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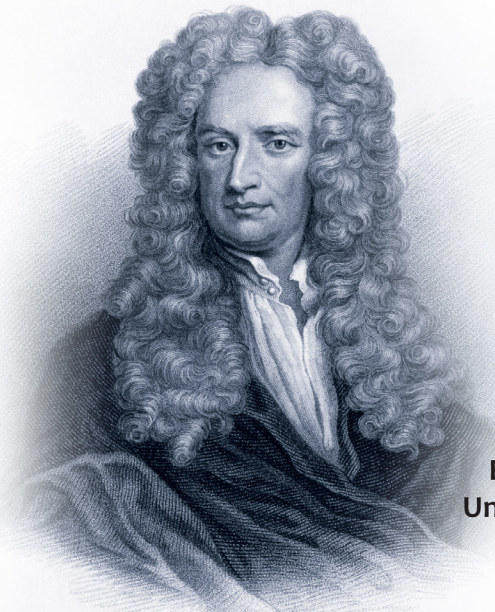

Birmingham
United Kingdom

International Conference "Process Management and Scientific Developments"

Birmingham, United Kingdom
(Novotel Birmingham Centre, October 13, 2021)

Proceedings of the International Conference
"Process Management and Scientific Developments"
(Birmingham, United Kingdom, October 13, 2021). Part 1

M67

ISBN 978-5-905695-25-4 (print)
ISBN 978-0-6452954-3-6 (online)

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UDC 330

CONTENTS

AGRICULTURAL SCIENCES

DOI 10.34660/INF.2021.45.93.001

VIETNAM E-COMMERCE POTENTIAL AND PROSPECTS

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Abstract. The results of the analysis of the development of e-commerce in the Socialist Republic of Vietnam are presented. The features of the development of e-commerce in the Republic, including the features of demography and user dynamics; the main channels of e-commerce and preferred methods of payment for online purchases are revealed. The features of the transition of Vietnamese business to the organization of e-commerce are shown. The prospects are studied and the main trends in the development of e-commerce in Vietnam are formulated.

Keywords: Socialist Republic of Vietnam, e-commerce

The Socialist Republic of Vietnam is one of the fastest growing economies in Southeast Asia. Having a favorable economic and geographical position and having rich labor resources, Vietnam demonstrates high rates of economic growth (the average annual growth rate of the Vietnamese economy in the period 1991-2020 was 6.92%)[1]. The COVID-19 pandemic has negatively affected the development of the Vietnamese economy, however, the country's GDP growth has maintained positive dynamics and in 2020 amounted to 2.91%.[2] The Economist magazine notes that "... Vietnam, as before, remained one of the countries with the highest rates of economic growth in the world, was among the 40 largest economies in the world and ranked 4th in ASEAN, and is also a representative of the group of 16 most successful economies of emerging economies".[3]

E-commerce played an important role in maintaining the stability of

[1]General Statistics Office of Vietnam (GSO) (2020a). Statistical Yearbook of Vietnam 2020. Hanoi: Statistical Publishing House. https://www.gso.gov.vn/wp-content/uploads/2021/07/Sach-NGTK-2020Ban-quyen.pdf

[2]General Statistics Office of Vietnam (GSO) (2020a). Statistical Yearbook of Vietnam 2020. Hanoi: Statistical Publishing House. https://www.gso.gov.vn/wp-content/uploads/2021/07/Sach-NGTK-2020Ban-quyen.pdf

[3]https://www.economist.com/the-world-in-2021

Vietnam's economy during the pandemic, the active development of which has a growing impact on the economic development of the country (see Figure 1). In 2020, the e-commerce market amounted to $ 11.8 billion, i.e., about 5.5% of the total retail sales of consumer goods and services.

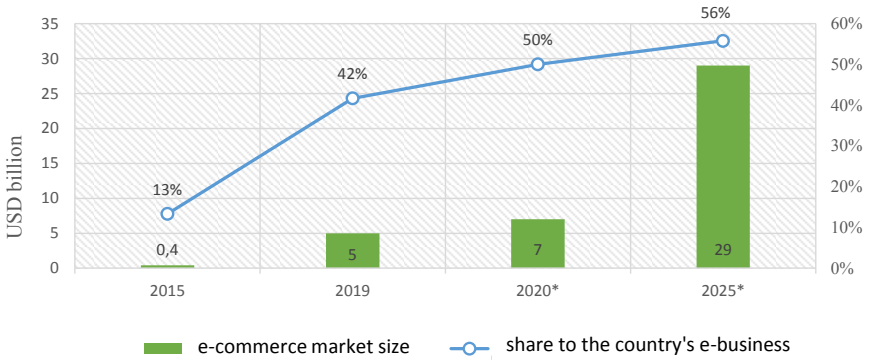

Figure 1. Dynamics of Vietnam's e-commerce market, in billions of US dollars

Source: Google, Temasek and Bain & Company – e-Conomy SEA 2020 – Viet Nam. - URL: https://storage.googleapis.com/gweb-economy-sea.appspot.com/assets/pdf/Vietnam-e-Conomy_SEA_2020_Country_Insights.pdf

The expansion of the e-commerce market in Vietnam is largely due to the peculiarities of the country's demography: 40% of the population - people aged 10 to 39 years – are the most active users of the Internet and its trading platforms (Table 1).

Table 1.
Dynamics of the number of online trading users

Indicators	2015	2016	2017	2018	2019
Percentage of the population using the Internet, %	45,0	53,0	58,1	69,8	68,7
including users who make online purchases., %	32,7	34,9	35,5	41,8	46,4
Average online purchase price, USD	160	170	186	202	225

Source: iDEA – E-Commerce White Book 2020. – URL: http://idea.gov.vn/file/5a4d2670-f7fc-4914-8e4b-d09d3b6bde83

The data presented in Table 1 indicate a positive trend in the number of users making online purchases, as well as an increase in the average purchase receipt. In 2019, 46.4% of the Vietnamese population made purchases online using e-commerce channels. Figure 2 shows the dynamics of the use of the main e-commerce channels in Vietnam.

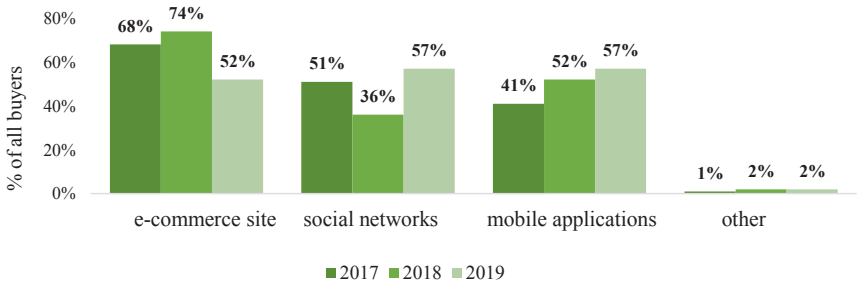

Figure 2. Vietnam's Main e-commerce channels

Source: iDEA – E-Commerce White Book 2020. – URL: http://idea.gov.vn/file/5a4d2670-f7fc-4914-8e4b-d09d3b6bde83

Social networks with the ability to quickly post information and reach a wide audience will help sellers quickly interact directly with buyers. Facebook is the most popular social media channel for electronic sales in Vietnam. According to the 2019 business review report of Sapo multi-channel sales and management platform, Facebook is in the group of 5 most frequently used and effective sales channels[4]. The main factors that have caused the growth in popularity of social networks and mobile applications for online shopping are the popularization of smartphones and social networks in Vietnam, and the usability of mobile device applications.

According to the data provided by E-Commerce White Book 2020, the most popular online purchases in Vietnam in 2019 were SPA and cosmetology services; music, videos, DVDs, electronic games (see Fig.3).

[4]Brands Vietnam. – URL: https://www.brandsvietnam.com/19979-Cho-Facebook-tang-suc-ep-cho-cac-san-TMDT

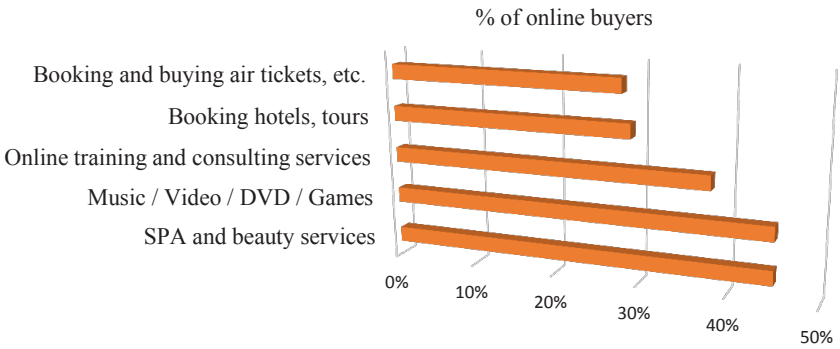

Figure 3. The structure of online shopping in Vietnam in 2019, in % of the total number of online buyers

Source: iDEA – E-Commerce White Book 2020. – URL: http://idea.gov.vn/file/5a4d2670-f7fc-4914-8e4b-d09d3b6bde83

Other popular services were online training and consultations; booking hotels and tours, booking tickets for various types of transport.

The main method of online payments in Vietnam are bank cards, which pay for about 31% of purchases (Fig. 4).

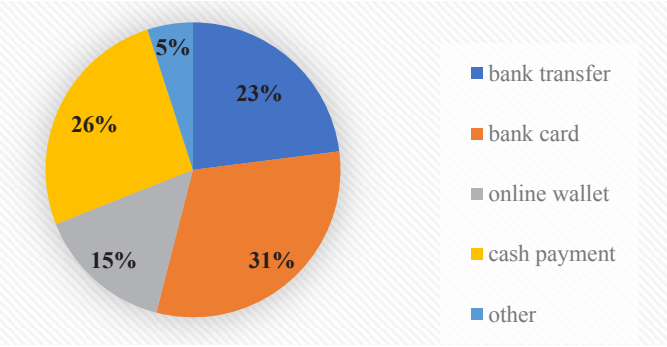

Figure 4. E-commerce payment methods in Vietnam in 2019

Source: E-commerce Payments Trends Report: Vietnam. - URL: https://www.jpmorgan.com/merchant-services/insights/reports/vietnam-2020

According to JP Morgan, the popularization of debit cards in Vietnam is much higher than credit cards. This payment method ensures the security of transactions and the possibility of integration with digital wallets, whose popularity is also growing in Vietnam.

Cash-on-delivery is also the preferred method of paying for online purchases in Vietnam, accounting for 26% of the e-commerce payments market. The high proportion of cash payments is explained by the fact that 7 out of 10 people in the country do not have a bank account. But more importantly, Vietnamese consumers do not fully trust online transactions, as there is a risk of fraud, as well as the likelihood of receiving substandard or counterfeit products. Among the affluent urban population, an electronic wallet is increasingly used when paying for online purchases; The most popular are MoMo, Moca and ZaloPay, through which about 90% of online payments pass.

Thanks to its advantages, including savings on rent, labor, advertising and sales, e-commerce increases competition between national companies in Vietnam. Many Vietnamese companies have expanded their business through e-commerce (Figure 5).

According to a survey conducted by the official agency for Electronic Commerce and Digital Economy of Vietnam in 2019, more than 45% of enterprises have their own websites, the share of enterprises selling goods through social networks increased from 28% (in 2015) to 39% in 2019. By 2019, the number of enterprises connected to digital e-commerce platforms increased by 4% compared to 2015 and amounted to 17%.

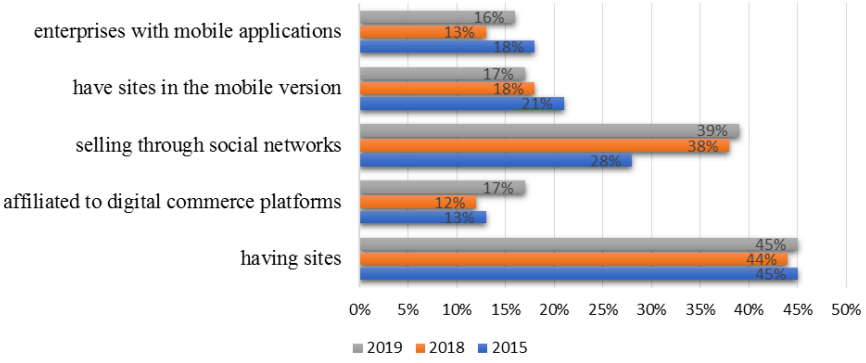

Figure 5. Introduction of e-commerce at Vietnamese enterprises in 2015-2019, in % of the total number of enterprises

Source: iDEA – E-Commerce White Book 2017, E-Commerce White Book 2020. - URL: http://idea.gov.vn/?page=document

The companies leading in the e-commerce market of Vietnam are presented in Table 2.

Table 2.
Leading companies in the e-commerce market of Vietnam

Ranking positions, 2019	Company	Monthly web traffic	Rating in Google Play	Rating in App Store
1	Shopee VN	43.156.700	1	1
2	The Gioi Di Dong	28.590.000	5	7
3	Tiki	23.990.000	4	2
4	Lazada VN	19.763.300	2	3
5	Sendo	17.596.700	3	4

Source: iPrice Insights/ - URL: https://iprice.vn/insights/mapofecommerce/

The leader of e-commerce in Vietnam in 2019 is Shopee VN, which has the largest sales volume (website traffic in 2019 amounted to 43,156 thousand dollars), and the number of downloads of mobile applications. Less effective e-commerce platforms are the companies Tiki, Lazada VN, Sendo and Gioi Di Dong - Internet platforms for the sale of household appliances and electronics [3, p.149].

The high growth rates of e-commerce in Vietnam stimulated the influx of foreign investment in this area. Major investors were such well-known Chinese companies as Alibaba Group (USD 2 million); investment company Tencent (USD 500 million); a Chinese company engaged in online trading and e-commerce JD.com (US$ 300 million). The Vietnamese e-commerce company Sendo actively cooperates with three Japanese investment companies. The attracted investments, of course, activate the development of e-commerce in the country. It is expected that in 2021, about 70% of the Vietnamese population will make online purchases, and the average purchase price will increase to $360.[5]

If we talk about the prospects for the development of e-commerce in the country, it is obvious that its trends will be based on the "National Digital Transformation Program until 2025 with a focus on 2030", approved by the government Decision in June 2020, which provides for the creation of 40 platforms "Made in Vietnam", which will certainly lead to the development of cross-border e-commerce. We can assume the launch of new types of e-commerce applications, including for mobile devices. An important aspect in the development of e-commerce is the need to improve the tech-

[5]THƯƠNG MẠI ĐIỆN TỬ VIỆT NAM NĂM 2021. – URL: https://wtocenter.vn/file/18499/bao-cao-tmdt-2021-v6-pdf.pdf

nological infrastructure to increase the competitiveness of Vietnamese enterprises in the world market. Great importance is given to solving network security problems, which will make the process of electronic purchase more attractive to the consumer [2, p. 91].

The implementation of these measures will serve as a source of realizing the potential of Vietnam's e-commerce, the prospects for the development of which are primarily related to investments in digital technologies and human capital.

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DOI 10.34660/INF.2021.11.57.002

INTEGRATION AS A FACTOR OF INCREASING THE COMPETITIVENESS OF THE UNIVERSITY IN THE WORLD MARKET OF EDUCATIONAL SERVICES

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Abstract. The article reveals the content of the concepts of "globalization" and "integration". The purpose of this article is to develop a model of university integration as a factor of increasing competitiveness in the World market of educational services. The novelty of the article lies in the fact that a system of interrelation between globalization, integration and the world economy has been developed, as well as the author's model of the university's integration into the world market. Conclusions and recommendations are made.

Keywords: globalization, integration, university, world economy, world market of educational services, university integration model.

The integration of the university in the modern world economy is a relevant topic for research because the world does not stand still. Under the influence of various factors, the structure of the modern global education market is changing, new smart learning technologies are emerging, considering modern market needs and factors of university competitiveness.

To maintain and strengthen its competitive position, any university in the modern world needs to keep up with the times and develop integration processes, even considering risk factors. The COVID-19 virus has become one of the new challenges of the modern education market. In 2020, we are faced with an insurmountable threat to the modern world - a pandemic. Many universities have switched to the online learning format. The realization that the virus was with us for a long time did not come immediately. All universities in the world began to develop rapidly, new forms of integration processes appeared, taking into account the epidemiological situation in a particular country. The purpose of this article is to develop a model of university integration as a factor of increasing competitiveness in the World market of educational services.

Constant companions are such concepts as: "globalization" and "integration". The history of the term "globalization" is still very young. “It is believed that the term“ globalization ”was first used in 1983 by Theodore Levitt, an American professor of marketing at Harvard University, in an article in the Harvard Business Review, describing the process of merging the markets of individual products produced by transnational corporations using this neologism. For a long time he has been a supporter of the globalization of markets for certain goods (for example: consumer durables), based on price and high quality. He argues that in different countries at the same time, similar segments appeared due to improvements in technologies that affect the level of development of communications, transport and tourism.».[1] Globalization is closely linked with the emergence of world currencies, the rejection of gold parities and the direct exchange of national money for gold. The emergence of unified forms of international settlements, unified rules of world trade and international economic organizations. All this is also globalization and integration of the world economy in the context of historical events. Wars have become an impetus for the rapprochement of nations and an awareness of the need to regulate the world law and order on a global scale.

«Integration is the state of unification of individual differentiated parts and functions of the system into a whole, as well as the process that carries out such a connection. Therefore, the concept of integration means, on the one hand, the process, dynamics, and on the other hand, the result, statics.».[2] Integration is one of the forms of increasing the competitiveness of the university in the world market of educational services. If university takes leading positions in world rankings, it means that it is developing in this direction. Integration is the development of the university at the global level. Each university chooses and develops its own forms of integration. Consider the theoretical structure of integration processes.

Thus, we came to the conclusion that the concepts of "globalization" and "integration" are interrelated, characteristic of different sectors of the socio-economic life of society and are components of the world economy.

We will develop a system of interconnection between globalization, integration and the world economy (Fig. 1).

[1]Levitt T. Globalization of Marke / Harvard Business Review. /1983.

[2]Misko O. N. International economic integration. - St. Petersburg: ITMO University, 2015.- - 174 p. 14.

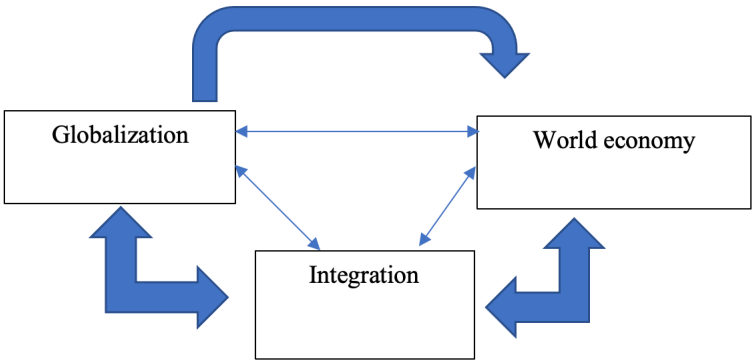

Figure. 1 The system of interconnection of globalization, integration, and the world economy

The system reflects the interconnection of the world economy, both with globalization and integration. Global processes of development of the world economy are inevitable and develop daily. Transnational corporations promote their products and services around the world using modern technologies, the social and economic sphere is also developing, integration processes have become firmly established in various spheres of society and business. The global education market is no exception.

The integration of the university into the world market of educational services is an important factor in competitiveness. One of the main impulses for the development of the integration of the international education system was the Bologna process. To ensure a competitive position in the world market, countries have united into a single education system. We will develop the author's model for integrating the university into the world market of educational services (Fig. 2).

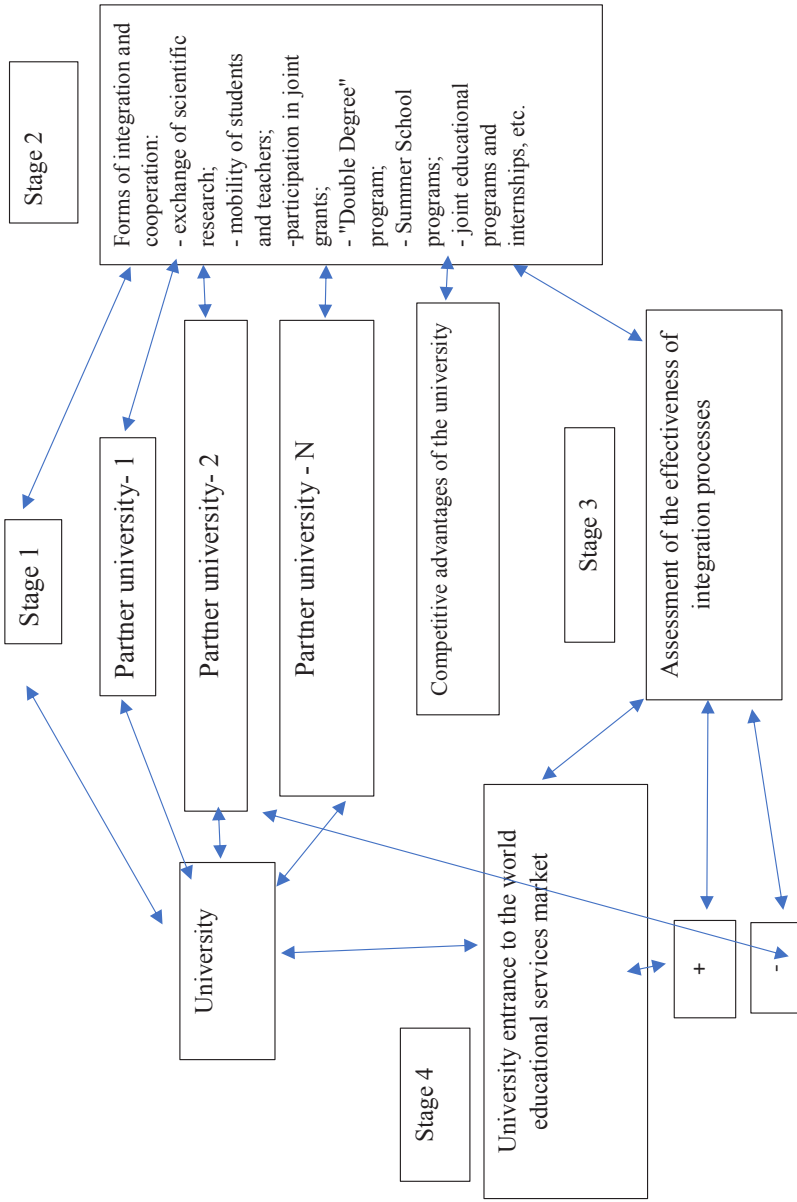

Figure. 2. Model of university integration into the world market of educational services

The university integration model consists of four stages. At the first stage, the university monitors, evaluates its competitive advantages, capabilities, resources, educational programs, professors, etc. to enter the international market and integrate with universities abroad in various forms of cooperation. The university conducts an analysis of possible partner universities in selected countries abroad. Negotiations are underway on the possibility of integration in the field of educational services and programs. In case of successful negotiations, an agreement or memorandum of cooperation is signed. At stage two, a mechanism for integrating forms of cooperation with partner universities is clearly developed, a structured division of areas of cooperation is being carried out, depending on countries and markets. The forms of integration and cooperation include:

- exchange of scientific research;
- mobility of students and teachers;
- participation in joint grants;
- "Double Degree" program;
- Summer School programs;
- joint educational programs and internships, etc.

At the third stage, the effectiveness of the university integration processes is assessed. In case of positive results, the university enters the world market of educational services and goes to stage four. In case of a negative assessment of the effectiveness of the integration processes of the university. We return to stage one and reevaluate and reengineer the university integration business process until a positive result is obtained.

Thus, the developed author's model of integration is universal and adaptable for any university in the world. It will allow organizing a step-by-step process of coordination and management of the processes of integration of the university in the world market of educational services. The model contributes to the timely reassessment, adaptation, and development of new forms of integration, taking into account the risk factor, including pandemics, etc., which contributes to the growth of the competitiveness of the university as a whole.

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DOI 10.34660/INF.2021.45.10.003
UDC 336.1

FINANCIAL MEASURES TO SUPPORT SMALL BUSINESSES THROUGH MFO WITH BUDGETARY PARTICIPATION [1]

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Annotation. In conditions of crisis phenomena, the role of financial measures of state support for the most unprotected stratum - small business entities - increases. One of the significant measures of financial support is the provision of microloans on concessional terms by microfinance organizations with budgetary participation. However, the capital of these MFOs at the expense of funds from the state is replenished irregularly, despite the fact that every year the requirements for their profitability are increasing more and more. This problem requires study and solution in the form of a long-term development strategy for microfinance organizations with budgetary participation.

Keywords: financial support measures, financial resources, small businesses, microfinance organizations with budgetary participation, money capital.

The role of microfinance and, accordingly, microfinance organizations (MFOs) as active participants in the financial market and business structures that support and influence the solvency of the population and business entities, increases in crisis conditions, further aggravated by the low financial literacy of the population and insufficient availability of borrowed financial resources business entities [1, p. 64]. And a significant place in the MFO system is acquired by MFOs with budgetary (state) participation.

According to the official website of the Federal Tax Service of the Rus-

[1]The study was carried out with the financial support of the Russian Foundation for Basic Research within the framework of scientific project No. 21-510-07003 "Formation of a financial and investment mechanism for supporting small businesses in the formation of a young state", 2021.

Compiled according to: Decree of the Government of the Russian Federation dated March 31, 2020 No. 378 "On Amendments to the State Program of the Russian Federation" Economic Development and Innovative Economy "[Electronic resource] // access mode: http://publication.pravo.gov.ru / Document / View / 0001202004020009.

sian Federation, as of January 10, 2021, the total number of small and medium-sized businesses in the country amounted to 5,684,561 units, including:

- 5 450 261 units (95.9%) - micro-enterprises;
- 216 615 units (3.8%) - small enterprises;
- 17,685 units (0.3%) - medium-sized enterprises.

According to official statistics, the share of small and medium-sized businesses in the Russian Federation by the end of 2020 should be 23.5%. In this regard, there is a growing need to implement urgent measures of financial support for this segment of the national economy.

In this connection, it is necessary to regularly send financial resources from the federal and regional budgets on a co-financing basis in order to replenish the capital of microfinance organizations. However, the resources for the capitalization of MFOs with budgetary participation in the amount of 13 billion rubles [2, 3] as part of the urgent support measures presented in the context of the spread of a new coronavirus infection were sent by the Government of the Russian Federation to the regions only in 2020, while from 2021 an increase the capital of microfinance organizations is assumed by calculation - in the amount of 5% of the available capital (in accordance with the Methodology for calculating indicators by the number of loans of the Ministry of Economic Development of the Russian Federation of 05/25/2020). Let's consider this situation in more detail.

Urgent measures of financial support in the form of microloans, financed from the Reserve Fund of the Government of the Russian Federation and the national project "Small and Medium Enterprises and Support for Individual Entrepreneurial Initiatives", from 2020 are characterized by the following conditions (Table 1).

Table 1. Conditions for providing microloans to small and medium-sized businesses as an urgent support measure from 2020[2]

Conditions for the provision of urgent measures	Providing microloans
Application consideration period	No more than 1 business day
Interest rate	No more than the key rate of the Central Bank of the Russian Federation
Maximum term of provision	No more than 2 years

[2]Compiled according to: Decree of the Government of the Russian Federation dated March 31, 2020 No. 378 "On Amendments to the State Program of the Russian Federation" Economic Development and Innovative Economy "[Electronic resource] // access mode: http://publication.pravo.gov.ru / Document / View / 0001202004020009

The interest rate on most microloans provided by MFOs with budgetary participation to SMEs is 4.25% per annum. At the same time, there are a number of preferential categories of microloans, such as "Monocities", "Interest-free", etc., for which the interest rate is 2.125% and 0% per annum, respectively. That is, even with the full repayment of microloans and the portfolio risk equal to zero, which in principle is impossible, the annual return of MFOs with budgetary participation in the Russian Federation in 2021 will be less than 4%. At the same time, operating expenses are not reduced at all, but rather increase due to the new calculation of reserves for possible losses on loans to MFOs [4].

Let us calculate the new requirements for additional capitalization of MFOs with budgetary participation using the example of the largest MFO in the Sverdlovsk region - the Sverdlovsk Regional Fund for Entrepreneurship Support. With the capital of MFOs as of 01.01.2021 in the amount of 1,744,170,170 thousand rubles, the required amount of additional capitalization in accordance with the requirements of the Ministry of Economic Development of the Russian Federation in 2021 will be:

1 744 170,170 * 5% = 87 208,508 тыс. руб.

Then, as with the standard interest rate on microloans of 4.25% with full capital utilization, the annual income of MFOs in 2021 will be:

1 744 170,170 * 4,25% = 74 127,232 тыс. руб.

Thus, the annual potential income of more than 13 million rubles. less than it is necessary to spend on additional capitalization of MFOs in accordance with the new requirements, and it is also necessary to ensure operating expenses and the formation of reserves.

