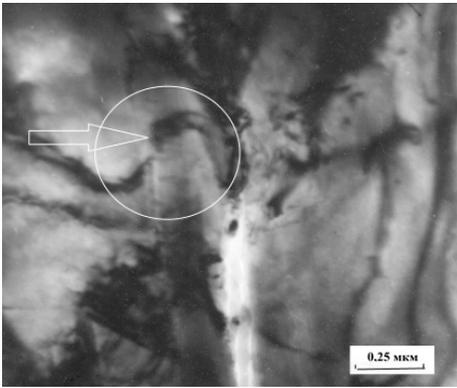


Figure 5. (A) – the area of local curvature of the nickel surface layer and extinction contours, (B) – the scheme of formation of local curvature of the surface layer

The mathematical expression of the curvature of the crystal lattice is described by expression (1). Atoms are allowed to move from the nodes of the crystal lattice to the inter-nodes in the curvature zones of the lattice. This helps reduce the size of the wear particles. The expression for the local curvature χ in the fold zone according to [9] is defined by the expression:

$$\chi(S, t) = 4\beta \operatorname{sech}[2\beta(S+4Vt)] , \quad (3)$$

where $\beta = \sigma_{zz} / bE$; σ_{zz} is the stress in the medium necessary for the propagation of the localized deformation band; V is its propagation velocity, the width of the localized deformation band; E is the elastic modulus; S is the coordinate; t is time.

The appearance of the topological curvature of the crystal structure of the surface layer of the material under triboloading is shown in Figure 4. A folded structure emerges in the deformed surface layer, with the height of the folds reaching 600 nm (Fig. 4). Naturally, a translationally invariant crystal cannot create such a folded structure. Therefore, the surface in accordance with the principle of least action is nanostructured, which is illustrated by the ring electronogram in the inset of Fig. 6 [3].

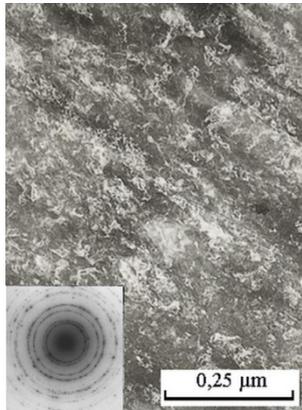


Figure 6. Formation of nanostructures

The development of distortion (Fig. 2, e, 4, 5) in zones of strong curvature of the crystal structure generates a high concentration of vacant lattice nodes [8]. Their coalescence causes the appearance of microporosity and nucleation of microcracks Fig. 2, c [3].

The greater the modulus of elasticity, the smaller β and, consequently, the amplitude of the corrugation fold (expression (3)). A decrease in the value of the modulus of elasticity and, accordingly, an increase in the porosity and friability of the nickel surface layer with an increase in the triboloading time in accordance with the above expression (3) increases the amplitude β of the corrugation fold. Let us estimate the value of the local curvature χ for two cases: for the case when the size of the formed structure $b \approx 3$ nm (Fig. 2, e), and for the case when $b \approx 250$ nm, which is typical for SMC structure.

Let us calculate the value of the local curvature of the crystal lattice for the surface layer of nickel as a function of the stress value (Table 2). The fundamental role of the crystal lattice curvature as a parameter describing the evolution of the metal structure under various external influences is beyond doubt [10]. The idea of the scale invariance of the crystal lattice curvature is promising and relevant. Therefore, it is necessary to assess the magnitude of the local curvature of the crystal lattice of the surface layer of nickel under triboloading.

Table 2.

The estimation of the value of local curvature of the crystal lattice of the surface layer of nickel under triboloading

$\sigma_{\text{лок}} / E$	b, nm		χ, degree/nm	
	3	250	для b = 3 nm	для b = 250 nm
0.1	3	250	≈ 0.03	≈ 0.0016
≈ 1	3	250	≈ 0.3	≈ 0.016
10	3	250	≈ 3.3	≈ 0.16
100	3	250	≈ 33.3	≈ 1.6

In [7] it was shown that the stress values in the local zones of the nickel surface layer exceed its modulus of elasticity by two orders of magnitude. Then, according to Table 2, the magnitude of the local curvature of the crystal lattice can reach tens of degrees per nanometer, indicating special unexplored properties of the highly nonequilibrium state of the nickel surface layer [11]. The dislocation density (ρ) in this case reaches $\approx 10^{19} \text{ м}^{-2}$ according to the expression:

$$\rho = \frac{1}{b} \chi, \quad (4)$$

where b is the Burgers vector of dislocations.