The introduced regulatory changes will contribute to the exit from the market of MFOs with budgetary participation, their possible merger with other organizations of the infrastructure to support SMEs, or an increase in interest rates on other groups of preferential microloans, which will negatively affect the provision of borrowed resources for small and medium-sized enterprises, and also on maintaining their liquidity and solvency.

In this regard, the state requires the development and implementation of long-term programs to support SMEs through the MFO system with budgetary participation, which will make it possible to ensure the long-term functioning of these entities and the progressive development of the national economy as a whole.

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DOI 10.34660/INF.2021.42.20.004

ECONOMIC AND GEOGRAPHICAL POTENTIAL OF CENTRAL ASIA AND THE PLACE IN IT OF WATER RESOURCES

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Abstract. The article presents the results of a study of the natural resource potential of the Central Asian region, the economic and geographical essence of water resources management, highlights the issues of the population of the region related to the availability of water resources.

Keywords: Central Asian region, water resources, population growth, GDP, surface waters, transboundary water resources.

The concept of the economic and geographical essence of water resources management appeared from the moment the Central Asian states proclaimed their national sovereignty, when they switched to a market model of development. An analysis of the research carried out on the fundamentals of water policy in the context of the transition to market relations on the example of some countries of the world [1] shows the growing shortage of water resources, which requires the need for fundamental reforms in their management. The experts are unanimous in the opinion that the creation of an institutional framework for water resources should be understood as a fundamental problem of social policy, and not as a purely engineering exercise. Accordingly, the system of distribution of water resources should reflect the variety of goals facing society, as well as their physical and mechanical properties, the system of equipping hydraulic structures. Regions in which water is used primarily for irrigation and with relatively hot climates (such as the western United States or southern Australia) have generally chosen relatively decentralized systems based on flow or allocation rights for a certain amount of water. The level of economic development of the countries of the region is different. In the region, the share of the agricultural sector in the national GDP is almost entirely accounted for by irrigated agriculture and by 2025 it will not increase (tab. 1).

Table 1.
Past and forecasted indicators of the share of the agricultural sector in GDP, %

Year	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
1990	34	45	25	31	33
1995	19	45	21	16	32
2000	15	38	23	26	26
2010	15	50	30	15	24
2025	15	50	30	15	20

The poverty level reflects the specific political and socio-economic conditions of each country in the region, but a high percentage of its share among the rural population remains common to all.

The region is characterized by population growth [tab. 2]. There are various estimates of the region's population in the near future and their incorrect application, for example, underestimation of labor migration processes [2], can significantly affect the choice of strategic approaches to the parameters of sustainable development.

Table 2.
Population of Central Asian countries, million people

Year	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan	Total
1990	16.7	4.3	5.4	3.7	20.3	50.4
1995	16.0	4.6	5.9	4.6	22.9	54.0
2000	14.9	4.9	6.1	5.4	24.3	55.6
2016	17.9	6.0	8.7	5.5	31.85	69.3
2025	25.9	8.4	9.0	13.1	40.3	96.7

Forecasts for 2025 for all five Central Asian republics show a gross population growth in the region compared to 2016 in the amount of 18.9 million people. Based on these data, it follows that by 2025 the total population of the region will increase with the average annual population growth rate, in the amount of 1.9%.

The low level of development of the Central Asian countries also causes a small volume of national GDP in them (tab. 3). Probably, this figure is even lower, since the income of private agricultural producers is often ignored in statistical reports, especially in its natural part, which goes to self-sufficiency.

Table 3.
Past and projected national GDP (billion US dollars) and per capita income (US dollars)

Year	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
1990	5.1 *2000*	14.0 *3200*	1.9 *320*	11.4 *3000*	14.6 *720*
1995	3.5 *1400*	1.5 *320*	0.6 100	5.9 *1100*	14.4 *630*
2000	3.0 *1150*	1.4 *270*	0.8 *130*	22.9 *4300*	17.4 *710*
2010	5.1 *1600*	1.5 *300*	1.8 *240*	127 *4800*	33.5 *1110*
2025	7.7 *1600*	2.6 *400*	2.92 *356*	207 *15800*	68.0 *1700*

GDP per capita data are shown in italics. Source: Royal Haskoning, GEF IFAS, 2012

Now let us consider the issue of water supply for the population, including both internal and external (transboundary) water resources.

In general, the region can be characterized as satisfactorily provided with water resources amounting to 4241 m^3 per person, which is 2.5 times higher than the critical level of water availability, taken in the amount of 1700 m^3 per person [3]. At the same time, the availability of water resources varies by country. Thus, in Uzbekistan, the available water resources per person are significantly less. Here, the indicator of the availability of water resources per capita is only 2074 m^3 per person (tab. 4).

Table 4.
Surface water resources in Central Asian countries (T. T. Sarsymbekov et al., 2004)

Country	Inland water resources		External (transboundary) water resources		Coefficient of transboundary dependence of water resources	Total	
	km³	m³/person	km³	m³/person	%	km³	m³/person
Kazakhstan	56.5	3.8	44.0	2.9	42	100.5	6745
Kyrgyzstan	46.5	9.5	-25.9	-5.3	0	20.6	4201
Tajikistan	61.8	10.1	-22.3	-3.7	0	39.5	6475
Turkmenistan	1.4	259.0	23.4	4.3	94	24.8	5593
Uzbekistan	16.3	671	34.1	1.4	77	50.4	2074
Region	182.5	3.3	53.3	765	18	235.8	4241

Efficient water use in the Central Asian region is hampered by the conflict of interests of the states of the region, based on the fact that more than 90% of all water resources of this territory are concentrated in the territory of Kyrgyzstan and Tajikistan (upstream countries), interested (for many reasons) in the development of hydropower, and downstream countries (Kazakhstan, Uzbekistan, Turkmenistan) mostly use water for the development of irrigation, the resources of which, and the agricultural production based on them, in the region have practically exhausted themselves today and cannot further serve the goals of sustainable economic development of countries and the region as a whole. It is obvious that the current level of agricultural development in the Central Asian countries does not so much determine their economic development as it provides for the minimum living needs of the population, that is, creates conditions for their survival. Agriculture itself functions at the level of simple reproduction.

The way out is seen in the diversification of economic sectors of the Central Asian countries, giving water an economic value, switching to modern agricultural technologies, and rational water use. All this will save up to a quarter of the runoff of the region's transboundary rivers a year and prevent damage from problems in water resources management, which, according to UNDP estimates, amounted to 1.8 billion US dollars in 2010 alone.

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DOI 10.34660/INF.2021.90.22.006

NEW DEVELOPMENTS IN ESP TEACHING AND LEARNING AT SCIENCE FACULTIES OF LOMONOSOV MOSCOW STATE UNIVERSITY

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Abstract. Moscow State University's own educational standards stipulate that its graduates achieve level B2 of foreign language proficiency, which promotes reconsideration of traditional methods of teaching, control and assessment. Teaching a foreign language at the university level means, in the first place, teaching language for specific purposes, in our case, English for specific purposes (ESP). An ESP certification examination in the standardized international format for the bachelor's degree course of English and a scientific interfaculty student conference held in English for the master's degree course proved their efficiency as novel forms of exit control and assessment and became the key factors in improving the entire teaching process at several MSU science faculties.

Keywords: ESP, ELT, exit control, assessment, MSU science faculties, level B2, examination format

In accordance with Lomonosov Moscow State University's own educational standards, since 2011 it has become mandatory for graduates of integrated master's degree and specialist degree programs of all faculties, including natural sciences, to achieve foreign language proficiency level B2 of the Common European Framework of Reference for Languages (CEFR) [Polubichenko 2014]. In international practice, level B2 (Vantage) is considered to be sufficient for those receiving higher non-linguistic education in a foreign language: "A consensus seems to be emerging that B2 would be adequate, and it is B2 that is specified for English-medium graduate degree programs at some universities" [Frumina, West 2012: 45]. Besides, the standards set the lower limit to the total workload of the discipline "Foreign Language" as 20 credit units, and this minimum is hardly ever exceeded at science faculties. Thus, foreign languages departments (in reality, it is almost exclusively English departments, as this lingua fran-

ca of modern science has long since displaced other foreign languages from almost all science faculties) are faced with the challenge of raising the often very low initial level of foreign language competence of first-year students (from zero to A2) to the desired level B2 that characterizes the Independent user.

The key to solving this problem at the Faculty of Biology became a radical ***revision of the forms of exit control*** of English language proficiency in both the bachelor's degree and integrated master's degree programs. We proceeded from the principle that what is going to be controlled has first to be taught; thus, having chosen the forms of exit control adequate to the task of achieving the required level B2, we expected to trigger overall changes of the curricula, teaching materials, evaluation criteria, assessment tools, etc.

In the undergraduate course of English, it was decided to abandon the traditional format of the final exam (written translation of a biological text from English into Russian (with a dictionary); summary of an English biological text in English; listening comprehension of an English biological text (questions to the text and/or its discussion); discussion of the student's academic interests, etc.) in favor of the internationally standardized format of B2 foreign language proficiency examinations. This being an ESP course, however, the subject matter of the examination texts had to be adapted to the professional needs of the students. Having introduced measurable parameters of multidimensional scales of assessment and standard criteria thereof, the new format allowed to unify the approach to well over 200 students from different academic groups and different departmental specializations, thus contributing to greater objectivity of assessment.

A pilot exam in the new format was first held in 2014 with 20 volunteers; in 2015, more than half of the undergraduates preferred to take the exam in the new format. Their results were thoroughly analyzed and widely discussed by the ELT community at conferences and in professional literature; students' preparation for the final exam constantly improved: the assessment criteria were introduced and explained to the students; new teaching materials were produced and included in the teaching process. Since 2016, the final ESP examination checking the level of communicative competence in the field of biological sciences has been held exclusively in the international format of standardized B2 English language proficiency examinations. Certificates confirming the holders' level B2 proficiency in English for specific purposes are issued with three types of grades:

86-100% - A

76-85% - B

61-75% - C

≤ 60% - Fail (in this case no certificate is issued).

The voluminous examination takes two days and consists of five traditional parts with traditional types of tasks in each of them: Reading, Use of English (vocabulary and grammar test), Listening, Writing, and Speaking, each contributing an equal share of 20% to the final certification grade [Polubichenko, Fursova 2018].

When translating the certification grade into the English course mark put in the diploma, one more language activity is taken into account due to the traditions of Russian higher education and its specific value for the future career and professional development of university graduates. The case in point, for obvious reasons absent from international language exams, is translation (in our exam, translation of scientific literature on biological subjects from English into Russian). The weight of this component is no longer 25% of the diploma grade, as it used to be the first few years of assessment in the new format; at present, it only comprises 15% and is calculated as the arithmetic mean of the three marks for translations that are mandatorily taken for credit at the end of each of the last three semesters of study. In some cases, translation helps to improve the diploma grade, since translation skills, important for future work, have traditionally been a strong feature of the graduates' language training.

The advantages of the certification exam format as compared to the traditional one became evident in the very first years of its implementation. As expected, the English proficiency level of biology students rose, though the major technical course parameters remained the same: the sum total of 208 contact hours of the full undergraduate course of English spread over 7 semesters (2 academic hours per week throughout the course). Among other factors, this success can be attributed to the clear and precise examination requirements and transparent assessment criteria communicated to students well in advance of the exam, which allows them to fully realize the extent of their own responsibility for the results of their studies and intensify independent work.

The objectivity and professionalism of assessment have also noticeably increased. Annual preparation of several sets of examination materials and conducting the exam by international standards became a truly collaborative effort of the whole English department, resulting in the teachers' retraining and competence development. All teachers are now capable of assessing multiple aspects of students' language proficiency according to unified sets of internationally recognized criteria and following standard procedures. Writing is double-checked in anonymous coded pa-

pers; Speaking is also taken by two examiners, one of whom talks with the student, while the other evaluates the student's language skills. The need to provide the intensified independent work of students with a sufficient number of adequate course materials led to creation of new textbooks and manuals on various aspects of language training, including electronic learning aids placed both on personal teacher websites and on the MSU distance education platform *distant.msu.ru*.

The example of biology students proved the effectiveness of the new form of assessment for an undergraduate English course, and the certification exam was gradually extended to two more MSU science faculties, those of biotechnology (since 2018) and soil science (included in the training program for students enrolled in 2021).

Biology students who manage to meet the requirement of the educational standard and master ESP at level B2 (grade A) while still in the bachelor's degree program are given the opportunity to choose German, Spanish or French as a second foreign language in the integrated master's degree program. The remaining students as well as those B2 students who opt to continue learning English, proceed with it in the master's program for three semesters with the same intensity of 2 hours per week. However, the focus of their studies is now shifted from the normative to the functional aspect of language mastery, i.e. the ability to effectively use the lingua franca of modern science to obtain relevant scientific information from oral and written sources and share the results of their own novel research with the international scientific community. It is only natural under the circumstances that the form of exit control and assessment of the formation of English language communicative competence at this stage of university education became ***the inter-faculty student scientific conference "Life Sciences in the 21st Century: Looking into the Future" held in English*** [Shevyrdyaeva 2018]. Every January since 2018, the conference offers young researchers an opportunity to report on their findings, discuss them with the colleagues from their own and other faculties and departments and, for the best presentations, to have the abstract of the paper published. In addition to these standard outcomes of any scientific conference, this particular one serves as a testing ground for the participants' mastery of English and communicative skills that get measured according to an elaborate system of unified criteria, correlated with international scales of assessment of foreign language proficiency, by a competent team of English language teachers. While for some of the participants testing their English may be no more than just a matter of curiosity and an additional bonus, for master's degree biology students it is the final examination at the end of their inten-

sive 3-semester ESP course.

The conference-examination assesses the functional knowledge of English as a means of written and oral professional communication, namely:

1. Skills of writing scientific texts of small genres (abstract of 350-400 words submitted at registration; presentation slides);
2. Ability to prepare a 10-minute public speech presenting the results of research to the academic community;
3. Mastery of spontaneous academic speech (asking and answering questions; participation in discussions);
4. Listening comprehension skills (understanding other students' presentations and questions, positions of discussion participants).

The conference participants are ranked in points (maximum - 100: 20 for the abstract, 50 for the presentation and 30 for participation in discussions) which are then converted into exam grades to go in the master's diplomas:

86-100 points - 5
75-85 points - 4
60-74 points - 3
Under 60 points - 2

Using the scientific conference as a form of final ESP control at the master's level fully justified itself, demonstrating the same advantages that the introduction of the undergraduate ESP certification exam gave: the ESP proficiency of master's students significantly increased as well as the objectivity of its assessment. Moreover, other foreign languages returned to the biology faculty in master's degree programs; and in 2021, a German section worked at the conference for the first time, to be followed by a French and a Spanish sections in the not too distant future.

All these positive developments encouraged the Faculty of Soil Science to follow suit and completely overhaul the approach to ESP teaching and learning at their integrated master's degree programs. Since 2021, the conference-based form of ESP proficiency exit control has become a must, which inevitably entails changes in teaching methodology, classroom activities and content of teaching materials.

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DOI 10.34660/INF.2021.58.28.007

DIDACTIC WORKING CONDITIONS FOR FILLING GAPS IN STUDENTS' KNOWLEDGE

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Annotation. The article discusses the didactic working conditions to fill the gaps in the knowledge of students. An algorithm for filling the knowledge gaps of students is presented, which consists of four stages: diagnostics, planning, implementation and monitoring. Practical examples are given.

Keywords: international experience, pandemic, education system, knowledge gap of students, didactic condition.

The pandemic crisis has had a profound impact on the global education system. International experts said school closures during the pandemic have affected the academic performance, quality and level of learning of the school curriculum by students around the world. According to UNESCO, 108 countries of the world did not spend an average of 47 days of full-time education due to the closure of schools in 2020, which is equivalent to a quarter of the academic year [1].

During the pandemic, in the process of switching to distance learning, the problem was exacerbated by the lack of skills in working with digital content among both students and teachers. When implementing distance learning, countries have dealt with the situation in different ways, using and adapting different solutions depending on the level of digital and infrastructural training before the start of the pandemic. Several countries (Singapore, France) used national LMS solutions developed several years before the pandemic. China has adapted the dingtalk app to meet the needs of

distance education. World famous platforms for organizing the educational process and conducting asynchronous, synchronous online classes, such as Zoom, Skype, MS Teams, Google Classroom, have been used in all countries, including our country. Also, Kazakhstani digital educational content covered all classes and subjects with online lessons.

With the forced transition to a distance learning format, Kazakhstan managed to effectively organize a continuous educational process. In connection with the sanitary and epidemiological situation in the academic year, the educational process in schools was carried out in traditional, distance, combined learning formats. Each school independently determined the list of subjects and the number of hours for full-time or distance learning.

On the TV channels "El Arna" and "Balapan" TV lessons were broadcast 5 days a week with sign language interpretation. TV lessons were posted on the educational platform of the Ministry online.edu.kz, on the YouTube channel and in the electronic magazine “Kundelik.kz”. A large-scale work was carried out to improve the qualifications of teachers for the development of digital competencies. However, in the context of distance learning, the question of a decrease in the quality of education, gaps in the knowledge of students began to be raised more often. [2].

Now, in the post-pandemic period, it is necessary to restore the educational process and create conditions for creating a system of educational organizations capable of responding to challenges. The work to fill the gaps in the knowledge of students requires constant and systematic work.

In Kazakhstan, the main task of the 2021-2022 academic year is to implement the program for the new academic year with filling the gaps in the knowledge of students over the past academic year.

In the instructional and methodological letter "On the features of the educational process in secondary education organizations of the Republic of Kazakhstan in the 2021-2022 academic year", recommendations (work algorithm) are given for subject teachers on how to work on mastering new educational goals with filling the gaps in the student's knowledge for previous years [3] (Table 1). The work algorithm consists of four stages: diagnostics, planning, implementation, monitoring.

Table 1.

Algorithm of work to fill the gaps in the knowledge of students

№	Stage of work	Work period	The content of the work
1	Diagnostics	1st week 1st quarter	1. Carrying out a diagnostic test on the educational objectives of the program of the subject for the previous years of study. 2. Based on the results of a comprehensive diagnostic work, *identify* learning goals / topics for which students have gaps and *determine* the corresponding learning goals 3. Based on the identified learning objectives, determine the sequence of difficult topics depending on the number of students with gaps in topics. *For example,* with a large number of students who do not know a topic, this topic is considered the most difficult. With fewer students who have not mastered the topic, it is considered less difficult.
2	Planning	2nd week 1st quarter	1. Drawing up short-term lesson plans that integrate the learning objectives of the new school year with the corresponding learning objectives of the curriculum of the previous school year. 2. Determination of topics that do not have educational goals, corresponding to the goals of training in the curriculum of the subject for the past academic year. 3. Depending on the gaps in knowledge on the learning goals that do not correspond to the learning goals in the new academic year, divide the students into groups. 4. Scheduling consultations for each group. 5. Principles for planning consultation schedules: 1) consultations before a new lesson; 2) consultations on Saturdays, if classes cannot be included in the five-day lesson schedule; 3) consultations on vacation days; 4) consultations during the summer school. 6. Identification of groups that need consultation before new lessons and scheduling. 7. As needed, identify and schedule groups for Saturday consultation. 8. Identification of groups that need consultation during the vacation time and scheduling. 9. Identification of topics to be repeated during summer school and scheduling.

			10. Preparation of a plan for analytical work and a schedule for systematic monitoring of the quality of knowledge of students in academic subjects for the new academic year (this reflects both the quality of the student's knowledge over the past academic year and gaps): 1) second week of September (diagnostic administrative control); 2) the table of summative assessment for the section; 3) table of summative assessment for a quarter.
3	Implementation	During the academic year	1. Achievement of the learning goals of the new academic year according to the curriculum of the academic subject with the filling of the first gaps in the knowledge of students through the organization of the lesson on the basis of an integrated short-term plan. 2. Achievement of the learning goals of the new academic year according to the curriculum of the academic subject with filling the gaps in the knowledge of students by consulting before a new lesson. 3. Achievement of the learning goals of the new academic year according to the curriculum of the academic subject with filling the gaps in the knowledge of students by consulting on Saturdays. 4. Achievement of the learning goals of the new academic year according to the curriculum of the academic subject with filling the gaps in the knowledge of students by consulting vacation days 5. Achievement of the learning goals of the new academic year according to the curriculum of the academic subject with filling the gaps in the knowledge of students by conducting classes during the summer school.
4	Monitoring	At the end of each quarter	1. Analysis and discussion of the results of the system monitoring of the quality of students' knowledge at the methodological association, methodological council, pedagogical council: 1) an analytical report of the diagnostic control work at the methodological association, methodological council, pedagogical council; 2) an analytical report on the results of the summative assessment for the section on the methodological association;

			3) an analytical report on the results of the summative assessment for a quarter at the methodological association, methodological council, pedagogical council. 4) an analytical report on the results of the academic year at the methodological association, the pedagogical council.

Let's consider some stages of the algorithm separately using the example of academic subjects.

For example, to carry out diagnostic work on the subject "Algebra" in the 7th grade, it is necessary to consider the curriculum of the updated content on the subject "Mathematics" for grades 5-6 of the level of basic secondary education [4]. In the 6th grade, ten sections are covered. The learning objectives that fully cover the content of the 6th grade are presented in table 2.

Table 2.
Learning Objectives for Grade 6

№	Section name	Learning objectives
1	Relationships and proportions	6.1.2.4 - recognize and make proportions; 6.1.2.5 - know and apply the basic property of proportion; 6.5.1.1 - recognize and solve problems in which quantities are related by direct and inverse proportions; 6.5.1.2 - solve problems for percent using proportions;
2	Rational numbers and actions on them	6.1.2.13 - perform addition with the same signs and with different signs of rational numbers; 6.1.2.14 - perform subtraction of rational numbers; 6.1.2.24 - find the distance between points on the coordinate line; 6.1.2.15 - perform multiplication of rational numbers; 6.1.2.16 - perform division of rational numbers; 6.1.2.22 - find the values of numerical expressions containing rational numbers; 6.5.1.4 - solve word problems with rational numbers;
3	Algebraic expressions	6.2.1.5 - know the rules for opening brackets; 6.2.1.6 - know the definitions of the concepts of the coefficient, similar terms; 6.2.1.7 - bring similar terms in algebraic expressions; 6.2.1.9 - perform identical transformations of algebraic expressions; 6.5.2.4 - compose expressions with variables and formulas when solving word problems;

4	Linear Equation in One Variable	6.2.2.3 - solve linear equations in one variable; 6.2.2.4 - solve equations of the form $\|x \pm a\| = b$, where a and b are rational numbers; 6.5.1.6 - solve word problems by writing linear equations;
5	Linear inequalities in one variable	6.2.2.8 - display numerical intervals; 6.2.2.9 - find the union and intersection of numeric intervals; 6.2.2.12 - depict solutions to inequalities on a coordinate line; 6.2.2.13 - write down solutions to inequalities in the form of a numerical interval and write down a given numerical interval in the form of an inequality; 6.2.2.14 - solve systems of linear inequalities with one variable; 6.2.2.15 - to depict a set of points on a coordinate line, given by an inequality of the form $\|x\|>a$, $\|x\| \geq a$, $\|x\|<a$, $\|x\| \leq a$;
6	Coordinate plane	6.3.1.4 - build a point in the coordinate system by its coordinates and find the coordinates of a point specified on the coordinate plane; 6.3.2.3 - find graphically the coordinates of points of intersection of segments, rays or straight lines with each other, with coordinate axes;
7	Statistics. Combinatorics	6.4.3.1 - know the definitions of the arithmetic mean of several numbers, the range, median and mode of a number of numerical data; 6.4.3.2 - calculate statistical numerical characteristics; 6.5.1.5 - solve problems of finding the average speed of movement; 6.4.2.1 - solve combinatorial problems by the method of enumeration;
8	Dependencies between quantities	6.5.2.10 - find and investigate relationships between quantities using graphs of real processes; 6.2.1.12 - know the formula and build a graph of direct proportionality; 6.5.2.11 - interpret graphs of real dependencies between directly proportional values; 6.5.2.12 - write down the formula of direct proportionality according to the description; 6.5.2.13 - build a graph of direct proportionality;
9	Linear equations in two variables and their systems	6.2.2.19 - solve systems of equations by substitution and addition methods

Organization of the lesson based on a short-term plan in which learning objectives are integrated (corresponding to the learning objectives of two consecutive classes).

Examples of integrating learning objectives for the academic subjects "Algebra" of the 7th grade and "Mathematics" of the 6th grade are presented in Table 3 [4-5].

Table 3.
Learning objectives for grades 6-7

7th grade learning goal	6th grade learning goal
7.1.2.4 - find the numerical value of a power with an integer exponent and represent the given numbers as a power;	6.1.2.13 - perform addition with the same signs and with different signs of rational numbers; 6.1.2.15 - perform multiplication of rational numbers; 6.1.2.16 - perform division of rational numbers;
7.2.1.1 - apply the properties of a degree with an integer exponent when finding the values of numerical expressions;	6.1.2.13 - perform addition with the same signs and with different signs of rational numbers; 6.1.2.15 - perform multiplication of rational numbers; 6.1.2.16 - perform division of rational numbers;
7.2.1.13 - perform identical transformations of algebraic expressions using actions on polynomials	6.2.1.6 - know the definitions of the concepts of the coefficient, similar terms 6.2.1.7 - bring similar terms in algebraic expressions 6.2.1.8 - know the definitions of identity and identical transformations; 6.2.1.9 - perform identical transformations of algebraic expressions;

If the subjects of the educational process realize the importance of working to fill the gaps in the knowledge of students, develop and implement a target work plan, then the development of the curriculum by the students of the new academic year with filling the gaps in the knowledge of students will be productive.

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DOI 10.34660/INF.2021.21.47.008

AGE-RELATED PSYCHO-VEGETATIVE CHANGES IN MINERS IN COMBINATION WITH THE ARTERIAL HYPERTENSION DEVELOPMENT

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Abstract. We examined 109 men working at a chromium ore mining enterprise exposed to occupational and psychosocial factors in order to study their psycho-negative state and its relationship with the development of hypertension syndrome. The patients were divided into two groups: the main group - 60 men working in underground conditions; comparison group - 49 men performing ground work. In connection with the established diagnosis of "Syndrome of arterial hypertension" in middle-aged people of the main group, it was divided into two subgroups - people under 45 years old (n = 20, age 38.45 ± 2.95 years), and people older 45 years old (n = 40, age 50.90 ± 1.46 years.); the comparison group is divided accordingly. Purpose of the study: to study the prerequisites for the development of hypertension based on the psychovegetative status and some changes in the biochemical and functional indicators of the cardio-vascular system, depending on the age-related changes in these indicators. Materials and methods: the patient underwent a study of the psycho-vegetative state with an assessment of the level of neuropsychic stress, personal and situational anxiety, attention function, subjective reflection of psycho-vegetative distress. The state of the cardiovascular system (CVS) was investigated according to the results of functional and clinical laboratory diagnostics. Results: A decrease in attention, an increase in personal anxiety and an increase in the number of psychovegetative complaints were significantly more often detected in the group of patients with hypertension (OR 7.50; 95% CI 2.39-23.58; OR 11.06 95% - CI - 4.35 - 28.10; CI 22.50; 95% CI - 7.09 - 71.41). Adaptive psychovegetative phenotypes were distinguished in two subgroups. The correlation of the parameters of psycho-vegetative

status with age and experience was established in the absence of their relationship with homeostasis indicators in patients under 45 years old. In patients over 45 years old, a negative relationship was established between age, experience and some parameters of psycho-vegetative status, as well as a direct relationship between these parameters and some indicators of homeostasis in the diagnosis of hypertension syndrome in 95% of patients in this subgroup. Conclusions: Thus, with an increase in age and experience, there is a transformation of the adaptive psychovegetative phenotype with an inversion of connections with psychovegetative parameters against the background of increased functional disorders of the cardiovascular system. Diagnostics of the transformation of this phenotype help to assess the risk of developing arterial hypertension in miners.

Keywords: psychovegetative status, dangerous underground work, functional changes, psychovegetative phenotype, arterial hypertension, psychosocial factors.

Introduction

The diagnostic significance of occupational and psychosocial factors in the formation of occupational diseases is an urgent problem. In connection with an intensity increase of production in many industries, including mining, the tension of the labor process rises, the load on the psychovegetative adaptation mechanisms of workers increases, the risk of developing cortico-visceral dysfunction and imbalance of the autonomic nervous system getting higher, which leads to a distress reaction, violation of the basal metabolism, neuroendocrine pathology, activation of free radical lipid oxidation, dysfunction of the vascular endothelium [1]. Psychovegetative stress is manifested in the implementation of somatic functional disorders, and subsequently leads to an increase in the proportion of psychosomatic pathology, more often - the formation of hypertension [2,3].

Purpose of the study: to establish the prerequisites for the development of hypertension based on the study of changes in the state of the psychovegetative status, biochemical and functional indicators of CVS in miners of middle and older age.

Materials and methods

The study involved 60 men performing underground work (main group, n = 60, age - 46.8 ± 2.0 years, experience - 22.0 ± 2.4 years), with a signed informed consent. The comparison group is represented by 49 workers of land occupations (age - 43.6 ± 3.8 years, experience - 16.6 ± 1.6 years). To study health indicators in the age aspect, patients are divided into 2 groups according the WHO age classification. Group I (n = 20) consisted

of workers aged 38.45 ± 2.95 years, work experience - 12.7 ± 3.0 years, group II (n = 40) - workers aged 50.90 ± 1.46 years , experience - 26.7 ± 1.9 years. In the same way 2 comparison subgroups were formed: 23 employees, aged 38.0 ± 2.8 years, experience - 9.3 ± 1.5 years (comparison group <45 years); and 26 employees, aged 49.2 ± 2.1 years, experience - 24.0 ± 1.8 years (comparison group> 45 years). The groups are comparable in terms of age, gender, social, living and working conditions, groups I and II are comparable in terms of working conditions ($p < 0.05$). After a comprehensive clinical examination the diagnosis "Arterial hypertension, grade I" was established in 38 patients (63.3%) of the main group, all of them were included in the group of middle-aged people (group II).

Several methods are used: the clinical conversation and questionnaires to highlight the personal characteristics of patients. An assessment of psycho-vegetative dysfunction was carried out using a battery of psychophysiological tests: "Determination of the neuropsychic tension of T. Nemchina"; "Integrative test of anxiety". Voluntary attention was investigated using a test with the Schulte-Gorbov table. The assessment of the subjective reflection of psychovegetative dysfunction was carried out according to the questionnaire "The severity of symptoms of psychovegetative syndrome". ECG, daily monitoring of blood pressure, ultrasound of the heart were conducted. The results of general and biochemical blood tests (glucose, creatinine, AST, ALT, sodium, potassium, serum uric acid, lipid spectrum, C-reactive protein) were evaluated. Statistical processing was carried out on a PC using the built-in analysis package for the spreadsheet processor Excel®2016 MSO (© Microsoft, 2016), the author's (© V.S.Sheludko, 2001-2016) package of applied spreadsheets (PPET) "Stat2015".

Results and discussion

All patients of the main group and the comparison group underwent clinical, laboratory and instrumental studies, the results of the study show that the homeostasis indicators were within the reference values (Table 1).

Table 1.
Functional changes in CVS and clinical and laboratory parameters of the blood of miners

Parameter	Main group (n=60), M±2m	Comparison group (n=49), M±2m
Functional changes in the CVS		
Mean systolic blood pressure, mm Hg.	131,20 ± 2,10	128,81 ± 2,21
Pulse blood pressure, mm Hg	46,17 ± 1,88	46,23 ± 2,30
Ventricular septum thickness, cm	0,97 ± 0,06*	0,86 ± 0,07
Clinical and laboratory blood parameters		
Atherogenic index	2,12 ± 0,15*	1,76 ± 0,20
Total cholesterol, mmol \ l	5,52 ± 0,37*	4,81 ± 0,29
HDL, mmol \ l	1,78 ± 0,09	1,77 ± 0,10
Uric acid, μmol \ l	311,43 ± 13,69*	296,42 ± 19,43
Platelets, 10^9\ cubic dm	250,08 ± 13,05	231,19 ± 13,18

Note: * - p <0.05 - statistically significant differences with the indicators of the comparison group

In the main miners group, a low level of attention (69.72 ± 6.03 sec., P <0.05) was established. A significant level of personal anxiety was determined (5.0 ± 0.4 points, p <0.05), demonstrating readiness for changes in the situation both at work and in social conditions. An average level of neuropsychic stress was established (42.7 ± 1.5 points, p <0.05), as well as an increase in the number of psychovegetative complaints (1.5 ± 0.3 points, p <0.05). These features of the mental state of patients are regarded as an adaptation of the psyche to hazardous working conditions, and represent a "psychological portrait" of an underground worker. An assessment of the risks of psychovegetative and clinical-functional indicators in patients with hypertension syndrome was carried out. A decrease in an attention, an increase in personal anxiety and an increase in the number of psychovegetative complaints were significantly more often detected in the group of patients with hypertension (OR 7.50; 95% CI - 2.39-23.58; OR 11.06 95% CI - 4.35 - 28.10; OR 22.50; 95% CI - 7.09 - 71.41). Also significantly more frequent are increases in SBP (OR 4.48; 95% CI - 1.80 - 11.16), pulse

blood pressure (OR 3.00; 95% CI - 1.14 - 7.86), ventricular septum thickness (OR 2.98; 95% CI - 1.26 - 7.06), AI (OR 3.20; 95% CI - 1.08 - 9.50), serum uric acid (OR 3, 86; 95% CI - 1.41 - 10.55).

In group I, it was revealed: a decrease in an attention, an increase in the level of neuropsychic stress with sympathicotonia, an increase in the number of complaints of a psycho-vegetative nature. From the functional indicators of the CVS, the following was established: a tendency to an increase in mean systolic blood pressure. Correlation analysis was carried out in group I: the presence of a moderate correlation between age and an attention level ($r = 0.554$, $p = 0.011$), a pronounced correlation between the experience and the level of neuropsychic stress ($r = 0.726$, $p = 0.0003$), a pronounced correlation between the level of neuropsychic stress and the number of psychovegetative complaints ($r = 0.645$, $p = 0.0021$). The correlation between the parameters of the psychovegetative state and functional changes in the CVS has not been established.

Thus, underground miners under 45 years old have a special adaptive clinical-psychovegetative phenotype, which we have identified as a “psychologically realizable adaptive phenotype”.

The results obtained demonstrate the realization of psycho-vegetative tension mainly by psychological mechanisms, and not accompanied by CVS disorders, which are not registered in this group.

In group II, a decrease in an attention, an increase in the level of neuropsychic stress with sympathicotonia, an increase in complaints of a psychovegetative nature, significantly higher level of personal anxiety were revealed. The correlation analyzing was carried out: a moderate negative relationship between age and neuropsychic stress ($r = -0.505$, $p = 0.0009$), age and personal anxiety ($r = -0.325$, $p = 0.026$), moderate negative correlation between experience and the decrease of an attention ($r = -0.394$, $p = 0.0119$). Thus, in workers over 45 years old, the relationship between the indicators of the psycho-vegetative state with age and experience changes qualitatively against the background of more pronounced functional changes in the CVS. This allows us to single out the "psychosomatically realizable adaptive phenotype."

Conclusion

In the group of miners, the characteristics of the psychovegetative status change, which is combined with some functional CVS and biochemical changes in homeostasis against the background of the formation of hypertension syndrome: attention decreases personal anxiety increases, and the number of psychovegetative complaints increases (OR 7.50; 95%

CI - 2, 39 - 23.58; OR 11.06 95% CI - 4.35 - 28.10; OR 22.50; 95% CI - 7.09 - 71.41). The study of the psycho-vegetative status allows us to distinguish 2 age-dependent phenotypes: "psychologically realizable adaptive phenotype" and "psychosomatically realizable adaptive phenotype". With an increase in age and experience, a transformation of the adaptive psychovegetative phenotype occurs with an inversion of connections with psychovegetative parameters against the background of an increase in functional disorders of the CVS.

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DOI 10.34660/INF.2021.20.65.009

DYNAMICS OF BODY TEMPERATURE IN THE ACUTE PERIOD OF SEVERE CONCOMITANT TRAUMATIC BRAIN INJURY IN CHILDREN

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Abstract. The average daily body temperature can serve as an objective indicator of the severity of SCTBI in children over 7 years of age. Maintaining the index at the subfebrile level of 37 ± 0.1°C can be represented as a positive effect of complex multifactorial (anti-inflammatory, decongestant, anticonvulsant, membrane-protective, etc.) intensive therapy in the acute period of SCTBI in children over 7 years of age.

Keywords: temperature, severe concomitant traumatic brain injury, children

Relevance

The combination of TBI with damage to other organs and systems exacerbates the severity of brain damage. On the one hand, this is due to the inadequacy of systemic compensatory reactions in the shock period, and on the other hand, to direct or indirect damage to various organs or systems. An essential role is played by the progression of extracranial disorders, which coincides in time with the period of subcompensation of hemo- and liquorodynamic shifts. Intensive therapy aimed at compensating for multisystem disorders may conflict with the regularities of the course of sanogenic and reparative processes in the central nervous system. An increase in brain temperature or core body temperature is associated with a poor outcome in acute brain injury. While there is a simple mechanistic explanation that fever is harmful in itself, there is also the fact that patients with more poor outcomes have more episodes of fever. Therefore, control of the temperature of the damaged brain is aimed at preventing hyperthermia and maintaining controlled hypothermia. An increase in brain temperature leads to increased brain oxygen consumption and increased cerebral blood flow, which can worsen ischemia. According to many authors, normothermia should be maintained in patients with acute brain injury. The use of guided hypothermia for TBI is widely practiced but remains contro-

versial. A 2004 Cochrane review and four separate meta-analyzes did not confirm the effectiveness of the method [1,2].

Lack of information on the topic prompted us to study one of the priority tasks of intensive care (severe concomitant traumatic brain injury) SCTBI in the acute period.

Purpose of work

To study and assess the dynamics of body temperature in the acute period of severe concomitant traumatic brain injury in children

Material and research methods

The indicators of a comprehensive examination of 16 patients with severe concomitant craniocerebral trauma (SCTBI) who were admitted to the ICU of the RSCEMI neurosurgical department in the first hours after an accident - 14, catatrauma - 2 patients were studied. Continuous hourly monitoring of the temperature indicator, and taiga hemodynamic parameters were carried out for 30 days after SCTBI. According to the indications of the patients, on admission, invasive mechanical respiratory support (MRS) was started. Mechanical respiratory support began with continuous ventilation (CMV) followed by a switch to SIMV. The severity of the condition was assessed using scoring methods for assessing the severity of concomitant injuries - the PTS (Pediatric Trauma Score) scale (Tepas J.J. et al. 1985), the assessment of the severity of injuries on the ISS scale, the severity of acute cerebral failure according to the Glasgow coma scale. On admission, impaired consciousness in 14 injured patients was assessed on the Glasgow Coma Scale (GS) 8 points or less. Patients were considered in three age groups: group 1 - 11.5±3 years (4), 2 - 10.6±0.9 years (4), 3 - 12.7±2.8 years (8 patients). Complex intensive care consisted in identifying and timely correction of deviations: MRS, after removing from shock anesthetic, anti-inflammatory, hemostatic, antibacterial, infusion therapy, correction of protein, water-electrolyte balance disorders, surgical, as far as possible, early correction, stress-limiting, cytoprotective therapy. According to the PTS classification, the interpretation was: if the total score on a scale of 9-12 points is a minor injury, 6-8 points is a potential threat to life, 0-5 points is a life-threatening condition, o points is a fatal situation. The probability of death according to PTS is at <8, hospitalization from a specialized department is required, 4 points, the probability of death is 50%, at <1, the probability of death is> 98%.

The use of the scale for assessing the severity of injuries ISS allowed for a more differentiated assessment of the severity of injuries. ISS scale analysis: 1-9 points - mild injury; 10-15 points - moderate severity; 16-24 points - heavy; over 24 is extremely heavy. Mortality at 16-24 points -5-7%;

> 24 points - over 30%. Duration of the hospital period: 1-9 points - about 4 days; 10-15 points - 6-7 days; 16-24 points - 8-10 days; > 24 points - over 12 days. The introduction of the scales made it possible to clearly delineate the severity of the shock and, depending on this, to determine the further tactics of action.

Results and its discussion

Admission in a serious condition was associated with SCTBI, severe cerebral contusion (SCC), severe closed brain injury (SCBI), open severe traumatic brain injury (OSTBI), subarachnoid hemorrhage (SAH), intraventricular hemorrhage (IVH), combined with severe injuries of other organs and fractures of the ribs, limbs, facial skeleton (tab. 2).

Table 1.
Characteristics of patients with concomitant severe traumatic brain injury over 7 years old

Groups	1	2	3
Numb. of pat.	4	5	7
Days at the ICU	7.7±1.7	14.8±2.2	34.6±14.1
Age, years	11.5±3	10.6±0.9	12.7±2.8
GS, points	10±0.4	8.2±0.9	7.8±0.7
ALV, days	2±0.9	10.7±2.6	22.2±4.5
PTS, points	4±0.2	1±0.3	1±0.25
ISS, points	52±8	60±13	47.8±8.5

Table 2.
Types of traumatic injuries

Damage types	Group 1 (4)	Group 2 (4)	Group 3 (8)
SCBI	50% (2)	-	75% (6)
SCC	75% (3)	75% (3)	62% (5)
Light CC	25% (1)	-	25% (2)
SOTBI	50% (2)	100% (4)	25% (2)
SAH	50% (2)	75% (3)	62% (5)
Imbibed by the brain blood	50% (2)	25% (1)	37% (3)
Intracerebral hematoma	50% (2)	25% (1)	37% (3)
Subdural hematoma	25% (1)	-	25% (2)

IVH	25% (1)	-	25% (2)
Dislocation syndrome	25% (1)	-	37% (3)
Facial bone fracture	50% (2)	75% (3)	25% (2)
Fracture of the pelvic bones	-	25% (1)	25% (2)
Fracture of the humerus, femur, shin bones	-	75% (3)	37% (3)
Lung contusion	50% (2)	50% (2)	-
Pneumothorax	25% (1)	25% (1)	-
Crushing injury of the liver	25% (1)	-	-
Ruptured kidney	25% (1)	-	-
Hemoperitoneum	25% (1)	-	-
Retroperitoneal hematoma	25% (1)	-	12% (1)
Laceration of the thigh	25% (1)	25% (1)	12.5% (1)

The severity of the patients' condition was mainly determined by the severity of the brain damage (tab. 1). With a comparatively less pronounced traumatic effect on the brain, timely etiopathogenetically determined measures were able to bring patients out of the state of severe traumatic shock in a fairly short time, timely surgical correction of bone fractures, effective intensive therapy of bruises of parenchymal organs, and compensation of blood loss.

The efficacy of treatment for severe cerebral contusion (CC) was more favorable with open TBI, as evidenced by the shorter recovery time in group 1 7.7±1.7 days, in group 2 14.8±2.2 days, ALV duration in 1 group 2±0.9, in group 2 10.7±2.6 days than with SCTBI (tab1). While the duration of intensive therapy in group 3 patients was significantly longer and amounted to 34.6±14.1 days ($p < 0.05$), ALV 22.2±4.5 days ($p < 0.05$) (tab. 1).

It is known that the initial severity of the condition is in direct proportion to the volume of traumatic injuries that cause more severe stress mobilization of defense systems. One of them is the systemic inflammatory response of the body, the objective indicator of the severity of which is thermoregulation. In this regard, an attempt was made to study and assess the dynamics of the temperature reaction depending on the severity of the condition of injured children over 7 years old.

As shown in Table 3, on the first day in group 1, the average daily body temperature was within the normal range, however, in groups 2 and 3, a tendency towards a hyperthermic reaction was revealed (the lack of reliability is associated with a large scatter of the indicator). In dynamics in the acute period of SCTBI in group 1 on the 3.4.5th day there was an increase in body temperature by 0.5°C ($p < 0.05$). A decrease to normal values was detected on the 8th day. In group 2 of traumatized children during the entire observation period in the ICU, no significant deviations from the indicator on day 1 were found. In children of group 3, on day 3, the average daily temperature increased by another 0.4°C, remaining at a subfebrile level for up to 30 days. In a comparative analysis, attention is drawn to the fact that in group 2 the temperature did not differ from that in the first in the first 9 days. However, in group 3, significantly higher rates were observed by 3,6,7,8 days by 0.4°C ($p < 0.05$). And also in patients of group 3, the average daily temperature reaction was more pronounced than in group 2 on days 10-15 by 0.4-0.6°C ($p < 0.05$, respectively).

Table 3.
Dynamics of thermoregulation in the acute period of severe concomitant traumatic brain injury in children

Days	Group 1	Group 2	Group 3
1	36.8±0.2	37.3±0.5	37.2±0.2
2	37.2±0.2	37.4±0.2	37.4±0.1
3	37.3±0.1*	37.3±0.1	37.6±0.1*‴
4	37.3±0.1*	37.3±0.2	37.4±0.2
5	37.2±0.1*	37.3±0.1	37.4±0.2
6	37.1±0.1	37.2±0.1	37.5±0.2
7	37.0±0.1	37.2±0.1	37.4±0.1‴
8	36.9±0.1	37.2±0.1	37.4±0.1‴
9	37.0±0.1	37.0±0.1	37.4±0.2‴
10		37.1±0.1	37.5±0.1⁰
11		37.1±0.1	37.6±0.2⁰
12		37.0±0.1	37.3±0.1⁰
13		36.9±0.1	37.5±0.1⁰
14		36.9±0.1	37.3±0.1⁰
15		36.9±0.1	37.3±0.1⁰

16			37.2±0.1
17			37.0±0.1
18			37.2±0.1
19			37.2±0.1
20			37.2±0.1
21			37.2±0.1
22			37.2±0.1
23			37.2±0.1
24			37.1±0.1
25			37.0±0.1
26			37.0±0.02
27			37.0±0.1
28			37.0±0.1
29			37.0±0.1
30			37.1±0.1

*- reliably relative to the indicator in 1 day
‴ - reliably relative to the indicator in group 1
⁰ - reliably relative to the indicator in group 2

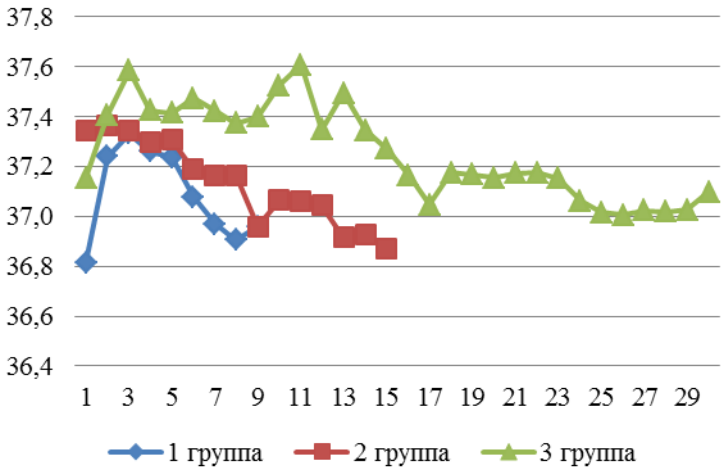

Figure 1. Dynamics of body temperature depending on the severity of the SCTBI

Confirmation of the effect on temperature regulation of the severity of SCTBI is confirmed in fig. 1, where, throughout the entire observation, the average daily body temperature in children of group 3 was higher than in children of groups 2 and 1.

Thus, the average daily body temperature can serve as an objective indicator of the severity of SCTBI in children over 7 years of age. Maintaining the index at the subfebrile level of 37±0.1°C can be represented as a positive effect of complex multifactorial (anti-inflammatory, decongestant, anticonvulsant, membrane-protective, etc.) intensive therapy in the acute period of SCTBI in children over 7 years of age.

Conclusion

The average daily body temperature can serve as an objective indicator of the severity of SCTBI in children over 7 years of age. Maintaining the index at the subfebrile level of 37±0.1°C can be represented as a positive effect of complex multifactorial (anti-inflammatory, decongestant, anticonvulsant, membrane-protective, etc.) intensive therapy in the acute period of SCTBI in children over 7 years of age.

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DOI 10.34660/INF.2021.58.36.010
UDC 613.632:615.9

ENVIRONMENTAL AND HEALTH ISSUES POPULATION AT APPLICATION OF COTTON DEFOLIANT «NITRODEF» IN AGRICULTURE

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Abstract. The toxicological characteristics of the "NitroDEF" defoliant preparation were investigated. The hygienic standards of the drug in environmental objects have been scientifically substantiated. Based on the studies carried out, the permissible daily dose (PDD) for a person at the level of 1.8 mg/person/day was calculated and scientifically substantiated. Recommended: maximum permissible concentration (MPC) in the water of reservoirs - 3.0 mg/l; the maximum permissible concentration (MPC) of the drug in the air of the working area at the level of 3.0 mg/m^3, the maximum permissible concentration (MPC) in the atmospheric air - 0.2 mg/m^3; the approximate permissible concentration (APC) in the soil - 0.6 mg/kg; the maximum permissible level (MPL) in cottonseed oil is "not allowed". It was found that the defoliant "NitroDEF" in terms of toxicity parameters belongs to the IV class of hazard (low-toxic compounds).

Keywords: pesticide, toxicity, medium lethal dose, irritant effect, hygiene standard, environment, regulations, safety.

Long-term fundamental and applied research contributed to the devel-

opment of the synthesis of domestic environmentally friendly preparative forms of chemical plant protection products with the development of hygienic standards in environmental objects (water, soil, air) and food products and regulations for safe use.

Currently, the strategy for sustainable agricultural development includes the improvement of farming systems and provides for the optimal use of pesticides and mineral fertilizers. Without proper special measures, crop losses from a complex of pests, diseases and weeds can amount to significant damage. On the other hand, the country's agriculture is undergoing changes associated with the transition to resource-saving soil cultivation technologies, replacement of the vehicle fleet, replacement of plant protection products, etc. Of interest is the assessment of the changes taking place in agriculture from a hygienic standpoint. The synthesis and testing of plant protection chemicals have taken on a huge scale. At the same time, the use of pesticides creates a potential danger to the health of the population, since many of them have a pronounced degree of harmful effect on the body, which is confirmed by numerous domestic and foreign publications [1]. According to previous studies, it is known that low-toxic pesticides, supplied in small quantities, but for a long time, can accumulate in objects of the environment and the body, adversely affecting them. Therefore, one of the most important hygienic problems is the prevention of the harmful effects of pesticides on the human body and the environment, and their regulation in environmental objects.

Purpose of the study: assessment of toxicity and development of hygienic standards and regulations for the safe use of the new defoliant "NitroDEF" when used in agriculture.

Materials and methods

Study of the new cotton defoliant "NitroDEF". Scientific research, on the toxic-logo-hygienic assessment, was carried out in accordance with the "Methodology for complex and accelerated rationing of pesticides in environmental objects" [2]. The degree of toxicity of the drug was determined according to the Sanitary Rules, Norms and Hygienic Standards of the Republic of Uzbekistan (SanPiN RUz) № 0321-15 [3].

Results and its discussion

Defoliant "NitroDEF". Physical state: solution, transparent, light yellow in color, with a slight aromatic odor. Ingredients: sodium chlorate, carbamides, monoethanolammonium nitrate, water. Specific gravity: 1.43 g/cm^3. Crystallization temperature: no more than 8°C. The drug is recommended for use in agriculture of the republic as a cotton defoliant.

The study of the acute toxicity of defoliant in order to establish the aver-

age lethal dose of the drug was carried out on 3 types of laboratory animals: white rats, mice, rabbits. The animals were injected intragastrically with the drug in doses of 1000.0 - 7000.0 mg/kg. At toxic doses, signs of intoxication were characterized by a sharp excitement of animals after administration of the drug, followed by depression, moisture in the coat, and minor convulsions. The clinic of intoxication in all animal species was the same. Statistical processing of the data obtained allowed us to establish the average lethal dose of the drug (LD_{50}): for white rats at the level of 4250.0 mg/kg, LD_{16} - 2375.0 mg/kg, LD_{84} - 6100.0 mg/kg; for white mice at the level of 4025.0 mg/kg, LD_{16} - 3275.0 mg/kg, LD_{84} - 4750.0 mg/kg; for rabbits at a level of 4700 mg/kg. Analysis of the data obtained allows us to conclude that the drug, according to the parameters of acute toxicity, belongs to substances of IV hazard class (low-hazard substance, Sanitary rules, norms and hygienic standards of the Republic of Uzbekistan № 0321-15).

The irritating effect of the drug on the skin was carried out on experimental animals - white rats. The drug was applied to the shaved areas of the skin in the abdominal region in its native form. After a 4-hour exposure, the preparation was washed off with running water and the experimental sites were monitored. After removing and washing off the preparation, slight edema and redness were observed on the test sites. The observed signs of irritation disappeared after 1 day from the beginning of the experiment, which suggests a weak local skin irritant effect.

The irritant effect of the drug on the mucous membranes of the eyes was studied on rabbits, in whose right eye 2 drops of the drug in a native form were introduced, the right eye served as a control. The introduction of the drug into the conjunctival sac of the eyes of animals led to anxiety in the animals, which tried to scratch the experimental eye with their paws. 1 hour after the introduction of the drug - there was a slight hyperemia, lacrimation. After 2 hours - narrowing of the palpebral fissure. By the end of the working day, the signs of irritation diminished and completely disappeared after 24 hours from the beginning of the experiment. Conclusion: the drug has a weak irritant effect on the mucous membranes of the eyes.

The study of the cumulative properties of the drug was carried out by the method of "subchronic toxicity" on white rats. The animals were divided into 2 groups, the weight of the animals was 150 - 180 grams, of both sexes. The first group received the drug at a dose of $^1/_{10}$ of the LD_{50}, the second group served as a control. Due to the absence of death of animals throughout the experiment, it was not possible to calculate the cumulation coefficient. However, according to the manifestation of some signs of intoxication and changes in the biochemical parameters of the blood of ani-

mals, it can be concluded that the drug has a weak functional cumulation.

Data on the toxicity of the drug for the intragastric route of administration are presented in table 1.

Table 1.

Toxicity parameters of "NitroDEF" for warm-blooded animals with a single introduction into the stomach

№	Indicator	Value
1.	Medium lethal dose (LD_{50},): - white rats - white mice - rabbits	 4250.0 mg/kg 4025.0 mg/kg 4700.0 mg/kg
2.	Local skin irritant effect	slightly irritating
3.	Irritant effect on the mucous membranes of the eyes	slightly irritating
4.	Cumulative properties	poorly expressed of a functional nature

As a result of studying the chronic toxicity of the drug, the threshold and maximum inactive doses of the drug were set at 7.5 and 1.5 mg/kg. Based on the data obtained, the permissible daily dose for a person was calculated and scientifically substantiated - 1.8 mg/person/day.

Maximum permissible concentration (MPC) in water bodies. Most pesticides, getting into water bodies, can have an adverse effect on the organoleptic properties of water: change the smell, taste, color, color, transparency and thereby limit the sanitary conditions of water use by the population. The effect of the drug on organoleptic properties was studied. In the experiment, the concentration of defoliant in water was tested from 0.3 to 10.0 mg/l, with each of which 3 series of experiments were carried out. The results of the study showed that the drug gives the water a faint smell and taste. The threshold for the sensation of smell (intensity 1 point) was at 3.0 mg/l, and the practical threshold (2 points) was at the level of 7.0 mg/l. The taste threshold was 5.0 mg/l and the practical threshold was 10.0 mg/l. In view of fluctuations in threshold values due to the individual sensitivity of tasters (odorators), the results were processed by the statistical Student-Fischer method, taking into account the pop-up values, in order to find the lower confidence limit, the arithmetic mean value of the threshold concentration for taste and smell. In order to check the accuracy and correctness of the experiments, a graphical method for evaluating organoleptic data was used, which made it possible to establish that the intensity of the taste and smell of the drug increases in proportion to the logarithms of their con-

centrations, i.e. the data obtained correspond to the Weber-Fechner laws. When comparing the indicators of the intensity of the smell and taste of the drug in water (1 point) according to various research methods, it can be concluded that they are practically at the same level, which indicates the reliability of the studies (table 2).

Table 2.
Influence of "NitroDEF" defoliant on organoleptic water properties according to various research methods

Organoleptic indicators and their intensity in points	Method for analyzing the results obtained		
	Concentration in mg/l		
	1	2	3
by smell			
sensation threshold	3.0	3.16	3.7
practical threshold	7.0	16.09	6.98
by taste			
sensation threshold	5.0	10.0	7.04
practical threshold	10.0	9.7	9.04

The drug at a threshold concentration in terms of its effect on odor did not change the color of water, transparency, and did not cause foaming. Based on the above, taking into account the data of the sanitary-toxicological experiment, the maximum permissible concentration (MPC) of the drug in the water of reservoirs is recommended at the level of 3.0 mg/l, the limiting sign of harmfulness is organoleptic.

Maximum permissible concentration (MPC) in ambient and work area air. Based on generally accepted approaches to the hygienic regulation of harmful substances in the air, taking into account the toxicity parameters and physicochemical properties of the drug, the following are scientifically substantiated and recommended by calculation: maximum permissible concentration (MPC) in atmospheric air - 0.2 mg/m^3, maximum permissible concentration (MPC) in the air of the working area - 3.0 mg/m^3.

Approximate permissible concentration (APC) in soil and maximum permissible level (MPL) in plant products. Based on the methodology of complex regulation of pesticides in environmental objects and foodstuffs, the following are recommended: approximate permissible concentration (APC) of the drug in the soil at the level of 0.6 mg/kg; the maximum allowable level (MPL) in cottonseed oil is "not allowed".

When using defoliant "NitroDEF" in agriculture, it is necessary to be guided by the developed hygienic standards and regulations for the safe use of the drug (table 3).