Conclusion

The fundamental role of the crystalline lattice curvature of the nickel surface layer in the formation of defect structure elements at different scale levels of deformation under triboloading has been shown. The existence of scale invariance of the local curvature of the crystal lattice of the nickel surface layer once again confirms the universality of the scientifically valid use of the fundamental principle of the least action for the creation, evolution, and destruction of materials, including nanomaterials of various functional purposes. It is proved that the application of this principle, which describes various kinetic processes at the junction of differ-

ent sciences: physics, chemistry, mesomechanics, nonequilibrium thermodynamics, etc. determines not only the kinetics of evolution, but also the search and establishment of fundamental, invariant regularities for processes occurring in the space-time continuum.

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苹果园喷洒机器人平台
ROBOTIC PLATFORM FOR SPRAYING APPLE ORCHARDS

Filippov Rostislav Alexandrovich

Candidate of Agricultural Sciences, Leading Researcher

Dmitriy Olegovich Khort

Candidate of Agricultural Sciences, Associate Professor, Head of the laboratory

Kutyrev Alexey Igorevich

*Candidate of Technical Sciences, Senior researcher
Federal Agroengineering Center VIM*

抽象的。在俄罗斯，没有大规模生产的专用机器人喷雾器，用于在密集的水果种植园条件下通过超低量喷洒处理水果作物。现有经验丰富的国产机器在喷洒时没有选择性作用，也不排除化学品对人体的有害影响。集约化园艺的特点对保护苹果树紧凑树冠的技术手段提出了严格的要求，为此，VIM设计了一种带有超小容量喷雾器模块的苹果集约化种植机器人平台。描述了其创建的主要阶段，考虑了其运行原理，给出了基于仿真数学建模的机器人模型在各种运行条件下的移动性分析。

关键词：机器人平台、农业、精准农业、苹果、喷雾、园艺。

Abstract. *In Russia, there are no mass-produced specialized robotic sprayers for processing fruit crops in conditions of intensive fruit plantations by ultra-low-volume spraying. Existing experienced domestic machines do not have a selective effect when spraying and do not exclude the harmful effects of chemicals on humans. The features of intensive gardening put forward serious requirements for technical means to protect the compact crowns of apple trees, for solving these purposes, a robotic platform with an ultra-low-volume sprayer module for intensive apple plantings was designed in VIM. the main stages of its creation are described, the principle of its operation is considered, the analysis of the mobility of the robot model based on simulation mathematical modeling under various operating conditions is given.*

Keywords: *robotic platform, agriculture, precision farming, apple, spraying, horticulture.*

The purpose of the research is to substantiate the design parameters, analyze the mobility analysis and the possibility of safe use of a robotic platform for differentiated chemical treatment of apple crowns. To develop a mock-up sample of a robotic platform with a sprayer capable of functioning offline.

Materials and methods

The study uses the analysis of technical and operational parameters of modern domestic and foreign systems, autonomous motion control of various operating principles: video, radar, ultrasonic, laser, etc. The main method of substantiating the design parameters of a robotic platform for chemical protection of apple trees is computer-aided design. When justifying the safe use of a robotic platform in machine agrotechnologies, regulatory requirements for spraying plantings and weed control in row spacing were used.

To assess the degree of the robotic platform's ability to perform chemical plant protection operations in changing environmental conditions, at each point of the path, to calculate the level of feasibility of the task in offline mode is possible according to the formula:

$$F^* = \frac{\sum_{i=1}^n N_i^a \cdot F_i^m}{\sum_{i=1}^n F_i^m} \tag{1}$$

where N_i^a – assessment of the possibility of performing this task element in offline mode, F_i^m – functional significance of this component of the task, n – the number of task components.

The time spent on completing the task is found by the formula:

$$F_i = F_{i^*} \cdot \prod_{i=1}^m k_i^{ct} \cdot p_i;$$

where F_{i^*} – estimated task completion time without taking into account probabilistic factors, p_i – the probability of an event leading to the manifestation of the correction factor, k_i^{ct} – correction factors that take into account the impact of the event on the task execution time. The values of the correction coefficients are determined empirically. Then there is a comparison with the time required to complete the task.