Table 3.
Hygienic standards and regulations for use defoliant "NitroDEF" in agriculture

№	Indicator	Value
1.	MPC in water of reservoirs, mg/l (limiting sign of harmfulness - organoleptic - smell)	3.0
2.	MPC in atmospheric air, mg/m^3	0.2
3.	MPC in the air of the working area, mg/m^3	3.0
4.	MPL in cottonseed oil, mg/kg	"not allowed"
5.	APC in soil, mg/kg	0.6
6.	Sanitary protection zone (SPZ), m	100
7.	Time to return to work, days	3

Conclusion

On the basis of the complex studies carried out, it was established that the NitroDEF defoliant belongs to the IV class in terms of toxicity; has a slightly irritating effect on the mucous membranes of the eyes and skin; cumulative properties are poorly expressed, of a functional nature. Recommended hygienic standards for the preparation: MPC in water of reservoirs - 3.0 mg/l, MPC in the air of the working area - 3.0 mg/m^3; MPC in atmospheric air - 0.2 mg/m^3; MPL in Cottonseed Oil - Not Allowed; APC in soil - 0.6 mg/kg. Recommended regulations for safe use: sanitary protection zone (SPZ) - 100 meters, time to go to work - 3 days.

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DOI 10.34660/INF.2021.38.16.011

SPECIFICITIES OF PREOPERATIVE EVALUATION OF OLDER PATIENTS WITH CANCER

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Abstract. According to the literature data, one of the factors determining the perioperative prognosis of a patient is the amount of functional reserves of the body. Older patients often have several chronic diseases, which, together with age-related changes, affects the functional state of the body and its reserve capabilities. The purpose of our study was to assess the sensitivity of the methods most common in preoperative assessment for patients over 60 years of age with cancer. We conducted a retrospective assessment of the medical history data of patients undergoing inpatient treatment at the Thoracic Surgery Department of the Pavlov First Medical University, St. Petersburg, Russia. All patients had verified primary lung or esophageal cancer and had no distant metastases, each patient underwent elective surgical treatment in the scope of radical surgery. The study included 100 patients (64 men and 36 women) aged 60 to 74 years (average age 67.02+0.56). 45% had stage III cancer, others had I and II stages. Preoperatively all patients were examined according to a standard algorithm, and they also underwent cardiopulmonary exercise testing.

42% of patients had perioperative complications. According to the results of the basic preoperative laboratory and instrumental examination, ASA, RCRI and P-POSSUM risk scores, there were no significant differences between the groups of patients with and without complications. We have identified some differences according to the results of cardiopulmonary exercise testing. The respiratory rate, the value of the ventilation equivalent in oxygen at the anaerobic threshold and at the peak of the exercise were higher in the group of patients without complications. Aerobic capacity on the anaerobic threshold was higher in the group of patients with complications. The results of our study show that a basic clinical and laboratory examination may not be sufficient for the preoperative assessment of elderly patients with cancer. Cardiopulmonary exercise testing can be used to assess the functional abilities of the body of this group of patients.

Keywords: cancer, risk stratification, functional reserves, cardiopulmonary exercise testing

Cancer is one of the leading causes of disability and mortality in the world, along with diseases of the cardiovascular and respiratory systems. According to the WHO data, the incidence of cancer increases annually, the highest morbidity rate is observed in the age group of 60-75 years [1]. Cancers of lung and gastrointestinal tract is among the most common oncological diseases. Surgical treatment of cancer of these localizations is associated with great traumatism, and, as a result, a higher incidence of complications and mortality rate in comparison with other oncological diseases. The risks of perioperative complications during radical operations for cancer diseases increase with age and are closely related to the prevalence of the oncological process, radiotherapy and chemotherapy performed before surgery, concomitant somatic pathology. Elderly patients have a number of factors that negatively affect the perioperative prognosis, including comorbidity, age-associated processes, geriatric syndromes and related functional disability [2,3,4]. Age and comorbidity-associated changes in the physiological functioning of the body worsen functional reserves, which affect the characteristics of the body's response to operational stress. So that, the risk of complications for elder patients increases in comparison with younger age groups.

Currently, there are many methods of operational risk stratification that are recommended for use by international communities. These include various risk assessment scales based on anamnesis data, laboratory and instrumental studies, as well as methods for assessing functional status by determining exercise tolerance. It should be noted that at the moment

there is no single algorithm for preoperative evaluation of older patients with cancer, which determines the relevance of further research and the search for the most effective methods of preoperative evaluation of geriatric patients.

The purpose of our study was to assess the sensitivity of the methods most common in preoperative assessment for patients over 60 years of age with cancer.

Materials and methods

We conducted a retrospective assessment of the medical history data of patients undergoing inpatient treatment at the Thoracic Surgery Department of the Pavlov First Medical University, St. Petersburg, Russia. All patients had verified primary lung or esophageal cancer and had no distant metastases. During hospitalization, each patient underwent elective surgical treatment in the scope of radical surgery. We evaluated the peculiarities of the course of the operation, the presence of complications and the features of postoperative period. Statistical processing of the material was carried out using specialized research application packages (Excel 2020).

The study included 100 patients (64 men and 36 women) aged 60 to 74 years (average age 67.02+0.56 years). 45% had stage III cancer, others had I and II stages. Preoperatively all patients were examined according to a standard algorithm, including evaluation of clinical, biochemical (ALT, AST, bilirubin, amylase, creatinine, urea, glucose, potassium, sodium) blood tests, ECG, echocardiography, computer tomography, endoscopy, spirometry. They also underwent cardiopulmonary exercise testing on a Cortex device using a bicycle ergometer. In the course of the study, gas analysis, ECG recording in 12 leads, saturation, metabolism assessment, and blood pressure measurement were continuously carried out. The standard protocol of continuously increasing (ramp) load was used [5]. The study began with the registration of indicators at rest, followed by the stage of pedal rotation from 55 to 65 per minute without any load. Both stages lasted 3 minutes. The next stage included a continuously increasing load with a constant increase of 10 watts per minute, while the patient had to keep the pedal speed at the selected level, regardless of their resistance, the duration of the stage was from 8 to 12 minutes. The criteria for the transition to the next stage – recovery – were the achievement of a submaximal heart rate (85% of the maximum heart rate) or the appearance of clinical symptoms (shortness of breath, dizziness, chest pain, ECG changes). The recovery period lasted 3 minutes, during which the load on the pedals was stopped, the patient continued pedaling without any load while maintaining the same rotation rate. The total duration of the study did

not exceed 30 minutes.

42% of patients had perioperative complications, 9% of all patients died because of complications. The types of complications included hemodynamically significant cardiac arrhythmias; the development of severe respiratory failure with transfer to an artificial lung ventilation due to the exacerbation of existing chronic lung diseases (COPD, bronchial asthma, chronic bronchitis); hypotension and bradycardia requiring inotropic support; delirium; perioperative myocardial infarction; pneumonia. The most frequent complication was paroxysm of atrial fibrillation (68%), 32% of them had more than one paroxysm.

The group of patients with complications had no statistically significant differences in weight, height, and body mass index in comparison with another group. There was no correlation between age, body mass index, the presence of verified coronary artery disease, arterial hypertension, chronic lung diseases, diabetes mellitus, chemotherapeutic treatment, the volume of surgery and the frequency of complications.

The main characteristics of patients are presented in Table 1.

Table 1.
The main characteristics of patients

	Patients without complications (n=58)	**Patients with complications (n=42)**
Mean age, years	66,9±0,5	67,1±0,6
Mean BMI, kg/m^2	25,8±0,7	26,1±0,9
coronary artery disease	15	15
hypertension	52	39
diabetes mellitus	7	6
chemotherapeutic treatment before surgery	48	32
chronic pulmonary diseases	35	28
smoking	40	30

Note: p>0,05

The risk of cardiac complications was assessed by the RCRI index [6], the surgical and anesthetic risk was assessed by ASA, the risk of developing any complications was calculated by P-POSSUM [7]. The data were comparable in both groups. According to the results of the basic laboratory

and instrumental examination, there were also no significant differences between the groups.

We have identified some differences according to the results of cardiopulmonary exercise testing. The respiratory rate, the value of the ventilation equivalent in oxygen at the anaerobic threshold and at the peak of the exercise were higher in the group of patients without complications. Aerobic capacity on the anaerobic threshold was higher in the group of patients with complications, at the peak of the exercise the results were comparable. The results are presented in table 2.

Table 2.
The results of cardiopulmonary exercise testing

	Group without complications	Group having complications
Respiratory rate (AT)	25,8±0,7*	23,1±0,7*
Respiratory rate (peak)	28,0±0,8*	24,5±0,7*
V'E/V'O2 (AT)	33,1±0,8	31,0±0,7
V'E/V'O2 (peak)	35,2±1,1*	33,1±0,9*
V'O2/WR (AT), ml/min/kg	15,0±0,5*	18,1±2,0*
V'O2/WR (peak), ml/min/kg	28,4±2,1	29,9±2,9

Note: AT – anaerobic threshold, peak - peak of the exercise, V'E/V'O2 - ventilation equivalent in oxygen, V'O2/WR - aerobic capacity.

*p<0,05

The ranges of ventilation equivalent on carbon dioxide, oxygen uptake on anaerobic threshold and the peak of the exercise were comparable in both groups of patients and showed most of them (88%) as high-risk patients according to the standard algorithm of preoperative assessment [8].

Discussion. According to the literature data, one of the factors that have the most significant impact on the perioperative prognosis is the level of the physiological reserve of the body and the possibility of its use under the influence of a stress factor [9,10]. Mobilization of compensatory-adaptive reactions during surgery is a non-specific adaptive response to surgically induced stress. These changes correlate with changes under the influence of any other stress factor, including exercise [11]. This allows the use of cardiopulmonary exercise testing in the preoperative examination of patients. In the course of our study, we obtained higher ventilation and respiratory rates during exercise, which may indicate higher physiological reserves and better implementation of them. The dynamics of oxygen use

per unit of power in a group of patients with complications can become an important sign of faster activation of functional reserves and, as a result, faster depletion of them, which determines the violation of the process of long-term adaptation. In our study, we found that in addition to the indicators of cardiopulmonary exercise testing used in the traditional protocol of preoperative assessment, it may be important to identify some other indicators that provide more information about the state of the body of geriatric patients with cancer.

Conclusion. The results of our study show that a basic clinical and laboratory examination may not be sufficient for the preoperative assessment of elderly patients with cancer. Cardiopulmonary exercise testing can be used to assess the functional abilities of the body of this group of patients. Further studies with a large number of patients are necessary to clarify the results obtained.

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DOI 10.34660/INF.2021.96.89.012

THERAPIST'S VIEW ON MENOPAUSAL HORMONE THERAPY

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Abstract. Hypoestrogenism as a result of menopause (natural or surgical) negatively affects a woman's quality of life. Menopausal hormone therapy is prescribed in order to neutralize the negative effects of menopause. The article provides a clinical example where the effect of menopausal hormone therapy on the lipid profile, anthropometric parameters and somatic diseases in patients in surgical menopause is evaluated.

Keywords: menopause, hypoestrogenism, menopausal hormone therapy, arterial hypertension

In 2014, the World Health Organization (WHO) identified "healthy aging" as one of its priorities in the work of national health care systems, since an able-bodied active person spends most of his life against the background of natural physiological processes of the body's withering.

In the Russian Federation, the average age of menopause is 49-51 years, and women live almost a third of their lives in conditions of estrogen deficiency. The onset of menopause is possible both spontaneously (natural menopause) and as a result of surgical intervention (surgical menopause). Currently, they refuse to divide menopausal symptoms into early, mid-term and late, because according to prospective studies, subclinical manifestations of estrogen deficiency begin to appear at the earliest stages of aging of the reproductive system. Estrogen deficiency leads to increased sensitivity of a woman's cardiovascular system to vasomotor instability and serves as a predictor of adverse health consequences in postmenopause. More and more studies indicate an increased risk of developing subclinical atherosclerosis and metabolic disorders in women with various vasomotor symptoms, as the correlation between hot flashes and insulin resistance, endothelial dysfunction, increased aortic calcification and vascular stiffness, increased thickness of the intima-media of the carotid artery, the level of markers of coagulation and inflammation has

been determined.

Estrogen deficiency, against which metabolic and neurovegetative disorders develop, affects the state of women's health and quality of life in general, and menopausal hormone therapy is prescribed to compensate for it. The purpose of menopausal hormone therapy is to partially compensate for the deficiency of sex hormones, using the minimum optimal doses of hormonal drugs that can improve the general condition of patients, stop menopausal symptoms, and prevent late metabolic disorders without side effects. The appointment of menopausal hormone therapy should be carried out after a thorough examination by an obstetrician-gynecologist.

After menopause, a woman's cardiovascular system loses cardioprotective protection of estrogens, which affects changes in the lipid profile, vascular stiffness, and blood pressure. In the Russian Federation, patients are quite wary of menopausal hormone therapy, so even when prescribing it, according to indications, they often make an independent decision to refuse the prescribed therapy.

One of the most pressing problems in gynecology is the steady growth of neoplasms of the reproductive sphere of women. About 30% of women undergo surgery with unrealized reproductive function.

Ovariectomy post-acute syndrome includes vegetative-vascular, neuroendocrine and neuropsychic disorders that have arisen after surgical castration in women of reproductive age [1].

The essential and fundamental difference between post-hysterectomy syndrome and menopausal syndrome is the rapid, almost total shutdown of the production of steroid hormones. Menopausal syndrome develops over several years, while compensatory mechanisms come into effect, smoothing out disorders associated with ovarian hypofunction. With posthysterectomy syndrome, there is a momentary shutdown of ovarian function, which is stressful for a woman's body and leads to a breakdown of adaptive mechanisms and the development of the syndrome of "surgical menopause", which is characterized by the rapid development of menopausal disorders characterized by a more severe course.

The frequency and severity of menopause symptoms (both natural and surgical) significantly depend on biological, individual psychological, as well as cultural, social and economic factors.

Taking into account the severe consequences that occur in women after forced removal of the uterus and ovaries, pathogenetically justified as early as possible replacement of estrogen deficiency by hormone replacement therapy.

Surgical intervention that occurs at a young age is especially difficult

to tolerate if a woman has not realized her reproductive role by the time of the operation [2]. At a dispensary appointment with a therapist, patients over 40 years old undergo a clinical examination and undergo a comprehensive laboratory and instrumental examination. As an illustration to the discussed problem of the expediency of prescribing menopausal hormone therapy in patients with surgical menopause, two clinical examples are given.

Clinical example No. 1. Patient M., 46 years old, higher education, married, 2 children (adopted son and daughter). At the age of 23, she underwent a pangisterectomy for the inflammatory process of the pelvic organs. A few weeks after the operation, «Divigel» 1 g was prescribed for the treatment of menopausal syndrome.

At the time of the examination, the patient does not complain of pain in the heart area. Over the past year, she has been noting rises in blood pressure with physical and emotional stress. Under the supervision of a gynecologist-endocrinologist, she continues taking «Divigel» 1 g. She adheres to a low-calorie diet with a sufficient content of dairy products. Leads a sedentary lifestyle. She denies bad habits.

Heredity: the mother has hypertension.

Objectively: the general condition is satisfactory. The skin covers of normal humidity. There is no swelling. Normal nutrition (weight 60 kg, height 164 cm). BMI =22.2kg/m2. Waist circumference is 84 cm, hip circumference is 106 cm, the ratio of waist circumference to hip circumference is 0.79. In the lungs, breathing is vesicular, wheezing is not heard. BH 16 per minute. The heart tones are muted, the rhythm is correct. Heart rate =PS=74 per minute. Blood pressure = 130/80 mmHg. The abdomen is not enlarged in volume, painless. There were no dysuric phenomena.

The average thickness of the intima-media complex of the main arteries of patient M., 46 years old:

Parameter	Common carotid artery		Internal carotid artery		External carotid artery	
	right	left	right	left	right	left
Diameter (mm)	6,6	6,5	4,7	4,5	4,0	4,0
Intima-media complex (mm)	0,5	0,6	0,5	0,6	0,6	0,6

The results of a biochemical blood test: total cholesterol - 5.44 mmol/l, triglycerides - 1.7 mmol/l, HDL-1.39 mmol/L, LDL-3.27 mmol/L, glucose -

5.38 mmol/L, urea 5.0 mmol/l, creatinine - 73 mmol/L, C-RB - 0 mmol/L.

Based on the available data, we can say that the patient has no pronounced changes in the cardiovascular system against the background of long-term use of «Divigel» 1 g.

The prognosis is favorable, however, given the presence of coronary heart disease factors, the patient should be monitored by a cardiologist with annual monitoring of the lipidogram.

Clinical example No. 2.

Patient K., 48 years old, special secondary education, single, no children. At the age of 20, a bilateral ovariectomy was performed due to cysts of both ovaries, the uterus was preserved. A few months later, menopausal hormone therapy was prescribed, but after 1.5 years, the reception was discontinued. Since the age of 29, the patient has been suffering from hypertension, with blood pressure rises to 170/110 mmHg, taking antihypertensive therapy. Since the age of 36, a diagnosis of type 1 diabetes mellitus has been established, insulin is used. Notes chest pains in recent years, disturbing 2-3 times a month, sometimes lasting up to 10 hours, relieving themselves. Does not follow a low-calorie diet, leads a sedentary lifestyle. Bad habits: smokes from the age of 14, drinks alcohol (beer). Heredity: the mother has hypertension.

Objectively: the general condition is relatively satisfactory. Skin with high humidity. There is no swelling. Normal nutrition (weight 60 kg, height 160 cm). BMI =23.2 kg/m2. Waist circumference 84 cm, hip circumference 96 cm, ratio FROM / ABOUT = 0.88. In the lungs, breathing is hard, wheezing is not listened to. BH 18 per minute. The heart tones are muted, the rhythm is correct. Heart rate =PS=95 per minute. Blood pressure = 160/100 mmHg. The abdomen is not enlarged in volume, painless. There were no dysuric phenomena.

The average thickness of the intima-media complex of the main arteries of patient K., 48 years old:

Parameter	**Common carotid artery**		**Internal carotid artery**		**External carotid artery**	
	right	left	right	left	right	left
Diameter (mm)	7,2	6,8	5,2	5,3	4,6	4,1
Intima-media complex (mm)	0,9	0,8	0,9	0,8	0,8	0,8

The results of a biochemical blood test: total cholesterol - 5.6 mmol/l, triglycerides - 1.77 mmol/l, HDL-C - 1.26 mmol/L, LDL-C - 3.8 mmol/L, glucose - 8.0 mmol/L, urea 5.9 mmol/l, creatinine - 104 mmol/L, C-RB - 0 mmol/L.

Based on the available data, we can talk about the presence of pronounced changes in the cardiovascular system in the patient. The patient is periodically disturbed by discomfort in the chest, she suffers from hypertension and type 1 diabetes mellitus. Taking into account the instrumental data against the background of changes in the biochemical analysis of blood, it is advisable to resolve the issue of correction of antihypertensive and hypolipidemic therapy, because concomitant type I diabetes significantly aggravates micro- and macroangiopathy, which negatively affects the prognosis of quality of life in women with a burdened gynecological history.

In the first clinical example, the patient can be assessed as a practically healthy woman from the position of a therapist, despite the existing risk factors [3]. She took the therapy recommended by the gynecologist immediately after surgery and continues to comply with doctors' prescriptions. The second patient is strikingly different in the presence of already formed somatic diseases, which can be associated both with the initial social status and with her lack of adherence to the recommendations of doctors during her life. Consequently, patients comparable in age and initial burdened gynecological history, as a result of different compliance with doctors, have objectively qualitatively different examination indicators and a different prognosis of life.

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DOI 10.34660/INF.2021.16.22.013
UDC 619:579.62

MORPHOLOGICAL AND FUNCTIONAL PARAMETERS AND SPECIES COMPOSITION OF *CYPRINUS CARPIO* MICROBIOCENOSES

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Abstract. The results of studies of the quantitative and species composition of microorganisms of microbiocenoses Cyprinus carpio are presented. During the species identification of microorganisms isolated from the intestinal contents of Cyprinus carpio, a total of 27 (71.1%) isolates were identified, including 13 (48.1%) E. coli; 4 (10.5%) K. pneumoniae; 3 (7.9%) P.vulgaris; 2 (5.3%) E. cloacae; 1 (2.7%) P. aeruginosa; 1 (2.7%) S. aureus; 1 (2.7%) S. epidermidis; 2 (5.3%) C. albicans; 1 (2.7%) C. parapsilosis. Gill histology is the preferred method for monitoring the effects of environmental factors affecting farmed fish in fish farms. In the gills, gill petals and branchial lamellae extending from them were identified. The main mass consisted of respiratory cells, characterized by small size, located in the center of the nucleus, basophilic cytoplasm. Myocardiocytes and blood vessels were identified in the heart. In the gastrointestinal tract, the integumentary epithelium and goblet cells of the villi and crypts of the intestinal mucosa were observed. The liver capsule and interlobular connective tissue were clearly distinguishable, uniform staining of the cytoplasm of hepatocytes was observed in the hepatic lobules, the nuclei had a clear outline and were located in the central part of the cells. In the spleen, the interstitial tissue of the stroma was observed, a clear border between the cortical and medulla of the lymphatic follicles.

Keywords: microbiocenoses, microorganisms, myocardiocytes, lymphocytes, lamellae, epithelium, villi, crypts

Introduction

The rapid growth of anthropogenic loads contributes to the pollution of water bodies, the immunosuppressive effect of antigens determines the

risks of the development of pathology of susceptible species of aquatic organisms [1]. In a microbiological study, the number of microorganisms of carp gill filaments was $3.3\pm3.8\times10^{6}$–$7.9\pm5.6\times10^{6}$ CFU/ml; intestinal contents – $1.4\pm2.9\times10^{10}$ –$1.7\pm6.0\times10^{11}$ CFU/ml. Among the identified microorganisms, *Aeromonas hydrophila* was dominant, accounting for 32.0% of the total number of isolates. In addition, the following species were identified: *Shewanella putrefaciens*, *Vibrio cholerae*, *Staphylococcus* spp., *Vibrio vulnificus*, *Pasteurella pneumotropica*, *Corynebacterium urealyticum* and *Micrococcus* spp. [2]. In the microbiocenoses of the carp intestine, the dominant microorganisms were *Fusobacterium spp*., *Proteobacterium spp*., *Bacteroides spp*. *Firmicutes spp* [3]. Of 84 fish samples, 32 samples (38.09%) contained *Salmonella spp*. Bacteria, 12.5% of isolates possessed the virulence genome - *invasin A* [4].

Infection of carp with *pathogenic bacteria revealed* pathological *processes* with abundant absorption vacuole, degenerative processes with signs of inflammation of the middle and distal parts of the intestine, fish mortality rates were 46.7–63.3% [5, 6]. To develop effective methods for assessing the physiological and immunological status of aquatic organisms, the priority task is to study the morphological parameters, quantitative and species composition of microorganisms of microbiocenoses *Cyprinus carpio*, which determined the relevance of research.

Materials and methods

The studies were carried out in compliance with the international requirements of the "Declaration of Helsinki on the Humane Treatment of Animals", "Declaration of Helsinki Ethical Principles", 2008 [7], "Directives of the Council of the European Community on the protection of animals used for experimental and other scientific purposes" [8].

The object of the research was fish *Cyprinus carpio*, three to four years old, weighing 1.0–1.5 kg, grown in a pond farm (n=5).

To study the quantitative and species composition of microorganisms, the contents of the intestine were examined for this, 0.5 g of each sample was placed in test tubes containing 10.0 ml of sterile 0.85% *NaCl* solution. To precipitate large particles, the samples were kept for 10–15 min at 18–20°C, then the supernatant was inoculated onto the surface of the differential diagnostic media; for the accelerated identification of microorganisms, the "*API 20E"* test system (*BioMereux*, France) was used. Determination of morphological, cultural and biochemical properties of microorganisms was carried out by conventional methods in accordance with the guidance "*Bergey's Manual of Systematic Bacteriology" (1984-1989)* and "Identifier of pathogenic and opportunistic fungi" [9,10]. For histological studies, the

material was fixed in a 10.0% solution of neutral formalin, embedded in paraffin, sections were stained with hematoxylin and eosin.

The results of the experimental data were processed by the method of statistical analysis using the Student's t-test, the results were considered reliable at p≤0.05.

Research results

Taking into account the quantitative and species composition of microorganisms of the intestinal microbiocenoses of *Cyprinus carpio*, the growth of microorganisms was observed in all the studied differential diagnostic media.

On *Brilliance agar* medium, due to the presence of sodium dodecyl sulfate in the medium, the growth of gram-positive bacteria was suppressed, the number of gram-negative bacteria was: 7.15 ± 0.12 - 9.33 ± 0.26. Taking into account the differential characteristics of 20 isolated gram-negative pure cultures of microorganisms, 19 (95.0%) isolates of bacteria of the *Enterobacteriaceae* family were identified, of which 12 (60.0%) were *Escherichia coli*, 4 (20.0%) - *Klebsiella pneumoniae*, 2 (10.0%) - *Proteus vulgaris*, 1 (5.0%) - *Enterobacter cloacae*.

On the *Cetrimide Agar* medium, the number of microorganisms was: 1.01 ± 0.12 - 2.01 ± 0.10. Out of 6 isolated pure cultures of microorganisms, 1 isolate (16.7%) of gram-negative aerobic bacteria *Pseudomonas aeruginosa* was identified.

The number of microorganisms on the *Yolk Salt Agar* medium containing 10.0% sodium chloride was 0.83 ± 0.07 - 1.36 ± 0.09. From 6 isolated pure cultures of microorganisms, 2 isolates (33.3%) of gram-positive bacteria were identified: *S. aureus* - 1 (16.7%), *S. epidermidis* - 1 (16.7%).

The number of colonies of microorganisms on *Hi Crome Candida Agar* medium was 1.74 ± 0.13 - 2.18 ± 0.03. Of the 6 isolated pure cultures of microorganisms, 3 isolates (50.0%) of yeast-like fungi were identified: *Candida albicans* - 2 (33.3%), *Candida parapsil osis* - 1 (16.7%).

During the species identification of microorganisms isolated from the intestinal contents of *Cyprinus carpio*, a total of 27 (71.1%) isolates were identified, including (48.1%) *E.coli*; 4 (10.5%) *K.pneumoniae*; 3 (7.9 %) *P.vulgaris*; 2 (5.3 %) *E. cloacae*; 1 (2.7%) *P.aeruginosa*; 1 (2.7%) *S. aureus*; 1 (2.7%) *S.epidermidis*; 2 (5.3%) *C.albicans*; 1 (2.7%) *C. parapsilosis*.

In the gills, gill lobes and branchial lamellas extending from them were observed. In the thickness of the gill petals, there was a cartilaginous hyaline arch, surrounded by connective tissue with large blood vessels located in it. The branchial lobe is covered with a stratified squamous respiratory gill epithelium. The main mass consisted of respiratory cells, characterized

by small size, located in the center of the nucleus, basophilic cytoplasm.

The primary branchial epithelium contained mucous and rod cells located in the areas between the branchial lobes and along the edge of the petal. Mucous cells were characterized by large size, displaced nucleus, oxyphilic cytoplasm. Rod cells had a regular round shape, a nucleus displaced to the basal part, and a weakly oxyphilic cytoplasm. The lamellae were covered with a two-layer squamous respiratory epithelium located on the basement membrane, under which the vascular layer is located, represented by a row of columnar cells, between the lateral surfaces of which cavities filled with blood are localized. The development of the pathological process in the gills was accompanied by swelling, areas of twisting and fusion, respiratory lamellae with the development of congestion were identified. An increase in the height of the branchial epithelium and a reduction in the surface relief of epithelial cells, necrosis of the petals of the second order were found. In the presence of a tumor of the branchial lobes, polymorphic multinucleated cells of the fibroplastic row were detected. Large yellow-green pigment granules were observed in the cytoplasm of the cells. In the central part of the tumor, degeneration and necrosis of cartilage tissue, disintegration of tissues at the base of the petals, degeneration of cartilage and deformation of the petals were revealed. Between the petals of the second order, mucus was visualized with an admixture of erythrocytes, leukocytes, macrophages and undifferentiated cells with a large light nucleus and cytoplasm. Areas of growth of the respiratory epithelium of lamellae and filament were identified. Hypertrophy and hyperplasia of the goblet cells were accompanied by dystrophy of the respiratory cells. Deformation of the filaments and atrophy of the lamellae were observed in the form of sloughing of the respiratory epithelium or the absence of lamellae on one or both sides of the filament. Necrotization of respiratory epithelial cells is more pronounced in the upper part of the lamellae. Histological examinations of the gills are markers for monitoring the effects of environmental factors affecting farmed fish in fish farms.

Myocardiocytes and blood vessels were identified in the heart.

In the gastrointestinal tract, the presence of integumentary epithelium of the villi of the mucous membrane was noted, intestinal crypts and goblet cells were detected. Collagen fibers were observed in the loose fibrous connective tissue of the submucosal layer of the mucous membrane of the small and large intestine. With the development of the pathological process in the intestine, hyperemia, edema of the intestinal mucosa were observed, the levels of diamine oxidase and D-lactate in the damaged intestine were increased ($p<0.05$). The activities of protease, lipase, amylase, Na^+/K^+-

ATPase and alkaline phosphatase are reduced (p <0.05), the permeability of the intestinal mucosa increased. The liver capsule and interlobular connective tissue were clearly distinguishable. In the hepatic lobules, uniform staining of the cytoplasm of hepatocytes was observed, the nuclei had a clear outline and were located in the central part of the cells (fig. 1).