The calculation of energy costs for the task is obtained by the formula:

$$F_{en} = F_{en^*} \cdot \prod_{i=1}^m k_i^{ct} \cdot p_i;$$

where F_{en^*} – energy consumption by the robot to complete the task without taking into account probabilistic factors, p_i – the probability of completing the task, k_i^{ct} – correction factors that take into account the degree of influence of the event on the energy consumption of the task. Then there is a comparison of F_{en} with the energy reserves available to the robot when performing the task [1].

Generalized indicator of local autonomy F_a calculated according to the functional dependence:

$$F_a = f(F^*, F_1, F_{en});$$

Discussion and results

The creation of a sprayer with a high degree of autonomy is the main direction of the development of the principles of designing modern agricultural machinery [1-3]. The main problem of the development of automatic robot motion control systems is the precise determination of the current location of the agricultural unit and the ability of the systems in automatic mode to efficiently collect and present reliable information about the condition of plants and the environment [3-6]. This information can be obtained with a high degree of accuracy using various types of sensors, sensors and instruments, such as field electronic sensors, machine vision, multispectral and hyperspectral systems [7-8].

The developed robotic platform for spraying fruit plantations consists of a frame, two front steerable wheels, two rear drive wheels with integrated electric motors, a control and navigation system with control and measuring devices, a power supply system, a spraying system with a tank for working solution and a rod (Fig. 1.).



Figure 1. General view of the robotic platform

For differentiated application of chemicals, the sprayer is equipped with an intelligent control system complete with an on-board BRAVO 400S computer. The technical characteristics of the robotic platform are presented in Table 1.

Table 1.
Technical characteristics of the robotic sprayer

Basic parameters	Meaning
Curb weight, kg	850
Load capacity, kg	500
Characteristics of the running system: Wheel size, mm: - diameter, no more than, mm - width, no more than, mm Torque on each of the drive wheels, Nm Wheel formula	wheel type 650 200 330 4*2
Machine dimensions, not more than, mm: - length - width, adjustable - height, no more than	2800,0 1840,0;1960,0;2080,0 1600
Track width, base, mm: - front wheels - rear wheels - base	1800 1800 1900
Ground clearance, mm	1200
The smallest turning radius, not more than, mm	3500
Forward speed, km/h - working - transport	2-6 8
Power plant: - type - generator power, W - power supply voltage, V	Gasoline generator, LIFAN S-PRO 5500 48
Drive: - type and quantity - power, kW - motor torque, Nm - motor shaft speed, rpm	Electric motor with two-stage planetary gearbox, 2 pcs. 0.6-0,8 kW 334 3000
Remote control operation	Remote control Fly Sky-T6 FS, transmitter frequency 2.4 GHz, channel width: 500kHz, modulation type: GFSK, antenna length 26 mm, sensitivity 105dBm

Management with technical vision	The autonomous control system contains an optical range finder (Lidar), 4 video cameras, laser distance sensors, a GPS navigation station, and an on-board computer
Steering, (type, design) Stepper motor:	Electric worm-type steering mechanism ST57-100 DM556E LEADSHINE Engine Driver Step-up power converter QS-488CCCV-1800W
Brake system (type, design)	Electric motor braking

The control and navigation system is combined and consists of a GLONASS positioning unit (GPS) and a computer (technical) vision unit, which includes a technical vision camera, ultrasonic sensors and a 3D rangefinder (LIDAR). This makes it possible to successfully apply the method of visually determining the location of the unit based on the analysis and subsequent comparison of video images obtained during the initial and subsequent passes. At the first pass, a set of primary images is formed in it, which allow you to form a database describing the mutual location of stable structures. During the subsequent automatic movement, the characteristics of the current image are checked for the identity of the descriptions stored in the database, and, if they match, they are bound to the current location (Fig. 2.).