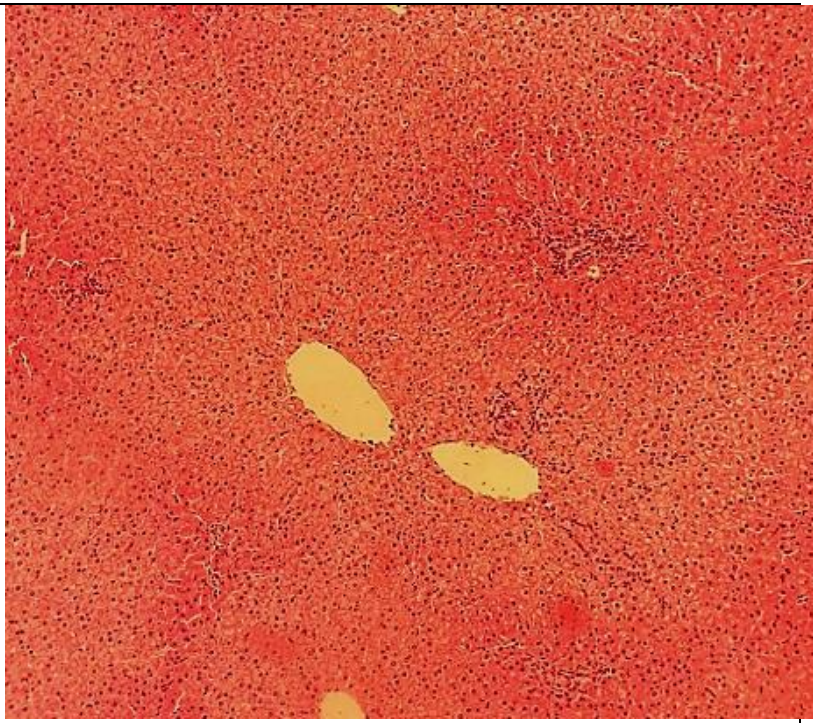

Figure 1 – Liver of Cyprinus carpio, 3 years of age, weighing 1.0–1.5 kg. Hematoxylin and eosin. Circ. 10, vol. 10, 40

In the spleen, the interstitial tissue of the stroma was observed, a clear border between the cortical and medulla of the lymphatic follicle. At high magnification of the microscope, plasma cells were found in the cortex of the lymphatic follicles. In the medulla, lymphocytes were visible, which had a uniformly colored appearance.

Discussion

Aquaculture is currently a promising direction for obtaining fish products; the limiting factors for the development of the industry are insufficient knowledge of the physiological and immunological status of aquatic organisms [11].

With the growth in the number of breeding achievements, attention should be paid to morphological variability when growing under conditions that differ from natural ones, in particular under conditions of recirculation, which is reflected in a decrease in the natural resistance of the organism to the effects of external factors that cause the risks of the development of pathology of susceptible species of aquatic organisms [12]. With an increase in jointly reared objects, the risk of the appearance of various pathologies increases, the share of under-received aquaculture production due to various fish diseases accounts for up to 30.0% of the potential "harvest" [13]. The survival rate of the white sea bream *Diplodus sargus* under experimental infection with *S. epidermidis was* 43.3–46.7% [5]. Seasonal changes affect the innate immunity of common carp, so the highest phagocytic and blood plasma complement activity was observed in autumn, decreased in summer and winter, and the lowest activity was found in spring [14]. The processes of intercellular communication, sorption, aggregation of heterogeneous biofilms and phenotypic plasticity of microorganisms expand the adaptive potential and cause the circulation of antibiotic-resistant strains among the population of susceptible species and environmental objects [15]. The addition of the probiotic *P. pentosaceus* at a *dose* of $1x10^8$ CFU/g allowed to increase (P<0.05) the activity of protease and lysozyme, the number of erythrocytes and leukocytes, the effect of interleukin-1beta (*il1b*) (P=0.016), interleukin 8 (*il8*) (P=0.007), interleukin 6 (*il6*) (P<0.001), catalase (*cat*) (P=0.041) and gene expression of glutathione peroxidase (*gpx*) (P=0.001), as well as superoxide dismutase (SOD) (P<0.001), glutathione peroxidase (GPx) (P<0.001), and malondialdehyde (MDA) levels (P<0.001) on intestinal tumor necrosis factor was established [1]. Dietary essential oil of oregano (15 g/kg) had a positive effect on the growth parameters of carp (*Cyprinus carpio L.*); degenerative changes were not detected in the intestinal villi with associated goblet cells, crypts, and submucosal tissues [16].

Conclusion

Taking into account the quantitative and species composition of microorganisms of microbiocenoses Cyprinus carpio, a total of 27 (71.1%) isolates were identified, including 13 (48.1%) *E. coli*; 4 (10.5%) *K. pneumoniae*; 3 (7.9%) *P.vulgaris*; 2 (5.3%) *E. cloacae*; 1 (2.7%) *P. aeruginosa*; 1 (2.7%) *S. aureus*; 1 (2.7%) *S. epidermidis*; 2 (5.3%) *C. albicans*; 1 (2.7%) C*. parapsilosis*. Gill histology is the preferred method for monitoring the effects of environmental factors affecting farmed fish in fish farms. In the gills, gill petals and branchial lamellae extending from them were identified.

The main mass consisted of respiratory cells, characterized by small size, located in the center of the nucleus, basophilic cytoplasm. Myocardiocytes and blood vessels were identified in the heart. In the gastrointestinal tract, the integumentary epithelium and goblet cells of the villi and crypts of the intestinal mucosa were observed. The prescribed treatment had a positive effect on the growth rates of carp (*Cyprinus carpio L.*), which in turn contributed to an increase in fish productivity.

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DOI 10.34660/INF.2021.26.33.014

NUMBER AND DISTRIBUTION OF THE MONGOLIAN GULL *LARUS (VEGAE) MONGOLICUS* IN SOUTH BAIKAL

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Abstract. The Mongolian gull is one of the few most widespread species of birds of the Southern Bai-kal - 16.0 ind./km2 or 48.2% of the total number of coastal birds. Its high number remains even under conditions of an acute shortage of forage resources, which is currently observed. Maintaining a high abundance in a limited number of shallow waters - about 7.0% of the total area of the lake Baikal is provided by a very ecological niche wide of this species and some of its morphological features. It is characterized by a relatively large size and a strong, even powerful, and sharp beak, which allows cutting of corpses. She is a polyphage with a very wide range of feeds used - from plant to animal sources and cannibalism. In addition, it is a eurytopic species that uses almost any station for nesting, from swamps and sandy spits and shoals to inaccessible rocky cliffs. The lack of fish resources, which is currently in connection with their strong overfishing observed, is by the transition to forage of anthropogenic origin compensated. There is a very strong decrease in the overall reproductive success of the species. Lack of food forces birds to use cannibalism, up to "sophisticated" predation, when birds kill and eat weaker individuals of their species. That is why this species in the modern period retains a high number, and the complex age structure, due to the long life expectancy, allows it to maintain a sufficiently high abundance in adverse environmental conditions.

Keywords: Southern Baikal, Mongolian gull, population density, lack of basic food, reproductive success, cannibalism.

Introduction

The Mongolian Gull *Larus (vegae) mongolicus* is one of the most common and widespread species of gull birds of Lake Baikal [6, 11, 17, 24]. Previously, this species belonged to the Herring Gull *Larus argentatus mongolicus* Suchkin, 1925 [15]. Later, in connection with the refinements

of taxonomists, he received a different species status – Yellow-legged Gull L. *Larus cachinnans mongolicus* Pall.,1811 [25-26]. Then, due to genetic proximity, it was to the Eastern Siberian Gulls *L. vegae mongolicus* Sushkin, 1925 assigned [28]. At present, this species is considered the Mongolian Gull *L. (vegae) mongolicus*, although it is possible that it is a subspecies of the East Siberian Gull [16, 22, 28].

The distribution of the Mongolian Gull over the water area of Lake Baikal is extremely uneven. In the estuaries and deltas of rivers, as well as on the islands of the Maloe More Strait and the Chivyrkuisky Bay, it is the most abundant bird, and its main nesting colonies here are located also. In other areas, this species is in small colonies found, as well as during periods of foraging, the formation of concentrations of resting birds and migrations. Southern Baikal (within the boundaries of the South Baikal climatic district) differs from the rest of the lake Baikal is much deeper and has a very narrow coastal strip. On this part of the lake, the signs of a large mountainous very deep-water body of water with a peculiar fauna of birds are clearly manifested [11]. The peculiarities of its development by the most massive and widespread species, which is the Mongolian Gull, is of undoubted interest.

Area of work, material and methodology

Physical and geographical features of the lake. Baikal can be divided into three climatic areas: South Baikal, Middle Baikal and North Baikal climatic districts. They differ in the severity of climatic conditions - it noticeably increases from south to north (the coefficient of continental climate according to Zenker increases from 62 to 64) [1]. At the same time, the division of the lake Baikal into three sections (South, Middle and North), performed by N.G. Scriabin's [23], does not coincide with the boundaries of climatic districts. Therefore, our similar names for different parts of the lake Baikal does not reflect its previous division and gives ornithological characteristics of the corresponding climatic districts.

The composition of the fauna and the number of birds of lake Baikal changes significantly in high-water and low-water years. The summer season of 2021 was characterized by strong high water levels, caused by prolonged, frequently repeated and prolonged rains, sometimes with heavy rainfalls. For p. The Selenga at that time was characterized by a very strong flood - the entire lower and part of the middle delta was flooded. If the Irkutsk hydroelectric power station had not carried out the passage of water in an emergency mode, it would have gone completely under the water. All sandy and pebble shallows along the coast and hag (the sandy spit separating the shallow sores of the Selenga river delta from the deep-

water part of Lake Baikal) were flooded. However, the spit in the area of the Posolsky Sor, having greatly decreased in size, has survived, clearly marking the coastline of lake Baikal.

As a result of field work from July 29 to August 5, 2021, we surveyed the coasts of Southern and, partly, Middle Baikal (the Selenga river delta, the mouths of the Bolshaya Goloustnaya and Buguldeyka rivers, Posolsky sor and Proval bay) using the SRV “Professor A.A. Treskov". From the boat, the coastal line was fully surveyed with outings to the shore during overnight stays and ship lay-offs during strong gale winds. At this time, small species of birds were taken into account, it is impossible to count and determine which from a boat even when using binoculars. The survey of coastal birds was carried out using 12x binoculars throughout the entire period of the vessel's movement along the coast.

The Mongolian Gull, like other species of coastal birds of Lake Baikal, assimilates water areas with depths of up to 10 m during the search for food. At the same time, the depth of the lake is very sharp and the zone of coastal shallow waters is insignificant here. According to N.G. Skryabin’s [23], it is only about 7.0% of the entire area of this huge lake, i.e. the area that birds can effectively master during the feeding period is very limited, which requires them to constantly stay at the edge of the coast. During the work on this section of Lake Baikal, 122 sightings of the Mongolian gull were recorded, and only one was recorded at a distance of 1500 m from the vessel. The average longest detection distance of the Mongolian Gull, found far from the coast, calculated as the geometric mean of all encounters [18], is from 171.8 m to 235.3 m. Exploring the coastal strip of 2 km (from one side 500 m for a detailed survey of the coast , and from another 1500 m of the water area of Lake Baikal), we actually count all birds, carrying out their absolute count. Occurrences of gulls at a greater distance are rare and were observed by us when crossing the lake Baikal from one coast to another (once in 7 crossings) before the storm. At a distance of about 10 km from the edge of the cape near Babushkin, 6 flocks of Mongolian Gulls were recorded, among which single individuals of the Common Gull *Larus canus* and Heuglin’s Gull *Larus heuglini* were recorded. The birds kept in flocks on the water, gradually moving in short flights to the opposite shore.

The calculation of the average density of the bird population was carried out on the basis of general recommendations for counting birds by route method [20]. For seated and flying birds, it was carried out separately, and then the data obtained were summed up. The average speed of the research vessel was 17.0 km / h, and when counting on the shore, the speed of the surveyor was taken equal to 3.0 km / h. The width of the

counting strip was determined on the basis of the geometric mean of all the detection distances of the Mongolian Gull. The error in determining the population density of the species under study is well related to the number of its meetings during the period of census work. To obtain an acceptable error value, it is necessary to have 15-20 sightings of each bird species. In such cases, it is equal to 0.3 ind./km^2 and this accuracy is sufficient if the average density of the bird population is a whole number (from 1.0 ind./km^2 and more).

The total length of the survey routes for the period of work was 577 km and their scheme is shown in the figure. At the initial stage of the work, a census of birds from the r.p. Listvyanka to the town of Slyudyanka, and then, under the other bank, a route was laid to the towns Baikalsk and Babushkin, and further to Selenga river delta (Proval Bay). During periods of severe storms, the ship defended at night in the Bolshaya Goloustnaya river delta and twice at the Buguldeiki mouth of the river (once a day). The peculiarities of the species distribution over the area and on Lake Baikal are given according to the latest reports from Russia and Siberia [4, 21-22].

Results

Characteristics of habitats of coastal birds of Lake Baikal is given by N.G. Scriabin's [23] and he distinguishes two groups of stations characteristic of this lake. **The first group of stations is the open deep-water part of Lake Baikal.** It covers a part of the lake with depths of more than 10 m, and its area is about 93.0% of its entire water area. However, in the life of coastal birds, this part of it is practically irrelevant [23]. Some species of birds are found here only occasionally, but the reasons for their appearance are usually accidental (rest during migrations). **The second group of stations includes the coastal shallow waters of Lake Baikal, with an adjacent strip of the coast.** In this group of stations, there are three well-defined habitats (stations) of coastal birds:

1. Coastal open water area of Lake Baikal. This is a strip of shallow waters (with a depth of less than 10.0 m), encircling, only occasionally interrupting, the deep-water areas of the lake. Along the western coast of the lake, it is well pronounced in the southern part of the Maloe More Strait and in the gubs of the Olkhonskiye Vorota. However, along the eastern coast, bordered by the narrow Baikal plain, it is well developed. The distribution of birds is often determined by the prevailing winds - they concentrate on the leeward side of large headlands. This type of habitat is very poor in vegetation, but rich in animal food, especially on stony soils [5, 23].

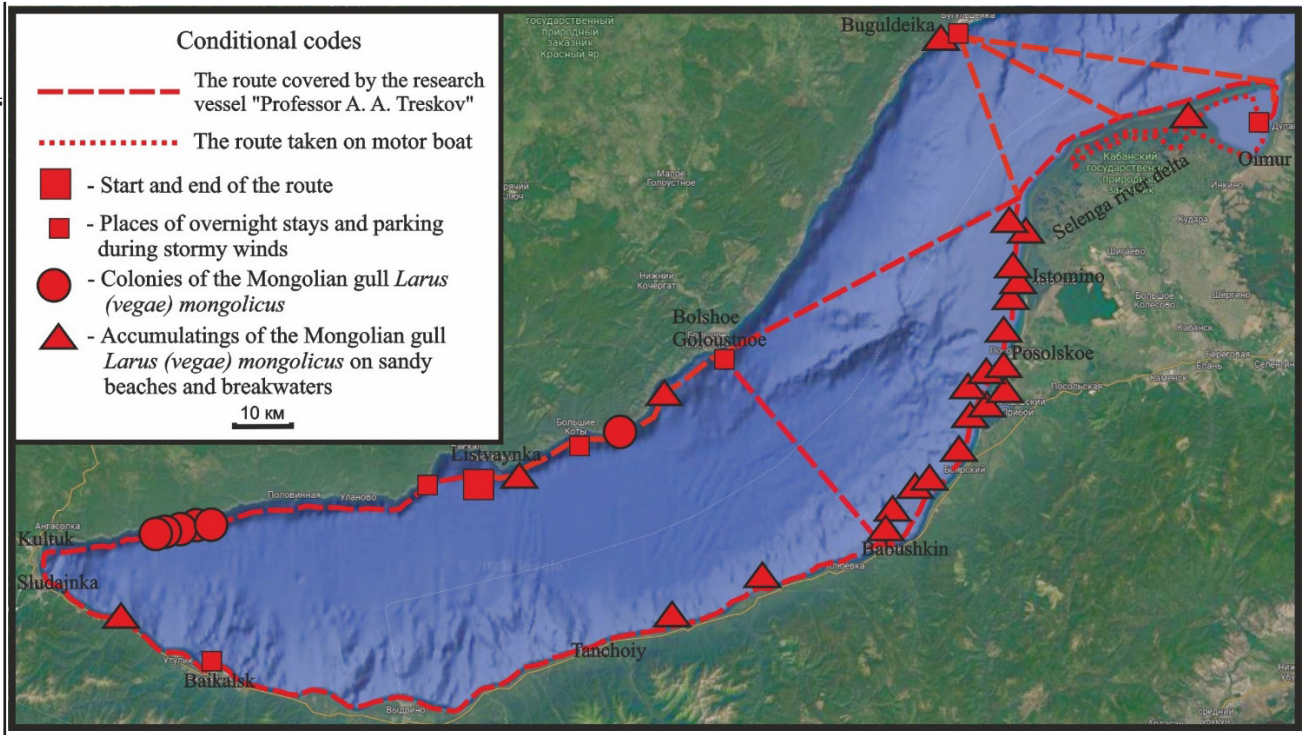

Figure. Sections of the Lake Baikal coastline surveyed with the SRV “Professor A.A. Treskov” at the end of July-beginning of August 2021

2. Shallow, closed and sheltered lips and bays. This station includes only internal parts of the lips and bays closed from the influence of wind and waves. In terms of habitat, they somewhat resemble lakes and, especially, litters. There are no such stations on the western coast of South Baikal, but on the eastern coast they are noted at the mouths of rivers flowing into it. On the western coast of Middle Baikal, they are more common, but they are found in rare spots in areas with a strongly indented coastline. They are characterized by good development of submerged aquatic vegetation and animal feed [5, 23].

3. Sections of the coast with rocky, steep shores. This station is typical for the entire southwestern coast of Lake Baikal. Usually these are clamps, scree and cliffs, steeply descending to the water of the coast. They are covered with rare trees of Common pine *Pinus silvestris*, Siberian pine *Pinus sibirica* and Siberian larch *Larix sibirica*, Drooping birch *Betula pendula* and shrubs: Dog-rose (rose hip) *Rosa acicularis*, Spirea average *Spirea media*, Cotoneaster brilliant *Cotoneaster lucidus* and Black cotoneaster *Cotoneaster malanocarpa* and, very rarely, Altai honeysuckle *Lonicera altaica* [23]. This station is rare on the east coast.

The Mongolian Gull dominates the coast of Southern Baikal everywhere and the average density of its population is 16.0 ± 0.1 ind. / km^2 or 48.2% of the total number of birds [11]. The main colonies of this species are located here on a small area of very steep rocky slopes-capes (from 144 km of the Circum-Baikal railway to the Piylovka station). Here, five colonies from 8 to 25-50 nests were counted, the largest being 60 nests located on rocky cliffs protruding towards Lake Baikal, covered with petrophilic vegetation. The actual size of the colonies during the period of mass nesting of birds was undoubtedly larger. However, during the census period, a significant part of the birds stopped nesting, although many of them still kept in the areas of the colonies. At the end of July, there were already single young birds that had risen “on the wing”, but most of them had not yet flown and kept on the water at the foot of the rocks occupied by nests. In addition, Mongolian Gulls were observed still incubating clutches. In recent years, such cases, characterized by high mortality of clutches as a result of “compulsive” (unmotivated eating of eggs and downy chicks of their own species) predation [9-10, 12-13], are not uncommon. Repeated and also third attempts at nesting of individuals that have lost their first clutches on Lake Baikal are a common event [11, 13-14].

The distance between the colonies ranges from 500 to 800 m and, in principle, they can all be considered as subcolonies of one large settlement of the Mongolian Gull (fig.). A similar small colony of this species (8 nests)

was recorded on the western bank of the Baikal near the Chayachye rock or Devil's bridge (near the village of Bolshiye Koty). On the eastern shore of Lake Baikal, no colonies of gull birds were found even in Selenga river delta. The main reason for this is the sharp rise in the water level as a result of prolonged rains and the melting of snowfields in the mountains. The entire lower and main parts of the middle delta were flooded.

However, along the entire eastern coast of South Baikal, there were common accumulations of these birds, resting on sandy beaches or breakwaters protecting the railway track of the East Siberian Railway from erosion (fig.). All species of large gulls and the great cormorant *Phalacrocorax carbo* fed here, which indicates a high abundance and availability of food resources. The sizes of aggregations varied significantly and in the Mongolian Gull varied from 20 to 320 birds. They were located in areas inaccessible to humans - quite far from settlements (10.0 km or more). It is characteristic that such clusters in the Selenga river delta, common here earlier on hags and in the mouths of large channels, we did not observe this season. It is clearly seen that all the flocks of resting birds were located in areas inaccessible or remote from human settlements.

Under normal conditions, the Mongolian Gull nests in these places as well. In this part of the Posol'skiy sor and the Selenga river delta has large colonies (up to 250-300 nests) of this species. A large number of birds found during the survey period (fig.) Indicates that the Mongolian Gull began to nest here, but its colonies were flooded during the flood. At the same time, the high concentration of birds underlines the significant abundance of food in this part of Lake Baikal at the end of summer. Undoubtedly, birds that lost their clutches in the first half of the nesting season and did not start re-nesting in other places are concentrated here.

Nesting colonies of this species on South Baikal were located in the areas of large settlements - the town of Slyudyanka and the village of Kultuk. This indicates that most of the birds in this part of the lake use anthropogenic forages to feed their chicks. Numerous works and our special studies show that all species of coastal birds nest in the maximum proximity to the main source of food [6-10, 13]. Consequently, the absence of colonies in places of food concentrations of birds indicates a lack of areas here that are well protected from predators and, above all, humans. On both banks along the edge of the lake Baikal is crossed by railways, there are a large number of small stations and there is a large flow of tourists. That is why all the colonies are concentrated on South Baikal in one place, where steep areas, which are difficult to reach even for humans, often with outcrops of rocks, provide the birds with safe nesting. Birds escape from smaller

terrestrial predators, using special defensive reactions - aggressive diving raids, often ending with a blow of the predator with a bend of the wing, paw or beak. At the same time, for the main part of the birds, intimidating raids with a characteristic cry and spraying with caustic foul-smelling droppings are more characteristic.

Judging by the number of chicks on the water in the area of nesting sites, the breeding success of birds was very low - from 10.0-15.0% to 20.0-25.0% of the eggs laid in different colonies. The same is noted by other authors [17-18]. Earlier, a significantly higher breeding success of this species was observed here. A survey of a small colony that existed on South Baikal in the 70s of the last century [2-3] in the 80s showed a high reproductive success of the species - 1.3-1.5 chicks per pair (own unpublished data) and it was underestimated by us, since at the time of the survey the first chicks had already risen on the wing and left the colony. The accumulations of young birds in the bay near the village of Kultuk, found by us at that time, most likely belonged to individuals from this colony.

The high breeding success of the Mongolian Gull at this time was also noted by other researchers - up to 1.89 fledglings per pair [15-17]. At present, the breeding success of the species is minimal. According to the literature, in a number of large colonies of the Maloe More Strait, where it is the most abundant species, the nesting success of the species did not reach 0.1 chicks per breeding pair [18]. A significant drop in the reproductive potential of this species in the modern period is confirmed by the observations of other authors [14, 19]. The same authors point to the obvious starvation of chicks and confirm the wide development of cannibalism in the Mongolian Gull directed at young birds [19]. The development of this phenomenon was previously traced by us in the Selenga river delta, but in the second half of the XX century it was not widespread [7-10, 12-13]. Now it is the usual feeding strategy of large gulls and, first of all, the Mongolian Gull [18]. Additional evidence of mass starvation of birds during the nesting period is the change in the ratio of different types of food. Earlier, at the beginning of the nesting season, aquatic insects were found in the feed of this species, and locust at the end of the nesting season, but fish clearly predominated [24-25]. At present, the share of insects in the diet of this species has increased sharply, and fish has significantly decreased [14, 19].

The strong overfishing of fish, which has been observed in recent decades, has greatly reduced the abundance of forage resources of the Mongolian Gull. The feeding situation has deteriorated sharply and due to the massive appearance on the lake Great Cormorant lake Baikal. The Mon-

golian Gull is not capable of active fishing and is a gatherer, i.e. picks up weakened, sick, heavily worm infested and dead fish from the surface of the water. At the same time, she masterfully pulls fish out of the nets, and this feeding method was most often observed among the large species of gull birds of Lake Baikal. Young birds quickly mastered it, imitating adult experienced individuals. The massive development of network fishing and the high availability of very cheap Chinese-made nets contributed to the rapid depletion of fish stocks in the lake Baikal.

Discussion

The Mongolian Gull is one of the most numerous bird species of Lake Baikal, found almost everywhere. At the same time, the species structure of birds in the immediate coastal area of Lake Baikal is rather limited, and only a few species reach high numbers here [11]. A high abundance and diversity of birds is characteristic of the entire Baikal basin (from the water's edge to the peaks of the highest mountain ranges surrounding the lake), and its water area is rather poor. The main reason for this is the very large depth and very small area of shallow waters (up to 10 m) - only 7.0% of the entire area of its water area. Despite the very high productivity of the lake pelagial and benthal [5], these forage resources are practically inaccessible for birds. Their main consumers are fish of various species [11]. In order to use their resources, a very high specialization of birds is required for active fishing in the water column.

There are very few such species of coastal birds, and on the lake Baikal, their species structure is limited. It includes several species of Merganser *Mergus sp*., Great cormorant, Hump-nosed scooter *Melanitta deglandi*, Black-throated *Gavia arctica* and Red-throated *G. stellata* loons, as well as several species of animal-eating diving ducks. All these bird species use depths up to 10 m, i.e. only 7.0% of its water area. Their number, with the exception of the great cormorant and mergansers, is low, and diving ducks prefer to use even during the periods of migration of the lakes and litter of river estuaries. South Baikal is one of the deepest basins of the lake, in which the area of shallow waters is very limited, especially along the southwestern coast, where often sheer cliffs break into the water and great depths are located right next to the coast.

In this regard, the high abundance of the Mongolian Gull requires a special discussion. First of all, it is an omnivorous species with a very wide range of stations used. However, it is incapable of actively catching live prey if it is not in extreme situations that limit its activity [8]. At the same time, a strong, even powerful beak creates the prerequisites for its use in killing and cutting prey. Therefore, the Mongolian Gull is able to use almost

any available food for food, often collected in the vicinity of human settlements and at tourist camps. The composition of her feed and the methods of obtaining them are unusually wide. This is facilitated by the high level of elementary intellectual activity of this species [7-13]. He, in certain circumstances, easily switches to cannibalism and can overcome the evolutionary prohibition on the use of conspecific individuals for food.

Depending on the current situation, the Mongolian Gull (as well as all species of large gulls) is able to learn to kill weaker individuals of its species, and “compulsive” predation underlies the main part of its specialized feeding strategies. More difficult is the transition to "sophisticated" predation, when birds begin to kill and eat weaker individuals of their species. Nevertheless, some individuals quite easily overcome the species stereotype of behavior, which prohibits the use of individuals of their own species for food. The initial prerequisite for this is the often repeated short-term starvation of birds (2-3 days each) during periods of stormy winds on Lake Baikal. On such days, in the colonies of all species of large gulls, a large number of downy chicks die from hunger and hypothermia. After the end of the storm in the surveyed colonies of gulls there are a lot of their corpses, but after one and a half to two hours all of them are collected and eaten by birds prone to cannibalism [7-13].

Conclusion

At the heart of the high number of Mongolian gulls on the lake. Lake Baikal has a high lability of the feeding behavior of the species associated with its omnivorousness, up to the use of plant feed for food (grain products in poultry farms with semi-free content of poultry). The composition of its food is very diverse (from plant to animal) and it easily adapts to living next to humans. A high level of elementary rational activity and the ability to solve non-ordinary tasks, along with a strong and sufficiently powerful beak and large sizes that allow butchering corpses, makes it possible to easily overcome the ban on the use of individuals of their own species for food. In this regard, cannibalism is one of the widespread feeding strategies of the species under conditions of an acute shortage of basic forages. That is why this species in the modern period retains a high number, and the complex age structure allows it to maintain a sufficiently high abundance for a long time in unfavorable environmental conditions.

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DOI 10.34660/INF.2021.47.48.015

ON THE ROOT PROBLEM IN SOME CONSTRUCTIONS OF ARTIN GROUPS

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Abstract. An algorithm for solving the root problem in a tree product of Artin groups with a tree structure and extra-large type is considered.

Keywords: Artin group, tree structure, extra-large type, root problem, diagram.

Consider a group

$$\breve{G} = \langle \sigma_1, \dots, \sigma_m; < \sigma_i \sigma_j >^{m_{ij}} = < \sigma_j \sigma_i >^{m_{ji}}, i, j = \overline{1, m}, i \neq j \rangle,$$

$< \sigma_i \sigma_j >^{m_{ij}}$ – a word from m_{ij} sequentially taken generators

$\sigma_i, \sigma_j, i \neq j, m_{ij}$ – numbers that are elements of the Coxeter matrix [1].

At $m_{ij} > 3$ for arbitrary, unequal indices, we have an extra large type $\breve{G}$ [1].

If the graph in the image $\breve{G}$ is a tree, then we obtain a tree structure [2].

Consider further the following construction:

$$G = \langle \prod_{k=1}^{p} * G_k; \sigma_{i_t}^{\alpha_{i_t}} = \sigma_{j_s}^{\alpha_{j_s}}, i, j \in \{\overline{1, p}\}, i \neq j \rangle,$$

which is the product of G_k having a tree structure or extra-large type, where $\sigma_{i_t}^{\alpha_{i_t}}$ – is the degree of the generator G_i, $\sigma_{j_s}^{\alpha_{j_s}}$ – is the degree of the generator G_j.

In the factors of this construction, the problems of identity (equality) and conjugacy are solvable [1]-[3].

Consider diagrams over a construction G. The conjugacy of elements will be denoted by the symbol ~.

Theorem 1. The *R*-diagram of the conjugacy of non-powers of generators of cyclically R, $\bar{R}$ – irreducible elements of G is one-layer.

The *R*-diagram of the equality of non-powers of the generators of R, $\bar{R}$ -irreducible elements of G is one-layer.

The proof of the theorem is similar to the proof presented in [3].

The *R*-diagram of the conjugacy of elements that are cyclically *R* and $\bar{R}$ -irreducible is called especially special [2] when there is a single region for which the syllable length of the intersection mark with one of the boundaries by 2 units differs from the syllabic length of the intersection mark with the other of the boundaries. We get that on one of the boundaries the syllable length of the element is less than on the other. Then the replacement of an element with a shorter syllable length is called a special annular contraction [2].

Definition 2 [2]. An element is called dead-end if the special annular cancellation is not applicable to it.

It is possible to construct an algorithm that establishes for any element whether it will be a dead end, which follows from [1] - [3].

Lemma 2. If two dead-end elements are conjugate, then their syllable lengths are equal.

Indeed, if one of the dead-end elements has a large length and is conjugated to a given one, then the abbreviations defined above can be performed in it. This can be easily seen in the contingency diagram of the elements.

Lemma 3. The construction G is torsion-free.

The proof follows from the fact that if an element of G is of finite order, then it must be conjugate to an element of finite order of some factor, but it follows from [4], [5] that the factors are torsion-free. Consequently, it is absent in the construction under consideration.

Lemma 4 [6]. Given a cyclically R, $\bar{R}$ -irreducible nontrivial element *u*, then there exists an element *v*, for which every power of R, $\bar{R}$ -irreducible, and $v \sim u$, or $v \sim u^2$.

Definition 3 [4]. Problem 1 is understood as the problem of constructing an algorithm that determines whether one element is a nonunit power of some other element.

Theorem 2. In the construction of *G*, Problem 1 is algorithmically solvable.

Lemma 5 [4]. Problem 1 is solvable in tree-structure factors of the construction *G*.

Lemma 6 [5]. Problem 1 is solvable in factors of construction *G* of extra-large type.

Let us proceed to the proof of the theorem.

First of all, note that Problem 1 is solvable in the factors of *G* on the ba-

sis of Lemmas 5 and 6. Therefore, we will consider the general case when there are at least two factors.

Suppose that in the construction *G* under consideration for some elements $u^n,\ w$ the equality

$$u^n = w. \tag{1}$$

Let us square both sides of equality (1). We get

$$(u^2)^n = w^2. \tag{2}$$

Carrying out the necessary cancellations *in u* we replace it with an element u_0 in accordance with Lemma 4 so that any degree u_0 $R,\ \bar{R}$ -irreducible. Then equality (2) takes the form:

$$u_0^n = z^{-1}w^2z. \tag{3}$$

The element $z^{-1}w^2z$ is equal to some $R,\ \bar{R}$ - irreducible element w_0. Equality (3) takes the form:

$$u_0^n = w_0. \tag{4}$$

Consider the diagram of equality of elements u_0^n, w_0, corresponding to (4).

Thus, *M* - is a simply connected diagram as in [3] with a boundary cycle $\partial M = \sigma \cup \delta$, where $\varphi(\sigma) = u_0^n$ and $\varphi(\delta) = w_0$.

By Theorem 1, this diagram will be one-layer. It follows from this that the number of regions having an exit to σ and δ is the same. The edges with an exit to δ are at most than the syllable length of the word v_0 $(||v_0||)$. The number of vertices cannot exceed $|v_0| + 1$. Therefore, the number of regions is limited by the exponent $k = ||w_0|| + \left||w_0|\right| + 1 = 2||w_0|| + 1.$

We have $n < ||u_0^n|| < k||r|| \le (2||u_0|| + 1)||r||,$ where r – is the longest defining relation, its length is not greater than the number $||w_0|| + ||u_0|| + 2$. Hence $n < (2||u_0|| + 1)(||w_0|| + ||u_0|| + 2).$

In the case when the diagram consists of disks and simple paths connecting them, the proof of the theorem is obvious.

Thus, the exponent can be limited, and this provides a solution to Problem 1.

Definition 4 [5]. Problem 2 is solvable in a group if, for any of its elements *u*, it is effectively established that there exists a non-trivial natural number *n* and an element *x* satisfying the equality $x^n = u$.

Theorem 3. Problem 2 is solvable in the construction of *G*.

The proof of this theorem follows from the validity of Theorem 1 in the construction *G*.

Corollary 1. In the construction of *G*, any sequence of subgroups generated by one element is stabilized.

The construction *G* considered in this paper is a generalization of the constructions presented in [3], [6]. Indeed, the author considers the union of groups by subgroups generated by the degrees of the generators of the corresponding groups, in the case when the exponents of these degrees are equal to zero, the groups from [3], [6] are obtained. And, therefore, problems 1, 2, 3 considered in this paper are solvable in them.

Definition 5 [6]. Problem 3 is understood as the problem of the existence of an algorithm that, for any two elements of a group that do not belong to the same cyclic subgroup, finds an integer *n* such that the *n*-th power of one element is conjugate in the group to another element.

Theorem 4. Problem 3 is solvable in the construction of *G*.

The proof repeats the proof of Theorem 3 from [6], since, based on Theorem 1, the diagrams have a structure similar to the diagrams considered in [3] of groups.

In this paper, the study of Artin groups by geometric methods is continued. Note that the main algorithmic problems, which include the identity (equality) and conjugacy problems, follow from [7], but the algorithms are cumbersome and more complicated than those proposed in [3]. In the further study of Artin groups, one can consider similar constructions, where other well-known classes of Artin groups, for example, of large or finite type, are taken as factors.

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DOI 10.34660/INF.2021.15.15.016

HEAT PRODUCTION DURING DEFORMATION OF INHOMOGENEOUS BODIES

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Abstract. A model of a rigid body with internal stresses and is presented, which makes it possible to describe the dissipation of energy when changing from the elastic stage of deformation to the plastic one. The dependence of heat release on the heat-physical properties of the contacting structures is noted.

Keywords: internal stresses, thermal conductivity in inhomogeneous media, contact thermal disturbances

In various technological processes of metal processing, residual stresses (internal, intrinsic [1]) are formed, which usually remain in parts after their manufacture. One of the important characteristics of a deformed solid is the strain tensor [2].

$$\varepsilon_{ij} = \hat{g}_{ij} - \mathring{g}_{ij} \quad (1)$$

which is introduced as a result of comparisons of two states of the body: the data considered by $\hat{g}_{ij}$ and the "initial" $\mathring{g}_{ij}$. There are theories in which the "initial" state is taken to be a state that is not really realized. This is the case when the metal solidifies and as a result of preliminary plastic deformation. Then, we can write down

$$\varepsilon_{ij} = \varepsilon_{ij}' + \varepsilon_{ij}^{*} \quad (2)$$

where ε_{ij}' is expressed in terms of displacement and satisfies the deformation compatibility equations, and ε_{ij}^{*} - is not expressed through displacement and, generally speaking, does not satisfy the conditions of compatibility. The tensor components ε_{ij}^{*} describe the "initial" deformed state. It is easy to see that the internal metric ε_{ij}^{*} can be Euclidean only in the absence of internal stresses [3]. Therefore, ε_{ij}^{*}, describes the incompat-

ibility of deformation and generates internal stresses [3].

The influence of residual (internal) stresses on strength under static and dynamic loads is known [1], the presence of internal stresses is unknown to us. In this paper, it is proposed to consider the features of heat generation during deformation of metals, taking into $\varepsilon\varepsilon_{ij}{}^{*}$unt internal stresses.

Approximate solution of some problems of heat conduction in contact with bodies with different thermophysical properties.

The formation of an inhomogeneous (granular) structure of metals in various technological processes occurs in different ways. Their occurrence is usually based on irreversible volumetric changes in the material. Therefore, in practice, problems are often encountered associated with the calculation of thermal conductivity in an inhomogeneous medium. The solution of such problems associated with the stepped behavior of the thermal diffusivity depending on heating and cooling [1] is fraught with great difficulties. In this regard, it is advisable to consider approximate methods for solving the heat equation based on the satisfaction of integral relations.

The process of thermal conductivity in a material is described by the Fourier equation:

$$\frac{\partial T}{\partial t} = \frac{\lambda}{c\gamma} \times \frac{\partial^2 T}{\partial \gamma^2}$$

T-temperature, λ-coefficient of thermal conductivity, c- heat capacity of the material, γ- density.

As a boundary condition, we will consider the heat flux on the wall, that is, boundary conditions of the second kind. For a semi-bounded body and a constant heat flux q_λ, going to heat the material, we write approximately the temperature profile in the form of a quadratic parabola.

$$T - T_0 = \frac{q_\lambda}{\lambda} \frac{(\delta_\lambda - y)^2}{2\delta_\lambda} \tag{3}$$

δ_λ - material heating thickness, T_0- the initial temperature of the material, in what follows we will assume $T_0 = const = 0$.

Let us integrate (2) within $0 \le y \le \delta_\lambda$ taking into account the boundary condition:

$$q_\lambda = -\lambda \frac{\partial T}{\partial y} \tag{4}$$

$$\frac{d}{dt} \int_0^{\delta_\lambda} T dy = \frac{q_\lambda}{\rho c} \tag{5}$$

We integrate (5) over time and substitute approximation (3) into (5), we obtain:

$$\int_0^{\delta_\lambda} q_\lambda \frac{(\delta_\lambda - y)^2}{2\delta_\lambda} dy = q_\lambda t\alpha \quad (6)$$

Where $\alpha = \frac{\lambda}{\rho C_v}$ – thermal diffusivity coefficient. From (6) we determine the heating thickness:

$$\delta_A = \sqrt{6\alpha t} \quad (7)$$

Thus, the temperature profile is described by the expression:

$$T(y,t) = \frac{q_\lambda}{\lambda} \frac{\left(\sqrt{6\alpha t} - y\right)^2}{2\sqrt{6\alpha t}} \quad (8)$$

The exact solution to this problem [4]

$$T(o,t) = 2\frac{q_\lambda}{\lambda}\sqrt{\frac{\lambda t}{\pi}} \quad (9)$$

The error does not exceed 9%, which is acceptable for applied tasks.

Now let us consider the process of thermal conductivity in the presence of contact between different materials. The process of thermal conductivity in material "1" does not depend on the thermophysical properties of material "2" and vice versa.

Consider the contact of two plates of finite thickness with different thermophysical characteristics (Fig. 1).

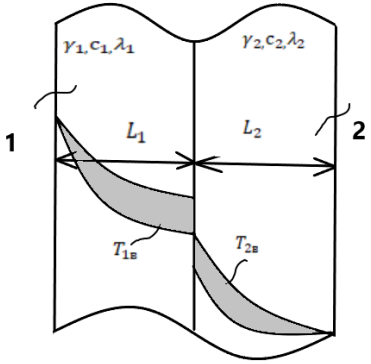

Figure 1. Temperature profile near contact surfaces

Let the temperature distribution function in material 1 $(0 \le y \le l_1)$ be the same as that of a semi-bounded body. Let us assume that the boundary conditions on the wall change in such a way that a constant flow q_∞ acts on the contact line for a certain time interval Δt.

The origin of q_∞ is explained by the existence of internal stresses δ^*

in the material and the coefficient of friction f of the contact planes (Coulomb's Law).

Then the temperature of the contacting surfaces at the end of the time interval Δt will be

$$\Delta T_1 = \frac{q_\lambda}{2\lambda_1}\sqrt{6\alpha_1 \Delta t}$$

$$\Delta T_2 = \frac{q_\infty}{2\lambda_2}\sqrt{6\alpha_2 \Delta t} \quad (10)$$

It follows from (10) that for $\frac{\sqrt{\alpha_1}}{\lambda_1} \neq \frac{\sqrt{\alpha_2}}{\lambda_2}$ (11)

There will be a temperature gap on the contact line.

In reality, of course, there is no temperature gap. Consequently, the assumption about the mutual independence of thermal conductivity upon contact of different materials is not true, since the following conditions must be met on the contact line:

$$\mathrm{T}_1 = \mathrm{T}_2$$

$$\lambda_1 \frac{\partial T_1}{\partial y} = \lambda_2 \frac{\partial T_2}{\partial y} \quad (12)$$

Then we represent the temperature in the vicinity of the contact line as a sum:

$$\mathrm{T}_1 = \mathrm{T}_{1\infty} - \mathrm{T}_{1\mathrm{в}}$$

$$\mathrm{T}_2 = \mathrm{T}_{2\infty} + \mathrm{T}_{2\mathrm{в}} \quad (13)$$

$\mathrm{T}_{1\infty}$, $\mathrm{T}_{2\infty}$ temperatures without taking into account mutual influence, calculated for a semi-infinite space;

$\mathrm{T}_{1\mathrm{в}}$ and $\mathrm{T}_{2\mathrm{в}}$ – temperature components due to the mutual influence of materials on thermal conductivity (contact disturbances).

Based on the conditions of the heat balance, it is necessary that the equality is observed: (Fig. 1)

$$-\mathrm{c}_1\gamma_1 \int_0^{L_1} \mathrm{T}_{1\mathrm{в}} dy + \mathrm{c}_2\gamma_2 \int_{L_1}^{L_1+L_2} \mathrm{T}_{2\mathrm{в}} dy = 0 \quad (14)$$

Hence it follows that the temperatures of contact disturbances should have opposite signs (13), and the heat fluxes of contact disturbances $\mathrm{q}_\mathrm{в}$ are equal and mutually opposite (Fig. 1). As applied to the example (Fig. 1), we have

$$\mathrm{q}_\mathrm{в} = -\lambda_1 \left(\frac{\partial T_{1\mathrm{в}}}{\partial y}\right)_{L_1} = \lambda_2 \left(\frac{\partial T_{2\mathrm{в}}}{\partial y}\right)_{L_1} \quad (15)$$

Thus, taking into account the mutual influence of contacting materials

is reduced to determining the magnitude of the heat flux of the contact disturbance $q_в$. From (10), (12), (13) we get:

$$\frac{(q_\infty - q_в)}{2\lambda_1}\sqrt{6\alpha_1 \Delta t} = \frac{(q_\infty + q_в)}{2\lambda_2}\sqrt{6\alpha_2 \Delta t} \quad (16)$$

From (16) we define

$$q_в = q_\infty \frac{1-k}{1+k} \quad (17)$$

$$k = \sqrt{\frac{c_1\gamma_1\lambda_1}{c_2\gamma_2\lambda_2}} \quad (18)$$

You can name the k-coefficient of thermal activity of the material "2" in relation to the material "1". Relation (17) was obtained with a constant heat flux on the contact line. Since the equation of thermal conductivity is linear, the obtained relation is valid for any law of change on the contact surface.

It follows from (17) that the magnitude of the thermal contact disturbance depends on the ratio of the thermophysical properties of materials (contacting grains with different internal stresses, etc.)

At k=1, $q_в$=0 — there are no thermal disturbances, the material is thermophysically homogeneous.

If k<1, then $q_в$>0, which means that material "2" has a cooling effect on material "1".

At k=0 - corresponds to absolute cooling.

If k>1, then $q_в$<0 - in this case material "2" turns out to be a heat insulator.

k=∞ corresponds to the absolute heat insulator. The heat flux on the contact line will be zero. There is a complete reflection of the undisturbed heat flux from the line of contact with the absolute heat insulator, and this reflected flux goes to heating material "1". At 1<k<∞ only partial reflection takes place, that is, a part of the thermal energy arriving at the contact surface goes to heating material "2" by thermal conduction.

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DOI 10.34660/INF.2021.12.67.017

PEROXIDE CELLULOSE FROM HEMP

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Abstract. Crushed hemp fibers (Cannabis sativa) was delignified with the reaction mixture "acetic acid - hydrogen peroxide - sulfuric acid catalyst - water" at a sulfuric acid concentration of 0.45% and a temperature of 85°C. with low fluid module 3.The influence of the initial concentration of hydrogen peroxide in the cooking solution (in the range 3 ... 5 g-mol/l) and the duration of the process (in the range 90 ... 180 min) on the yield and strength properties of technical cellulose has been studied. With a yield of 78 ... 90% and a degree of grinding of 36 ... 38°SR, the cellulose had a breaking length of up to 5.4 km, a fracture resistance of more than 140 double bends and a very high tear resistance - more than 1800 mN. Due to its high strength characteristics, peroxide cellulose from hemp fibers can be used in composition with other fibrous semi-finished products in the production of various types of paper and cardboard products.

Keywords: hemp, fibers, cellulose, delignification, hydrogen peroxide, peracetic acid, cellulose strength

During decortication (mechanical, chemical or biological treatment of hemp straw), two types of fibrous products are obtained - shives and fibers. Both types of fibers can serve as raw materials for the production of paper and cardboard products, but the technologies for their processing are different.

We reported earlier about the delignification of hemp shives with peroxo compounds and the properties of the resulting cellulose [1]. The chemical composition of fibers has a number of characteristics. Table 1 shows the results of a number of analyzes performed by conventional methods [2]:

mass fraction of cellulose - by the Kurschner-Hoffer method, lignin - by the sulfuric acid method in Komarov's modification, extractives - by extraction in a Soxhlet apparatus with an azeotropic ethanol-toluene mixture. Unlike wheat straw and hemp shives, fibers contain significantly more cellulose and less lignin. This makes it possible to reduce the consumption of delignifying reagents - hydrogen peroxide and acetic acid - for cooking. Preliminary experiments have shown that in this case it is advisable to reduce not the concentration of reagents in the cooking solution, but the liquid module during cooking.

Table 1.
Chemical composition of plant raw materials

Vegetable raw material	Mass fractions of components in raw materials,%			
	cellulose	lignin	extractive substances	ash
Wheat straw	46.6	22.0	1.22	5.37
Hemp shives	41.2	23.4	4.64	1.10
Hemp fibers	71.2	5.35	0.32	1.75

We have studied the influence of two variable factors of peroxide delignification, the initial concentration of hydrogen peroxide in the cooking liquor and the duration of the process, on the yield and properties of technical cellulose from fibers.

The raw material for the research was hemp fibers of the "Surskaya" brand, the chemical composition of fibers is shown in table 1.

Hemp fibers were crushed in a dry disc mill. For the experiments, a fraction passed through a sieve with a hole diameter of 8 mm was used.

The prepared fibers were delignified with the reaction mixture "acetic acid - hydrogen peroxide - sulfuric acid catalyst - water". Constant delignification conditions: the initial concentration of acetic acid in the cooking solution is 6 g-mol/dm^3 (36%); sulfuric acid concentration 0.046 g-mol/dm^3 (0.45%); liquid module 3.0; isothermal cooking temperature 85°C.

Variable brewing factors:

X_1 – initial concentration of hydrogen peroxide in the cooking solution (variation range 3 ... 5 g-mol/dm^3);

X_2 – cooking duration (variation interval 90 ... 180 minutes).

The values of these factors varied according to a three-level design of the second-order experiment on the elements of a cube [3] (table 2).

The pulp washed after cooking was ground in a CRA apparatus (Yokro mill) for 19 ... 22 minutes to a grinding degree of 36 ... 40 °SR. Paper casts

of 75 g/m^2 were made on a Rapid-Keten sheet-molding machine. The experimental results were characterized by the following output parameters:

Y_1 –cellulose yield, %;
Y_2 – breaking length, m;
Y_3 – elongation before breaking, %;
Y_4 – bursting resistance, kPa;
Y_5 – tear resistance, mN;
Y_6 – break resistance, number of double kinks.;
The results of the experiments are shown in table 2.

Table 2.
Experimental conditions and results

Mode number	Variable factors		Output parameters					
–	X_1	X_2	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6
1	4	135	80.7	3285	3.11	272	1373	45
2	3	90	84.5	4612	2.75	225	1144	132
3	4	90	89.7	5348	2.87	248	1216	118
4	5	90	81.0	46.71	2.99	241	1295	161
5	3	135	83.1	4687	2.66	225	1177	105
6	4	135	78.5	3244	2.79	262	1570	118
7	5	135	79.2	4249	2.74	226	1857	142
8	3	180	78.0	4036	3.36	226	1393	69
9	4	180	77.9	3790	3.01	228	1236	91
10	5	180	75.8	4389	2.69	209	1425	75
11	4	135	78.5	3455	2.25	190	1465	90

Mathematical processing of the results was performed using the Statgraphics Centurion software package. The dependence of each of the output parameters on variable factors was approximated by polynomial second-order regression equations [3]:

$$\acute{Y} = b_0 + b_1X_1 + b_2X_2 + b_{12}X_1X_2.$$

Regression coefficients are shown in table 3.

Regression equations were used to graphically represent the results in the form of three-dimensional response surfaces [4].

The dependence of the yield of technical cellulose on the variable factors of cooking is shown in Figure 1. As expected, an increase in both factors, the initial concentration of hydrogen peroxide and the duration of the process, leads to an additive decrease in the yield. At the same time, contrary to expectations, the tear resistance of paper castings decreases

almost symbatically (figure 2). This may be due to the removal of hemicelluloses from the fiber surface or partial destruction of the outer layers involved in the formation of interfiber bonds. The contribution of both of these processes to the formation of the paper-forming properties of the fibers is not excluded. An indirect indication of such a possibility can be the complex nature of the dependence of the elongation of paper castings at break on the conditions of delignification (in fact, on the yield of cellulose or the depth of delignification) (figure 3). Of course, these assumptions need more detailed study.

Table 3.
Coefficients and statistical characteristics of regression equations

b_{ij} coefficients and statistical characteristics	Output parameters					
	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6
b_0	192.39	7797	0.4033	158.9	227.3	98.57
b_1	-2.575	-224.8	0.6242	24.8	223.1	29.25
b_2	-0.111	-27.1	0.0188	0.480	4.210	-0.16
b_{12}	0.007	1.63	-0.0050	-0.183	-0.001	-0.13
Coefficient determination, %	72.8	28.2	28.1	18.9	38.1	13.6
Standard error of Ý forecast	2.43	1473	0.290	26.2	193.7	81.4

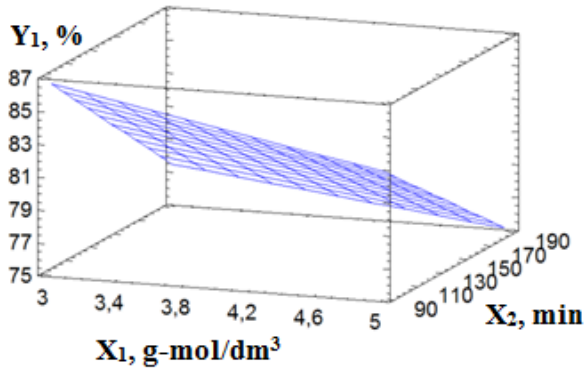

Figure 1. Dependence of technical cellulose yield on cooking conditions

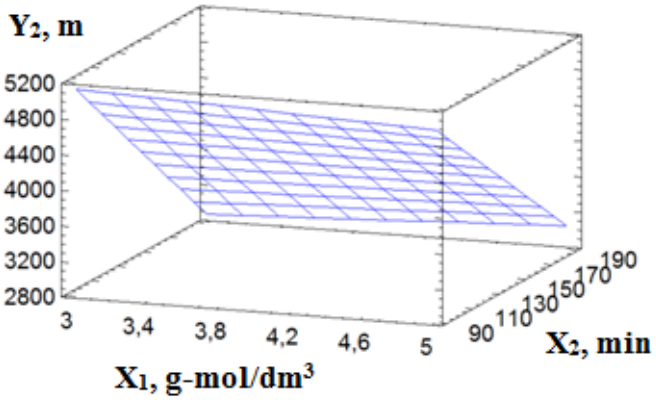

Figure 2. Dependence of tensile strength of paper castings on cooking conditions

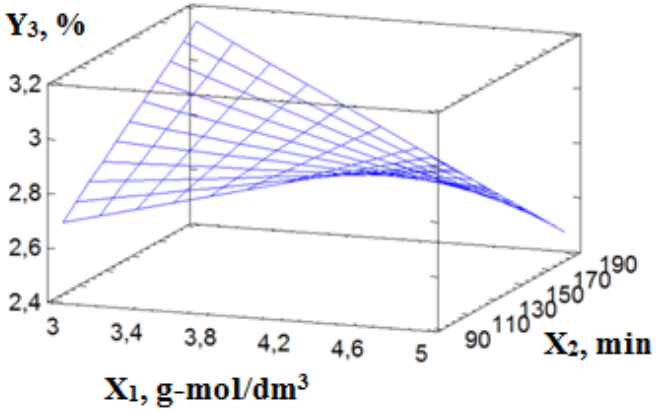

Figure 3. Dependence of elongation of castings at break on cooking conditions

A positive correlation is usually observed between the values of the resistance of a paper sheet to tearing and punching. In the experiment under discussion, this relationship manifested itself as a trend (the linear correlation coefficient is 0.64), which can be seen when comparing figures 1 and 4.

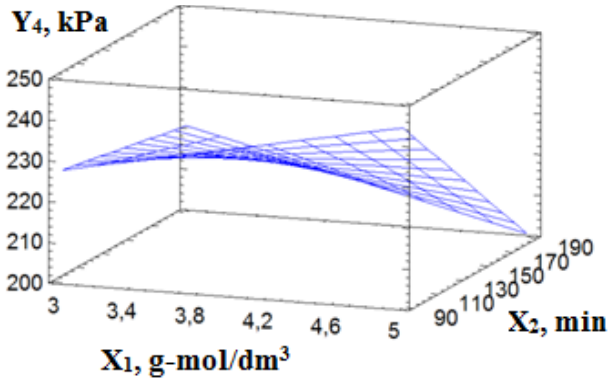

Figure 4. Dependence of resistance of castings to punching shear conditions

The dependence of the resistance of castings to tearing on the cooking conditions is consistent with a priori information on the delignification of the stems of other cereal crops: the value of the indicator increases with the deepening of delignification (figure 5). Note an essential feature of this property in hemp fibers - a very high value of tear resistance, which we have never observed in cellulose from other types of plant raw materials.

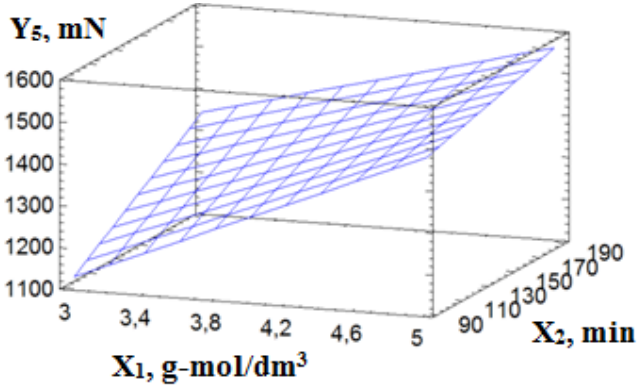

Figure 5. Dependence of the tear resistance of castings on the cooking conditions

There is a weakly expressed correlation between the indicators of resistance to rupture and fracture (figures 2 and 6; the correlation coefficient

is 0.55), which is consistent with the available a priori information on the properties of cellulose from other types of plant materials.

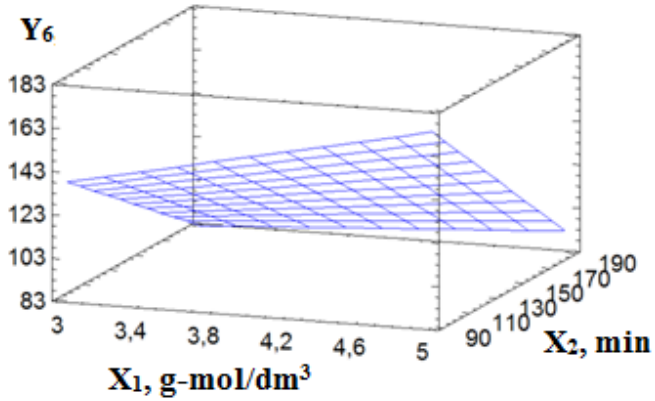

Figure 6. Dependence of the resistance of castings to fracture on the conditions of cooking

Summary. The peroxide delignification of hemp shives can be successfully performed at a low liquid modulus. Engineering design of alkaline delignification methods with modules 2.8 ... 3.2 are used in industrial installations for continuous cooking.