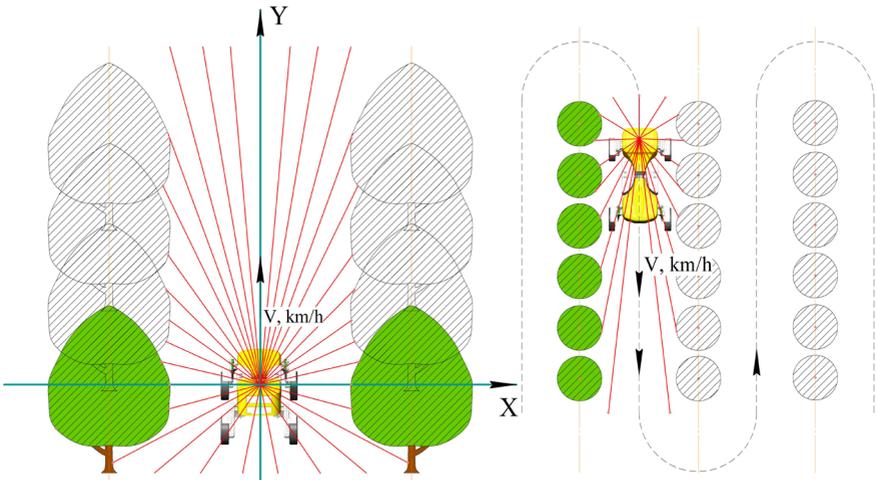


Figure 2. The control and navigation system of the robotic platform using LIDAR

Motion control through the analysis of photo and video images of the surrounding environment and visual location determination ensures complete autonomy of the movement of the robotic platform. When moving in rows, technical vision systems with LIDAR sensor are used. At the same time, an intelligent module for recognizing fruit trees in rows is used by converting a stream of photo and video data with selected plant contours with the determination of their dimensional parameters for accurate application of chemicals (Fig. 3.).

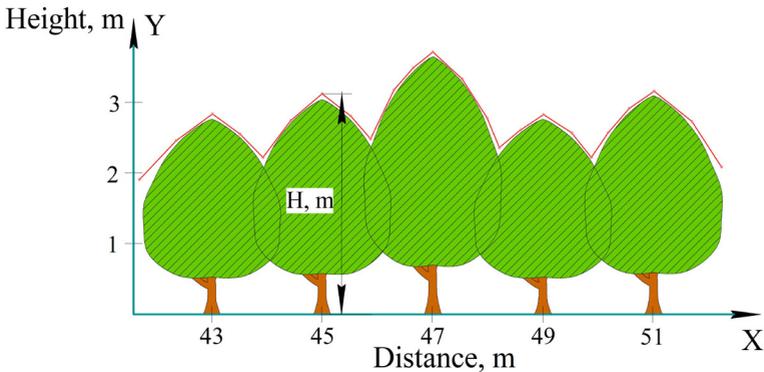


Figure 3. Determining the height of plants in rows using LIDAR

Motion trajectory control is implemented on the STM32 microcontroller, which operates in real time, without any operating system based on data from the LIDAR sensor. If necessary, the operator has the ability to remotely monitor the operation via a tablet computer. In case of a malfunction of the automatic movement system, the robot can be controlled by the operator using a remote control. The patency of the robotic platform is sufficient for confident movement in the rows of fruit trees. To work at night, additional lighting installed on the frame of the robotic platform is used. During the automatic movement, the robotic platform makes an independent detour of obstacles. The robotic platform is equipped with two types of batteries: lead-acid or iron-phosphate. If the batteries are not sufficiently charged, the gasoline generator, LIFAN S-PRO 5500, is automatically started.

Conclusions

As a result of the conducted research, the parameters of a robotic platform with a sprayer module for processing intensive apple tree plantings are justified: the power of two electric motors is 2 kW, the track width is 1800 mm, the ground clearance is 1.2 mm, the smallest turning radius is 3.5 m. The obtained parameters make it possible to use the robotic tool in intensive apple plantations with

a row spacing of 3-4 meters. The value of the generalized indicator of local autonomy, which is equal to 69%, is determined, which allows the robotic platform to perform chemical treatment of the crown of trees efficiently and promptly in automatic mode without human intervention. The greatest economic effect from the use of the sprayer will be observed in intensive apple plantations or other fruit crops with an area of 5 hectares. The use of a robotic platform with a sprayer will ensure the safety of the chemical treatment of plants, will improve the quality of plant treatment, as a result, the number of treatments can be reduced, which saves labor costs by 15-25%.

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