Studies were carried out in the laboratory "Deep processing of plant raw materials" of Reshetnev Siberian State University of science and technology. This work was supported by the Ministry of Science and Higher Education of the Russian Federation within the framework of State Assignment of the "Technology and equipment for the chemical processing of biomass of plant raw materials" project (FEFE-2020-0016).

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DOI 10.34660/INF.2021.75.97.018
UDC 693.55

USING THE PRESTRESSING METHOD IN THE CONSTRUCTION OF BUILDINGS AND STRUCTURES FROM MONOLITHIC REINFORCED CONCRETE

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Abstract. The article deals with the application and development prospects of the method of prestressing reinforced concrete in the construction of buildings and structures for various purposes. Structures made of concrete reinforced with artificially stressed iron are called prestressed. The prestressing method was first developed in the second half of the 20th century by Soviet scientists and became widespread in the construction industry. The main method of tensioning the reinforcement used in the USSR was the electrochemical method of tensioning the reinforcement. After the collapse of the country, the use of the electrochemical method of tensioning the reinforcement had to be abandoned due to the sharp rise in the cost of electricity. The most common method of tensioning reinforcement at present is the mechanical method, in which the concrete is compressed by pre-tensioning the reinforcement laid in the formwork, which tends to return to its original dimensions after the tensioners are removed. The use of the method of prestressing reinforcement in the construction of buildings and structures made of monolithic reinforced concrete can significantly reduce the labor intensity, energy consumption, material consumption of construction production while maintaining the high strength of structures. The prestressing method prevents the formation of cracks in the area of concrete under tension. In addition to a tangible economic effect, the use of prestressing technology can significantly increase the set of architectural and planning solutions in the design of buildings and structures by increasing the length of spans between supporting structures up to 18 m, the ability to create contours of various shapes and horizontal surfaces.

Keywords: reinforced concrete, prestressing, electrochemical tensioning of reinforcement, mechanical tensioning, strength, compression.

Today, there is a tendency towards an increase in the share of monolithic structures in the volume of construction work performed. World construction practice demonstrates that at present it is monolithic construction that is promising in terms of reliability and durability.

Unfortunately, monolithic construction also has disadvantages associated with the use of obsolete methods of building construction, incorrect design decisions and low qualifications of construction workers and line personnel, etc.

Some of the above-mentioned disadvantages of monolithic construction can be eliminated through the use of innovative methods for the construction of buildings and structures designed for the use of prestressed elements.

Reinforcement with iron prevented the destruction of concrete in the event of tensile loads, while the crack resistance of the material still did not reach high values. The crack resistance of reinforced concrete can be increased by prestressing the material at the construction stage, as a result of which the direction of the stress arising in the concrete is opposite to the stress from the load resulting from the load.

Structures made of concrete reinforced with prestressed iron have less sagging and increased resistance to cracking compared to non-stressed ones. This makes it possible to mount building structures with large spans with an equal cross-section of the horizontal beams.

The method of prestressing reinforced concrete was widely used in the second half of the 20th century in the USSR. The country's scientists have developed design methods and technologies for the construction of prestressed reinforced concrete structures. [1]

The annual volume of construction of reinforced concrete structures using the prestressing method was about 30 million cubic meters. m. Widespread in the last century, the method of prestressing reinforcement was the method of electrothermal method.

The destruction of the USSR led to the interruption of the process of widespread use of prestressed reinforced concrete, the volume of construction of structures of this kind decreased tenfold due to the rise in the cost of electricity, which made the use of the electrothermal method of stressing reinforcement unprofitable from an economic point of view.

In modern conditions, the use can find a mechanical prestressing method, the use of which is possible in the production of both prefabricated and monolithic reinforced concrete buildings and structures. When using the mechanical method of creating stress, the concrete is compressed by pre-tensioning the reinforcement embedded in the formwork, which tends

to take its original dimensions after the tensioning devices are removed.

For the production of prestressed reinforced concrete, reinforcement with increased strength is used.

The prestressing of concrete delays the time of cracking, reduces the width of cracks, and increases the service life of building structures.

The use of prestressed reinforced concrete makes it possible to reduce the total weight by about 40 percent and the cost of buildings and structures by 30 percent while maintaining the high reliability of building structures.

In addition to the tangible economic effect, the use of prestressing technology can significantly increase the set of architectural and planning solutions in the design of buildings and structures in connection with the possibility of increasing the size of spans between the bearing elements and the possibility of creating contours of various shapes. [2]

Today the technology is used in the construction of residential and office buildings, industrial facilities, highways and runways in Moscow, St. Petersburg, Yaroslavl, Voronezh, Saratov.

Comparison of the results of evaluating construction indicators using conventional reinforced concrete and prestressed reinforced concrete allows us to make an unambiguous conclusion about the economic efficiency of using the latter (fig. 1).

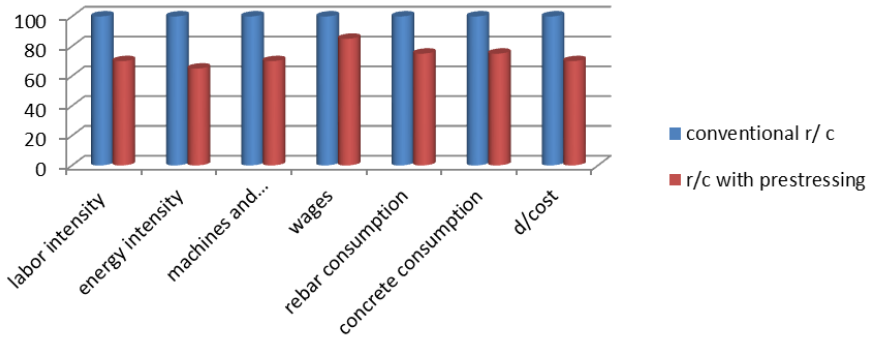

Figure 1. Comparison of the results of assessing construction indicators using conventional monolithic reinforced concrete and prestressed monolithic reinforced concrete

Table 1 shows data confirming the economic feasibility of using structures made of prestressed reinforced concrete. The indicators were obtained by analyzing the data of design estimates. [3]

Table 1. Values of indicators of the resource intensity of construction, per 1 square meter of floor area of monolithic reinforced concrete

Indicator	Project	Purpose of the structure		
		Apartment building [1]	Business center	Shopping center [3]
Rebar consumption	Without prestressing reinforcement and concrete	0.034 tons	0.040 tons	0.051 tons
	With prestressing reinforcement and concrete	0.016 tons	0.019 tons	0.021 tons
Concrete consumption	Without prestressing reinforcement and concrete	0.25 m^3	0.25 m^3	0.35 m^3
	With prestressing reinforcement and concrete	0.23 m^3	0.22 m^3	0.25 m^3
Labor intensity	Without prestressing reinforcement and concrete	2.5 man-hours	2.7 man-hours	3.2 man-hours
	With prestressing reinforcement and concrete	2.5 man-hours	2.3 man-hours	2.4 man-hours
Energy intensity	Without prestressing reinforcement and concrete	5300 Wh	5500 Wh	7100 Wh

Thus, significant savings in resources are evident in the construction of all categories of buildings in the case of using prestressed monolithic reinforced concrete. The use of prestressed monolithic reinforced concrete is justified from both constructive and economic points of view.

Along with saving resources, the construction of buildings and structures using prestressed structural elements can significantly increase architectural and planning solutions.

Today, the technology of prestressing reinforced concrete is used in the construction of various kinds of buildings and structures in cities such as Veliky Novgorod, Voronezh, Saratov, Yaroslavl, however, it is necessary to spread the technology of prestressed reinforced concrete throughout the territory of the RF.

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DOI 10.34660/INF.2021.23.67.019

SYSTEM ANALYSIS OF TECHNICAL AND TECHNOLOGICAL SOLUTIONS OF ELEMENT CONNECTIONS IN FULL-ASSEMBLED CONSTRUCTION IN RUSSIA AND ABROAD

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Abstract. Currently, there has been a significant trend and unique growth in the construction industry, especially in the sector of prefabricated structures due to various advantages, like price, as well as the speed of construction; therefore, new technologies can minimize construction time .

This article discusses the benefits of producing this type of structure, the most common types of joints utilized in it, and the technique of installation.

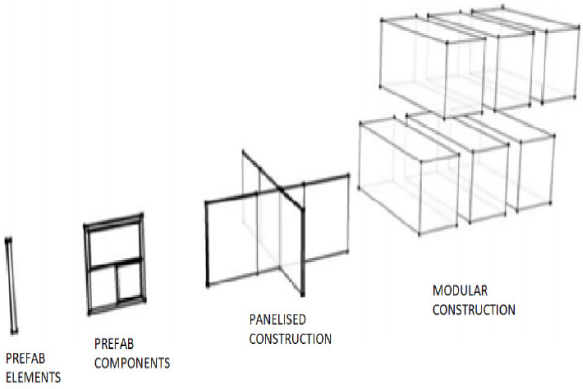
Keywords: Modular building, precast concrete structures, construction, prefabrication, precast connection

Introduction

Modular building is a building technology in which structures are extensively prefabricated off-site by the production of volumetric modular pieces. These room-size pieces are extensively prefabricated with high precision and then shipped on-site for quick assembly. Modular construction, as opposed to a single kind of structure, refers to the use of a range of structural systems and building materials [1]. Off-site manufacturing prefabrication can result in a shorter total construction timeline, higher quality, and less resource waste.

Prefabricated construction can be more readily applied to any preassembled element of a structure. Prefabricated construction can include any dry wall system, roof truss, plumbing system, etc [2]. Modular prefabrication is the most advanced, with the ability to complete up to 95 percent of the structure before it is installed on-site . In prefab architecture, modules are also one of the most definable industries. (See Fig. (1).

(a)



(b)

Figure 1. (a) Craning of a modular unit during the final assembly of the building

(b) Degree of prefabrication in construction

Precast concrete structures, which may be split into three of building structures, namely, precast concrete wall-based structures, frame structures, and frame-wall combination structures [3], play an essential part in modern construction industries. The essential technology of these buildings, regardless of whether type, is the connection between components, which usually includes the connections of column-wall, beam-wall, column-beam, wall-floor, and so on. The overall performance of the connections, energy-consuming capacity, and economic performance are all important

factors in these types of buildings. The materials used in modular building units can be categorized based on the primary structure, such as concrete, steel, or wood. GFPR (glass fiber reinforced polymers) has also been considers as a part of the new materials that are being tried in the developing market of modular construction .

Types of precast elements

According to the information provided below, two primary types of precast concrete elements are used: (See Fig. 2)

i. Precast reinforced concrete elements:

These must have reinforcing bars and/or welded wire meshes inside the elements to give structural strength as required by the component, such as façade walls, beams, columns, slabs, stairs, and parapet walls.

ii. Precast pre-stressed concrete elements:

These shall consist of pre-stressing tendons within the elements to provide a predetermined force needed to resist external loadings and cracks such as hollow core slabs, beams and planks [4].

Pod element

Parapet beam

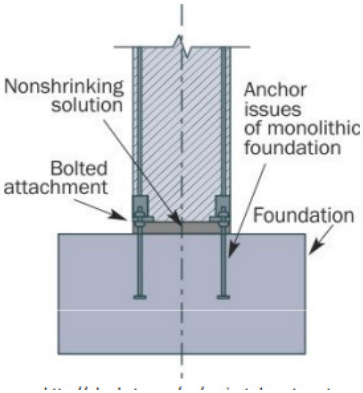
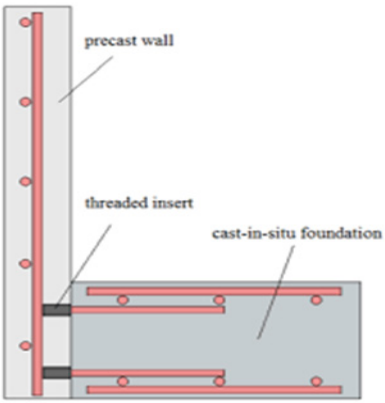
Hollow core slab

Figure 2. Precast Concrete Elements

Types of precast connection elements

In the prefabricated building, there are elements that are connected to each other[5,6], and each of them has a special methods of connection that are shown in table 1:

Table 1.
Types of precast connection elements

Type of connection	Example of connection	Method of connection
Column to foundation connection		1-Socketed connection 2- Bolted or base plate connection 3- Mechanical splice connections 4- Grouted connections
Wall panel to foundation connection		1-Corrugated Duct 2- Grout Coupler 3-Precast Shoe

Beam to column connection		1-The vertical member is continuous -hidden connections -visible connections 2-The vertical member is discontinuous -beam-ends resting on top of columns continuous -beams anchored at the head of the beams.
Column to column connection		1-Splice connection 2-Anchor bolt connections 3-Screw butt joint

Connection types of precast concrete frame joints

There are some rules for joint design to ensure safety, such as that the components can resist ultimate design loads in a ductile manner, the precast members can be manufactured economically and erected quickly and safely, manufacturing and site erection tolerances do not negatively affect intended structural behavior, and are catered for in a 'worst case' situation, and the acceptable final appearance. In general, the choice of joint depends on the type and location of the structural elements to be connected. There are several types of joints, according to the following [7]:

(1) Wet connection joint : The wet connection combines the precast concrete components with post-cast concrete during assembling .In this system, a post-cast concrete includes a service hole, and U-shaped rein-

forcements are arranged at the end of the beam [8,9]. (See Fig 3)

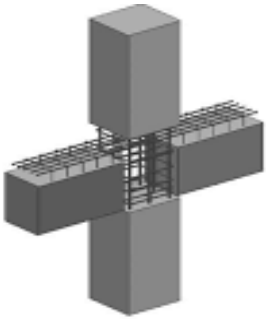


Figure 3. Wet connection joint

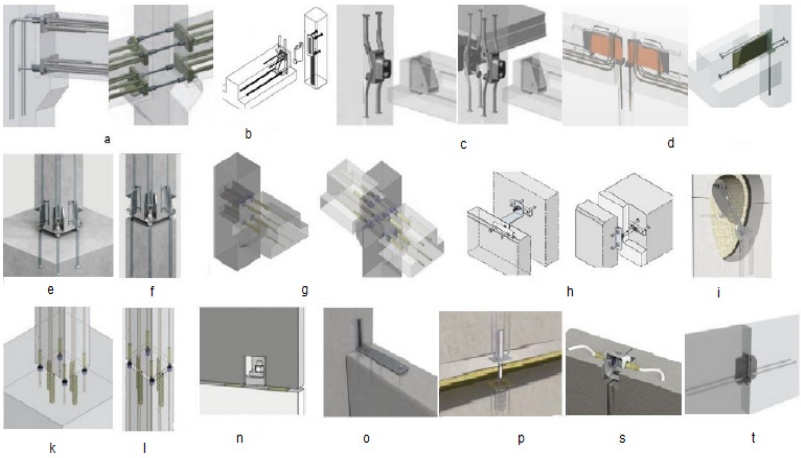


Figure 4. Examples of options for "dry" joints when using reinforced concrete elements: a - anchor-bolted beam-column; b — inserted beam-column; c - insert beam-column; d - insert beam-column; e — anchor-bolted column-foundation; f - column – column; g - anchor-bolted beam-column; h - anchor and bolt facade systems; i - anchor and bolt facade systems; k — anchor-bolted column-foundation; l - anchor-bolted column-column; n — anchor-bolted panel-panel; o - anchor-bolted panel-panel; p - anchor-bolted panel-panel; s - anchor-bolted panel-panel; t - snap-on panel-panel

(2) Dry connection joints: Dry connection decreases the need for cast-in-place, which increases construction efficiency and eliminates environmental contamination. There are two types of dry connections: (1) welded connections [10], and (2) prestressed connections. (See Fig 4)

3- Pin jointed connections

Pinned connections are typically called 'joints' because they include just one bearing surface. Frequently utilized in precast constructions because they may be constructed by element to element bearing in the simplest possible way. The precast design itself provides the possibility to build simply supported connections, in order to ensure that bending continuity between the various parts is avoided [11]. (See Fig. 5)

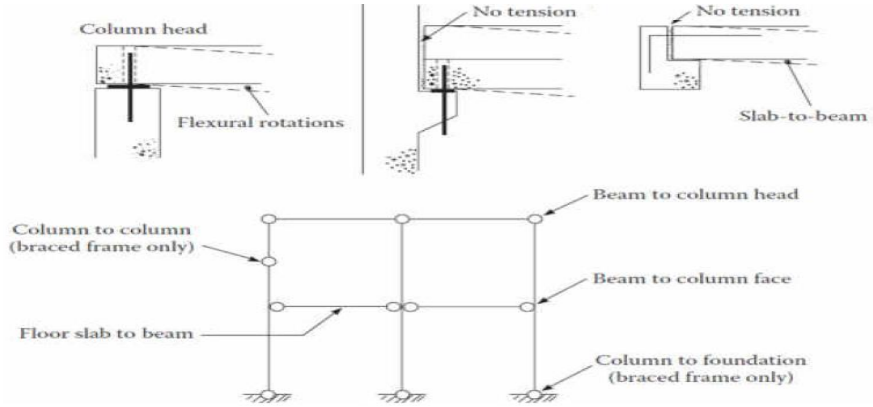


Figure 5. Position of pin-jointed connections in structures

4-Pivot Hinges connection

Installation of a passive system includes zero-energy assembly mechanisms and precise control components, such as pivot hinges, which can be utilized to connect column to the floor or wall to others wall . This technique helps to speed up installation work since it is manufactured as a single unit in the factory and then opened and installed in its designated location on the work site [12,13].

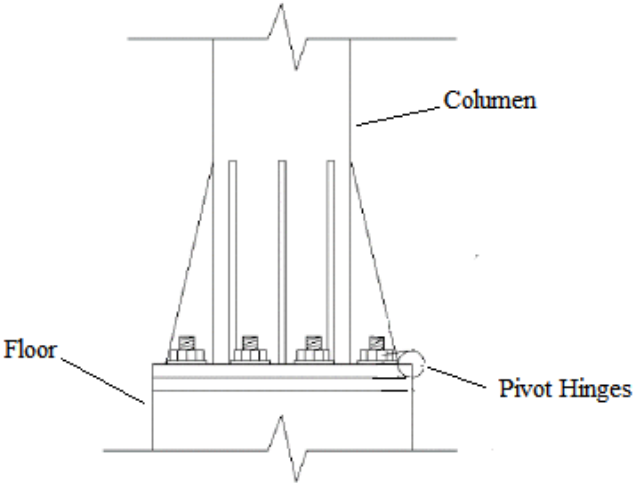


Figure 6. Using pivot hinges connection

Conclusion

Bringing modular technologies to the forefront of the modern building construction markets seems like a necessary evolutionary step towards a more efficient and productive industry. Strength, volume changes, ductility, durability (including fire and corrosion), easy for connection in fabrication structure , installation and maintenance, and loading conditions are all important factors in precast structural design.

The most important aspect of precast concrete structures is the connection. The connection transfers force between the precast components and determines the overall structure's strength, stiffness, and ductility. Failure of a single joint should not result in structural instability.

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DOI 10.34660/INF.2021.80.18.020
UDC 314 (57[1]6)

INVESTMENTS IN THE ECONOMY OF THE FAR EAST AND DEMOGRAPHIC PROBLEMS OF THEIR DEVELOPMENT

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Abstract. The current state of demographic potential and opportunities for regional development, with the increasing role of the eastern regions of Russia possessing huge natural resources, are considered. With the population of the Far East continuing to decline for many years, their development becomes problematic. The interrelation of the current trends in the development of the demographic potential of the Far Eastern region and attracted investments designed to ensure sustainable growth rates of the regional economy is analyzed. Migrants leaving the region outnumber the number arriving in the territory. The interrelation of demographic potential and the implementation of large-scale economic development projects are poorly interconnected. The low standard of living of the population makes the vast territory not attractive for migrants.

Keywords: Far East, demographic potential, investments, migration factors

Currently, much attention in research is paid to the dynamic development of economic and social factors, of which the most important are the trends emerging under the influence of state policy. With the beginning of economic reforms, the Far Eastern region lost its priorities in the social sphere, lost its attractiveness for migrants, and the population living in the region reacted by changing their migration and reproductive behavior. The decline in the permanent population has persisted in the Far East for almost thirty years. At the beginning of 2019, 6182.7 thousand people lived in the region (with the Trans-Baikal Territory and the Republic of Buryatia

[1]The article was prepared within the framework of the state task: registration number AAAA-A16-116110810013-5 "Geographical and geopolitical factors in the inertia, dynamics and development of various ranked territorial structures of the economy and settlement of the population of Pacific Russia".

- 8235.07 thousand people) [5]. Against the background of the positive dynamics of natural reproduction of the population in all Far Eastern regions, a steady migration decline of the population remains, although its intensity decreases.

The compensating factor of population decline is natural growth. A decrease in the birth rate and an increase in mortality rates is a legitimate response to the modernization of society. From 2005 onwards, its values became positive in the Republic of Sakha (Yakutia), the Chukotka Autonomous Okrug, with subsequent years positive dynamics in other subjects of the Far East [1, 7]. However, by now (2020), natural growth has been maintained in the Buryatia River, the Chukotka Autonomous Okrug, and the Sakha River (Yakutia).

The negative balance of migration is completely formed due to interregional migration flows. The most intensive migration outflow is observed in the northern regions. The most mobile is the population of working age, with the greatest migration activity at the age of 25-29 years (36,5 %) [2, 4]. Among the migrants who have left, the predominance of persons with secondary general education is especially noticeable, which every fifth migrant has, and every fourteenth with secondary special education. Among the arrivals, there is a decrease in the proportion of people younger than working age throughout the territory. This indicates that there are still few grounds for improving the qualitative characteristics of the population in the region. In other words, there is a tendency not just to decrease the population, but to replace the population with a high level of capitalization of the population with a lower social status.

The socio-economic situation and the deterioration of the quality of life in comparison with other Russian regions are a decisive factor in the migration orientations of the population of the Far East. The desire to leave their city and region is also demonstrated by the youth of the Far East. During the 2010s, the Far East "gave" to the Russian regions almost 5.3 times more migrants (596.9 thousand people) than it received from the CIS countries – only 112.7 thousand people. [1, 7]. In essence, the Far East is a donor of population and labor resources for the Russian federal districts, while none of them gives a positive balance in exchange with the Far East.

Differences in the participation of the population in spatial mobility leads not only to a change in the population, but also to the transformation of the gender and age structure of the population in the receiving and giving territories. By the end of the first decade of the XXI century, there is a significant aging of the population in the age structure. The increase in older persons observed in the Far East as a whole is especially intense

in the northern regions [3]. For the most part, Moscow and the Moscow Region and the subjects of the central district are at the forefront of the influx of those leaving the northern and eastern regions. There is a direct influence of social reasons: large-scale housing construction, capital social packages, better and affordable medical care, expanded opportunities for leisure and domestic well-being, the effect of social cards of a metropolitan resident, the possibility of seasonal migration in the summer to the regions of suburban development, etc.

The current socio-economic situation and living conditions in the Far Eastern Federal District are the main factor in the formation of migration orientations of the population. Gradually, there was a threat of changes in the future of the national, sexual and social composition of the population of the region. There are such problems as the growth of social tension, lack of housing and infrastructure. The main socio-demographic threat is the outflow from the district of the qualified part of the labor potential in active working age. At the same time, the territory is filled with low-skilled, not always ready to communicate people, among whom most do not have the necessary professional skills, and sometimes with primary education. There is also a job for such migrants because for many subjects of the federation there are 3-4 vacancies for every unemployed person. As a rule, these are vacancies in the field of construction, agriculture, housing and communal services, transport. For a long time, the level of education of migrants who left was higher than that of those who arrived. The situation is changing by the early 2020s. In all regions of the Federation, the arrival of persons, especially those with higher education, becomes a priority over the departure.

In the short term, neither an increase in the retirement age nor an increase in labor productivity will be able to compensate for the depopulation of the population. The Far East is suffering large population losses due to interregional exchange, and it is possible to reverse this trend only by bridging the gap between nominal and real incomes of the population. All this indicates the need for the formation of additional measures to support the population, conditions for attracting migrants, improving the quality of medical care and the development of social infrastructure, increasing income [8].

One of the main factors of slow socio-economic development is determined by the resource orientation of the development of the territory of the region. Since 2006, since the announcement of the priority of development to the east, the inflow of investments has been provided by federal investments, but this cannot stop the outflow of the population. The proclaimed

policy of "turning to the east" has made more substantial support from the federal budget to the Far Eastern subjects, especially in the extraction and development of natural resources, but not in support of the population living here, Fig. 1.

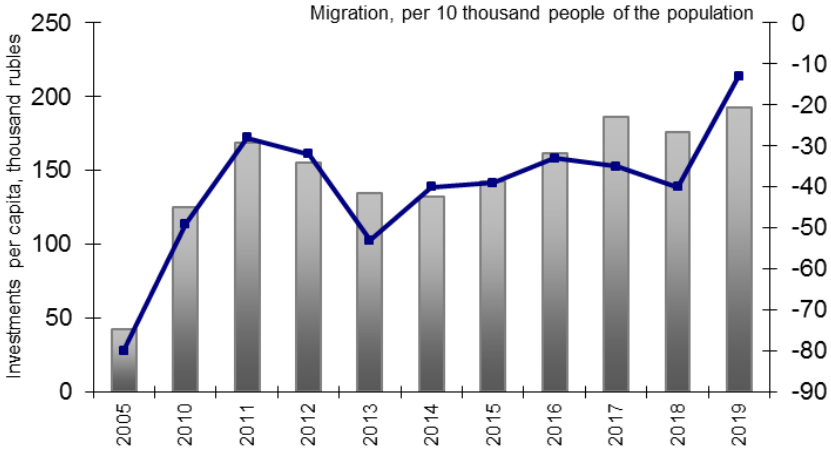

Fig. 1. Investments in the Far East and migration results

The system of distribution of income received from this does not provide a fair distribution of earned funds. The region credits one hundred percent of the fees to the federal budget, and returns significantly less from the listed financial funds. Preferences, for example, in the form of territories of advanced development, free economic zones (Nakhodka, Greater Vladivostok, in the Jewish Autonomous Region (EVA), in the Magadan Region, in the Vanino-Sovgavan industrial and transport hub of the Khabarovsk Territory), did not bring success to the region, but only benefits to business, with a reorientation from domestic to foreign markets. Investors, mostly foreign, practice investing in the region in order to get rent and withdraw it. Exports from the regions of the Far East (2019) amounted to $28,200.7 million, and imports – $ 8,014.07 million. It is possible to achieve high growth rates of the gross regional product if we keep a constant, annually high increase in public investment, which will be able to ensure a high growth rate with certain multipliers. It is legitimate to conclude that it is necessary to change management methods, restore the processing of extracted raw materials to obtain final products, revive industrial enterprises, the construction industry, etc.

The investment programs currently proposed have inherited many socio-economic problems that cannot be solved in the region. First of all, there is a weak concern for people living in the region. The distance between neighboring Far Eastern settlements sometimes exceeds 100 km, with irregular transport accessibility, in many cases only by air transport, cause high living costs for the population. For example, it is cheaper to fly from Magadan to Vladivostok or Krasnoyarsk via Moscow than by direct flights. Since 2006, the task of making life better in the Far East than in the central regions has not been fulfilled due to the use of Moscow's economic criteria of thought, and this does not work on the periphery. Moscow is a "different country", where the average salary of a teacher, for example, is 110 thousand rubles, and in the south of the Far East – 40 thousand rubles [5]. The same situation is with the northern territories of the whole country. Given the disparity in the development of the regions, the number of potential migrants cannot increase at the expense of those people who were born outside the Far East. We need a different approach to the development of the periphery, which is important in all respects. Following the asymmetry in the standard of living, the difference in the mentalities of the European and Far Eastern population is not taken into account. Given the weakness of the current Russian state, the main direction of the development of the Far Eastern territories may be to encourage the unorganized resettlement of migrants who are able to create jobs for themselves. It is also useful to recall the positive experience of settling the south of the Far East in previous periods of development [9].

Regional disparities in the quality of life violate the unity of the economic space of the state, limit social progress, lead to the complication of the problem of interregional migration, interregional exchange, the emergence of the threat of separatism [8]. The investment programs currently proposed have inherited many socio-economic problems that cannot be solved in the region. They need their own potential. First of all, we care about the people living in the region. There is a need to update labor policy, the practice of social and labor relations in order to increase labor efficiency, strengthen social justice in the economy and society. To do this, it is necessary to strengthen social security in the field of employment, including reducing the wage gap and poverty; the development of a system of jobs based on the structural reorientation of the economy from raw materials to manufacturing industries, as well as the high-tech sector. There have been changes in the sphere of social and labor relations caused by informatization, the spread of knowledge and their universal interdependence, globalization processes, and increasing economic uncertainty. Di-

versification and flexibility of the labor market segment is urgently needed under the influence of the networking of the economy, STP, the formation of new non-standard forms of employment and new types of labor relations (individualization); new models of labor pricing, pension system and pension insurance as elements of social security in wages.

Conclusion

Before taking care of present and future migrants who would like to come to the Far East for residence, you need to take care of those who live here and will continue to live. After the optimization of the education and medical care system, access to such services turned out to be limited due to their remoteness from small settlements. The critical condition of housing and communal facilities, the low quality of life of the indigenous population, the sharp polarization of income by industry within the region, do not contribute to the influx of migrants. All this leads to adverse consequences in the form of negative demographic indicators, the outflow of highly qualified labor resources, the lack of a large-scale and effective personnel training system, an imbalance between the supply and demand of labor resources in territorial and professional terms.

From the point of view of solving demographic problems, social guarantees (in employment, health preservation, education) for people living in the region can become an incentive to increase the security of the population. A more important and necessary task may be to solve the issues of increasing the incomes of Far Easterners and social guarantees of employment.

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DOI 10.34660/INF.2021.49.94.022

CONDITIONS AND FACTORS FOR KARST DEVELOPMENT IN THE SOUTHERN URALS AND CIS-URALS

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Abstract. The conditions and types of karst are given, three main groups of factors of its development are identified: geological-geomorphological, climatic-hydrogeological and technogenic. The main regularities of distribution and modern activity of karst are established depending on the factors of its development.

Keywords: sulfate karst, carbonate karst, a group of karst development factors, geological-geomorphological, climatic-hydrogeological, technogenic.

Introduction

Numerous existing definitions of karst reflect three approaches to this process [19]. Geographers and geomorphologists consider karst as a phenomenon, studying its surface and underground manifestations; geologists see in it a polygenetic process of changing the properties of rocks; hydrogeologists and geological engineers understand karst as a unity and totality of a process and phenomenon. The author, like a number of other researchers (Anikeev, Gvozdetsky, Maksimovich, Sokolov, Stupishin, etc.), understands karst as the totality of the process and the phenomena caused by it. Namely, karst is an exogenous geological process caused by the dissolving and eroding activity of natural and man-made waters circulating in relatively readily soluble rocks, as a result of which underground and surface karst forms (karst manifestations) are formed.

If the conditions for the development of karst are interpreted quite unambiguously by most researchers, then, as Timofeev D.A., Dublyansky V.N., Kiknadze T.Z. [19], a unified approach to determining the factors of its development does not currently exist. Researchers have identified more than 100 factors of karst development, which are combined into groups of constantly acting, slowly and rapidly changing [21] factors: geological, hy-

drodynamic, hydrochemical, geomorphological, climatic [1, 3, 18, 20, etc.].

Despite more than two centuries of studying the karst of the Southern Urals and the Cis-Urals, scientific publications contain various interpretations of the conditions and factors of its development, and special systemic works on studying the factors of karst development in the region, in addition to considering its individual aspects [6, 7, 8, 18 and etc.], have not been conducted before.

Purpose of the study – systematization of the main conditions and factors of the development of karst in the region under consideration and analysis of their influence on the intensity and activity of its development at the present stage.

Initial data and research methods

The initial materials for the research were the information collected by the author about the karst of the Southern Urals and the Cis-Urals, the analysis of the intensity of distribution and the activity of its development, contained in the reports of OJSC "Bashkirgeologiya", CJSC "ZapUralTISIZ" and OJSC "Archstroyizvskaniya", as well as the author's own research, individual aspects karst region, published in 2014-2021. [9-16].

Results and discussion

Terms accepted in the article and their current definitions.

The intensity of the distribution of manifestations of karst – the magnitude of the change in the geological environment as a result of the development of the karst process over a certain period of time (for the region under consideration from the Pliocene to the present day). Most often it is expressed through the karst content coefficient (the number of karst sinkholes per unit area within the karst fields) and the karst occurrence of the territory (the ratio of the number or area of karst forms per unit area of karst areas within which they are developed).

Karst development activity – the magnitude of the change in the geological environment (a measure of its variability in time) as a result of its development [21]. Usually expressed in terms of karst denudation (mm); the ratio of the number and (or) volume of newly formed karst forms to a unit of area and time (pcs./km^2*year or units*m^3/km^2*year); the average annual increase in their volumes (m^3/km^2*year) [19].

Karst development factors – natural conditions and technogenic circumstances that determine the scale of the development of the karst process: the intensity of the distribution of karst forms and the activity of its new manifestations.

Conditions for the development of karst. Currently, it is generally accepted that for the development of karst [according to 18, p. 126], a simul-

taneous combination is necessary: the presence of soluble rocks and their permeability, the presence of moving waters and their aggressiveness to water-bearing rocks. The absence of one of these four conditions makes the development of karst impossible. In this regard, karst can be characterized as a process of activity with dissolving capacity, circulating in readily soluble rocks of natural and man-made waters. That is, karst develops with the interaction of two natural environments - rock and water.

Karst development factors. Based on the basic conditions for the development of karst, all (more than 100) known factors can be divided into two main groups - geological-geomorphological and climatic-hydrogeological. At the present stage, they are joined by a group of technogenic factors. The first two groups are determined by the geological structure and natural conditions of the territory, and the third - by the degree of anthropogenic load on the geological environment.

Group of geological and geomorphological factors

Factor of the composition of karst rocks and the frequency of their composition. The distribution of karst in terms of the composition of karst rocks and conditions of occurrence is correct in Figure 1, from which it can be seen that mainly sulfate, carbonate and sulfate-carbonate karst is developed in the Southern Urals and in the Cis-Urals. It developed most intensively in karst rocks devoid of insoluble impurities. Klastokarst [16] and locally sulfide karst [14] are also developed in the region to a limited extent.

Water permeability factor of karst rocks is manifested by the greater karst formation of areas with increased water permeability, due to more intense fracturing in the zones of disjunctive faults and tectonic faults with a general tendency to decrease with depth [4].

Thickness factor of sediments overlying karst rocks in the region it is most clearly manifested in the areas of development of sulfate karst in the karst country of the East European Plain. As the karst gypsum of the Kungurian stage sinks in the western direction under the non-karst sediments covering them, the karst content of the territory gradually decreases, and where the gypsum roof is at a depth of more than 100 m, it is practically absent [13], which is the basis for mapping the western boundary of the distribution of sulfate karst.

The factor of the composition of the sediments covering the karst rocks, defining genesis, strength properties and their water permeability is the basis for distinguishing the types of karst in the region under consideration by the nature of the overlap of karst rocks by non-karst ones: open (bare or Mediterranean), covered (sub-eluvial-deluvial or Central European) covered (sublimnic), overlapped (sub-alluvial or Kama) closed (Russian) [4, 15].

Relief formation history factor is predetermined by the history of the geological development of the territory and is due to neotectonics. At the present stage, in the Southern Urals and in the Cis-Urals, karst develops inherited from the course of relief formation in the Neogene-Quaternary. In the Early Pliocene, during the inception and the beginning of the formation of deeply incised (up to 200 m) Late Pliocene paleovalleys of rivers [22], there was a sharp activation of the development of karst, which weakened in the Pleistocene, interrupted by periods of activation during the formation of pradolines of rivers in the early Neopleistocene [4].

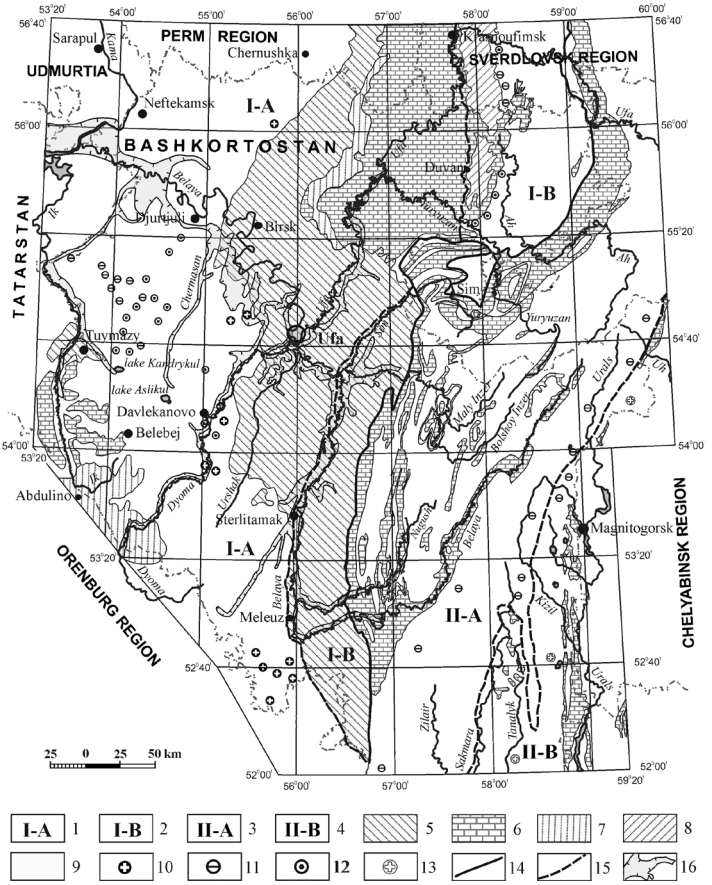

Fig. 1. Types of karst in the Southern Urals and Cis-Urals (Smirnov, 2021 [based on 4, 13, 15, 16])

Karst country of the East European Plain (I): 1 — (I-A) flat karst in horizontally and gently lying rocks of the Cis-Urals; 2 — (I-B) flat and foothill karst of the Cis-Urals in gently sloping and weakly dislocated rocks. Ural karst country (II): 3 — (II-A) mountain and foothill karst in dislocated and highly dislocated formations of the Urals; 4 — (II-B) flat karst in folded-block sediments of the Trans-Urals. Karst types: 5 — sulfate, 6 — carbonate, 7 — sulfate-carbonate, 8 — clastokarst, 9 — areas with no surface manifestations of karst. Local manifestations of karst: 10 — sulfate, 11 — carbonate, 12 — klastokarst, 13 — sulfide. Boundaries: 14 — karst countries, 15 — types of karst by the nature of the relief and the conditions of bedding of rocks. 16 — contour of paleovalleys of rivers, mapped by N.N. Tolstunova on a scale 1:500 000 (1994) according to the data of the state geological survey of the scale 1:200 000.

Factor of the structure of river valleys and watersheds determines the strengthening of karst from the "cores of watersheds" to the valleys-drains [18, p. 265] and is the basis for the identification of geomorphological types of karst: karst of river valleys and karst of interfluves [4, 5]. Karst of the first type is developed everywhere more intensively.

Group of climatic and hydrogeological factors

Hydrochemical factor predetermines the rate of karst development from the ability to dissolve karst rocks. In the region under consideration, sulfate rocks have the highest solubility in the hypergenesis zone. In distilled water at a temperature of 25°C in 1 liter, it reaches 2.1 g, and in salt waters even 7 g. The solubility of calcium carbonate in distilled water at a temperature of 25°C is low - only 15 mg in 1 liter, but it increases significantly in the presence of in water, carbon dioxide, which enters the rocks along with infiltration water from the atmosphere and soil-vegetation layer. In the presence of free CO_2 - 199.5 mg/dm^3 in 1 liter of water, the solubility of calcite is 455 mg/dm^3, and in its absence - only 11 mg/dm^3. At the same time, an increase in temperature significantly reduces the calcite capacity of carbon dioxide waters. If an increase in the CO_2 content in water leads to an increase in the rate of karst development in carbonate rocks, then in sulfate rocks this does not happen, but on the contrary, it even slightly decreases [3, 8, 18].

Hydrodynamic factor determines the nature of groundwater discharge in river valleys, where there are two main hydrodynamic environments that characterize the development of karst - the hydrodynamic environment of intense and hindered water exchange in fractured karst waters (fig. 2) [10].

The hydrodynamic environment of the hindered water exchange of

fissure-karst waters is characterized by a slow discharge of groundwater due to the development of a loamy-clay cover on gentle slopes and low interfluves. The hydrodynamic environment of intensive water exchange in fissure-karst waters is typical for steep slopes of drainage valleys, where pinching out of impermeable and aquifers and free discharge of groundwater in the form of springs or an invisible overflow from the upper strata to the lower ones along the fissures of the side resistance is observed.

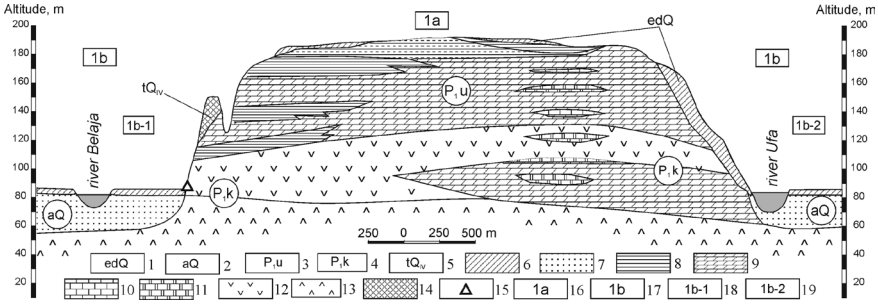

Figure 2. Schematic geological section along the latitude of the center of Ufa [based on 10]

1− eluvial-deluvial deposits of slopes and watersheds; 2 − deposits of above-floodplain accumulative terraces; 3 − clay-marl-sandy-calcareous red-colored stratum of the Ufa stage; 4 − gypsum-anhydrite stratum of the Kungurian stage; 5 − loam, clay; 6 − sand-gravel-pebble deposits; 7 – mudstone; 8 – limestone; 9 – sandstone; 10 – marl; 11 – dolomite; 12 – gypsum; 13 – anhydrite; 14 – railway track on the Ufa karst slope; 15 – spring karst: 16 – interfluve, 17 – river valleys. 18 – Hydrodynamic environment of intensive water exchange in fissure-karst waters; 19 – Hydrodynamic environment of hindered water exchange in fractured-karst waters.

Climatic (meteorological) factor at the present stage of karst development, it manifests itself in the activity of water exchange in the upper hydrodynamic zones, depending on the amount of precipitation and the regime of karst waters, in particular, the thickness of the zone of seasonal fluctuations in the level of karst waters [18].

Group of technogenic factors

Anthropogenic activity can both promote and hinder the development of karst [5, 7, etc.].

Factors contributing to the development of karst: violation of the water-

proof properties of the overburden; the emergence of technogenic sources of formation of aggressive groundwater; mechanical impact of production and technological processes; pollution of atmospheric air and surface waters by aggressive emissions and effluents of industrial enterprises [6]. To these can also be added the pollution of groundwater from the extraction of hydrocarbons; blasting operations and the creation of man-made cavities (wells, mines, adits, drifts, etc.) during the exploration and operation of minerals, the construction of underground storage facilities and subways.

Factors hindering the development of karst: elimination of surface karst manifestations; an increase in the thickness of the water-protective cover over karst rocks; creation of artificial waterproof coatings (asphalting, concreting, etc.); streamlining the flow of atmospheric waters by creating storm collectors; Carrying out targeted engineering anti-karst preventive measures and liquidation plugging of deep forms of karst.

Implementation of the factors of karst development in the region

Due to the higher rate of dissolution of sulfates in comparison with carbonates, the intensity of the spread of karst occurrences in the development areas of the first is up to 5 times higher than that of the second. The incidence of karst landforms associated with the development of sulfate karst reaches 25% (sometimes even higher), while carbonate - does not exceed 5%, and usually is less than 1%. At the same time, the maximum karst content of sulfate karst is observed in areas composed of white sugar-like gypsum without admixtures, and for carbonate karst, everywhere - the most pure organogenic organogenic-detrital limestones in composition [4, 9, 15].

The maximum distribution of surface karst manifestations is observed in areas of open karst. With the same composition of the sediments covering the karst rocks, the infestation by surface karst manifestations is inversely proportional to their thickness. With the same thickness of the overburden, the density of surface manifestations of karst increases from physically strong rocks to weaker ones and from impermeable rocks to water-permeable ones along cracks, with the greatest damage to the overburden deposits, the water permeability of which is due to their porosity. With the same thickness and composition of the overburden, the surface karst content naturally decreases from ancient to young landforms [17] and from positive neotectonic structures [2] to negative ones or to areas with monoclinal gypsum bedding.

The most frequent and diverse forms of sulfate karst on the bedrock slopes of the valleys (karst of river valleys). At the same time, on high slopes in an environment of active water exchange, karst forms are more

diverse and numerous than on low and gentle ones, where water exchange is difficult. Steep slopes with gypsum outcrops and adjacent valleys of watersheds with a width (up to 1.5 km) are often affected by karst more than 10%, and gentle slopes are not more than 5%. In addition, in areas where the hydrodynamic environment of intensive water exchange of fractured karst waters is formed, the activity of karst development is always higher than in areas with hindered ones. Thus, long-term (~ 40 years) monitoring observations of karst occurrences on the Ufa slope under conditions of intensive water exchange established the formation of an average of two new sinkholes per year [11], while under conditions of difficult water exchange of fractured-karst waters on the right slope of the valley of the river Ufa (see fig. 2), the formation of karst sinkholes is recorded extremely rarely. In addition, on the Ufa slope, it was found that most often dips are formed in spring, and in the long-term series - in years with an increased amount of atmospheric precipitation [11].

In regional terms, more than half of modern karst sinkholes in the last 20 years have formed in the bottoms of drainage valleys, where the thickness of the deposits covering the karst gypsum is reduced by the erosional activity of rivers. At the same time, the overwhelming part of them is confined to the rear parts of river terraces, the foothills and edges of the modern slopes of river valleys and the slopes of paleovalleys. Along with this, most of the karst sinkholes have arisen in the areas of development of closed and overlapped types of karst in the areas within which they were previously recorded, and in most cases are confined to territories with an increased incidence of surface karst forms in the contours of neotectonic uplifts [15].

Technogenic factors at the present stage are mostly factors that accelerate the development of karst in the cities of Ufa [5-7], Blagoveshchensk, Birsk and in the extraction of minerals, which is manifested in the formation of new karst sinkholes. In 2000-2020, the formation of at least 35 large failures was reliably recorded in the residential areas of the listed cities [12, 15]. Their formation was repeatedly recorded in quarries and their surroundings during the extraction of limestone and gypsum, as well as in the contours of the Tuymazinskoye oil field. The last pitcher-shaped karst sinkhole at the Tuymazinskoye field was formed in May 2012. Its depth was 11.5 m, the diameter from the surface was 2.5, and along the bottom - 9.0.

Conclusion

The conditions for the development of karst are uniquely determined by all karst researchers and are implemented in the Southern Urals and the Cis-Urals as well as in other karst regions.

The factors of karst development are determined by the peculiarities of the geological structure and natural conditions of the region under consideration. The identified groups of factors (geological-geomorphological, climatic-hydrogeological and technogenic) determine the differences in the intensity of distribution and the activity of karst development in its individual parts of the Southern Urals and the Cis-Urals. At the same time, most often they affect the rate of karst development in a complex manner, and often the allocation of only one of them is relatively conditional.

Further studies of karst in the region should be aimed at studying the climatic-hydrogeological and technogenic group of factors, which, in comparison with the geological-geomorphological group of factors, have been studied to a much lesser extent.

The work was carried out within the framework of the State Budgetary Topic № 0246-2019-0118.

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DOI 10.34660/INF.2021.66.81.023

INFLUENCE OF THE AGE OF THE FIRST FRUITFUL INSEMINATION ON THE PRODUCTIVE LONGEVITY OF COWS

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Abstract. The article studies the effect of the age of the first fruitful insemination on the exterior features of gooshtinized black-and-white heifers, live weight, frequency of inseminations and productive longevity of cows in the "Dmitrievo" breeding farm of the Kasimovsky district of the Ryazan region of the Russian Federation.

Keywords: heifers, cows, live weight, frequency of inseminations, productive longevity, measurements, black and white breed.

It is known that cattle of all breeds, including black-and-white, were improved with the Holstein breed. [1 p. 1; 2 p. 3, 3]. In the breeding plant "Dmitrievo" of the Kasimovsky district of the Ryazan Oblast, where our research was carried out, the blood of black-and-white Holsteinized animals has approached 100% by now. Thanks to the optimal conditions for feeding, keeping, breeding, the farm specialists managed to increase milk productivity to 8.0 and more tons per cow per year. However, with an increase in milk yield, there was a decrease in productive longevity from 4.0 to 3.1 calving.

According to the author [2 p. 11], the productive longevity of cows depends on genetic and paratypical factors, therefore, on the intensity of rearing heifers, and their optimal age of the first fruitful insemination.

Of course, a short period of raising a cow is more profitable, especially from an economic point of view, since the costs are reduced, expressed in labor savings, accelerated turnover of funds, and a decrease in the amount of feed required for feeding from birth to calving. At the same time, the rapid change of generations in the herd contributes to an increase in the

number of replacements.

In this regard, the study of the influence of the age of the first fruitful insemination of heifers, their live weight, the frequency of inseminations on the productive longevity of cows is a very important area of research.

The task of the research was to study the productive longevity of cows depending on changes in the basic measurements of heifers at different ages of the first fruitful insemination of their live weight, the frequency of inseminations.

As a result of the research, from the number of retired cows, three groups were selected, which differed in different ages of the first fruitful insemination: the 1st group was fertilized up to 15 months, the 2nd and 3rd, respectively, at 16-18 and more than 18 months.

It was found that the heifers of the first group were fertilized at 14.4, the second and third, respectively, at 17.5 and 18.8 months. (table 1)

Table 1.

Productive longevity of cows in connection with the age of their first fruitful insemination, basic measurements, live weight, frequency of inseminations

Indicators	Groups of cows			± to 2-nd	
	1-st	2-nd	3-rd	1-st	3-rd
Average age of the first fruitful insemination, months	14.4	17.5	18.8	+ 3.1	- 1.3
Height at withers, cm	117 ±0.76	119 ±0.62	118 ±0.69	+ 2	-1
Oblique body length, cm	143 ±0.88	144 ±0.73	142 ±0.81	+1	-1
Productive longevity, calving	3.4± 0.1	3.8± 0.08	3.3± 0.06	+0.4[x]	+0.5
Live weight at 1-st fruitful insemination, kg	370 ±11	415± 9	434± 6	+45[x]	+64[x]
Frequency rate of inseminations, times	1.2	1.2	1.9	-	+0.7
Sperm production costs, rub. for 1 head.	228	228	361	-	+133
Live weight at the 1-st calving, kg	551 ±14	558 ±17	578± 17	+7	+27
Productive longevity, calving	3.4± 0.1	3.8± 0.08	3.3± 0.06	+0.4[x]	+0.5

[x] – authenticall

Table 1 also shows that heifers of the Holsteinized black-and-white breed of the second group, inseminated at the age of 17.5 months with a live weight of 415 kg, subsequently had the greatest productive longevity equal to 3.8 calving, which differed from their peers by +0.4 and +0.5 calving. Consequently, a decrease or increase in the live weight of heifers by the age of fertilization from 16 to 18 months of 415 kg contributes to a reduction in the longevity of cows.

Assessment of the influence of the main parameters of the conformation (height at the withers and oblique body length) on different ages of the first fruitful insemination of heifers did not allow us to establish reliable relationships between these indicators.

Due to the fact that the heifers of the third group were inseminated relative to the first and second groups later by 4.4 and 1.3 months, their frequency of inseminations, respectively, was 0.7 times higher, which caused the higher costs of sperm production.

Conclusion

Consequently, in order to increase the productive longevity of cows in highly productive herds with a milk yield of 8.0 tons or more, it is necessary to focus on the optimal parameters of the live weight of replacement heifers at the level of 415 kg by the age of the first fruitful insemination and the economic feasibility of age in this period of 16-18 months.

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DOI 10.34660/INF.2021.11.27.024

THE INFLUENCE OF VARIETIES OF SIDERAL CROPS AND THEIR COMBINATIONS ON THE STRUCTURAL STATE OF MEADOW-TURF SOIL OF SAKHALIN ISLAND

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Abstract. The influence of green manure crops of different botanical affiliation (cabbage, legumes, bluegrass) and their combinations on the structural state of meadow-soddy heavy loamy soil has been established. The effect of the biomass of almost all green manure on the creation and preservation of the most agronomically valuable soil units (68.7-76.7%) was assessed positively. The most efficiently influencing the structure of the soil included mono-sowing of oil radish, combinations of spring rape and oats with annual lupine, white mustard with oats and lupine.

Keywords: green manure, action, soil structure.

Interest in the structural state of the soil, which, according to researchers [1-4] is one of the most important properties of fertility, and the factors of its formation, does not dry up to the present time [4-6]. The main factor in the formation of the most valuable soil aggregates in the agronomic concept is organic matter [4, 6, 7]. It is well known that its main source is various types of organic fertilizers, which include green manure [8, 9]. The positive role of the latter in creating a favorable soil structure has been assessed in numerous studies [5, 10, 11].

In island agriculture, the use of green manure can be considered, first of all, from the standpoint of a supplier of plant organic matter to the soil and only for a very limited number of crops (winter rye and triticale, fodder root crops, perennial grasses) - as a direct source of mineral nutrients. This is due to the peculiarities of the island's climatic conditions: the optimization of the temperature regime and soil moisture begins here in the second half of May. In this situation, the beginning of the growing season of most of the agricultural plants cultivated on the island, including those intended for green manure, falls on practically the same dates.

The main results characterizing the green manures used in our experi-

ments and their complexes as sources of biomass, NPK, humus, the effect of green fertilizers on the nutrient regime of the soil and the production process of rapeseed and oats are given in the source [12].

The proposed communication presents experimental data on the effect of a variety green manure mass on the structural state of the meadow-soddy heavy loamy soil of about. Sakhalin.

The purpose of the research - is to establish the degree of influence of varieties of green manure and their mixtures as a biological means of reproduction of fertility on the main agronomic properties of the soil.

The primary tasks of the research included the determination of the composition of green manure crops capable of adapting to the peculiar soil and climatic conditions of the island, establishing the volume of soil replenishment with plant organic matter and nutrients, and taking into account the influence of green manure on the structure of meadow soddy heavy loamy soil.

Methodology

Experiments to study the effectiveness of green manure crops and their aftereffect were laid on the lands of the SakhRAI. The meadow-soddy old-arable soil of the experiments was characterized by significant heterogeneity. The acidity indicators varied within the very acidic (pH 3.4) - medium acid (pH 4.8) categories. The humus content was 3.23-4.76%. The amount of mineral nitrogen was low - 15.8-18.1 mg/kg (N-NO3 + N-NH4). The soil was characterized by a very high content of mobile forms of phosphorus - 354.0-385.0 mg/kg, medium and high - 114.0-130.0 mg/kg - the content of exchangeable potassium. All determinations were carried out according to generally accepted methods.

On the basis of analytical data, the amount of newly formed humus and manure (approximate), which entered the soil with the plant mass of green manure, was calculated [13, 14].

The structural state of the soil was established by the method of dry sieving through a column of sieves proposed by N.I. Savvinov. [15], adopted by the RF.

Green manure crops in the described experiment were represented by white mustard, oil radish, spring rape, annual lupine, spring and winter vetch, oats. In addition to single-component crops, multicomponent crops were used, combining two (50:50%) and three crops (30:30:40%).

After plowing the green manures, stubble crops of rape and oats were carried out in order to be able to reveal the effectiveness of the action of the main green manure group on the productivity of the following crops and to obtain an additional volume of biomass, taking advantage of the favora-

ble weather regime of the second half of the growing season.

The discussion of the results

Based on the data in the table. 1, the sums of the most agronomically valuable aggregates (10.0-0.25 mm) corresponded to the good structural state of the soil [1] in the overwhelming majority of variants. This indicator dropped slightly below 70.0% after the cultivation of spring rape and a triple mixture with white mustard, oats and winter vetch. However, in the process of structure formation, their action, as well as oats in combination with annual lupine, turned out to be the most effective relative to other green manures.

Among green manure mono-crops, the advantage of different levels (an excess of 1.9-8.4%) in improving the structure of the soil was revealed when plowing the oil radish biomass.

In accordance with the proposed in the source [3] a qualitative assessment by the value of the structural coefficient (C_{str}), the structure of the meadow-soddy soil, judging by the data presented in Table. 1 to the values of the coefficients, had an excellent state of aggregation in all variants. In the variants with green manure, characterized as the most effective in structure formation, the values of the structure coefficients turned out to be higher than 3 units. The value of the coefficient in the control variant is also noteworthy. It is possible that here, with a low input of plant organic matter, only in the late autumn period conditions of weak mineralization of humic substances developed, which contributed to the preservation of the soil structure.

Table 1.

Influence of varietal green manure on the structural state of meadow-soddy soil

Siderat	The amount of structural aggregates,%		Structural coefficient
	10,0-0,25 mm	3,0-1,0 mm	
Control (oats - summer sowing)	72.6	35.8	2.65
Spring rape	68.7	30.6	2.19
Oil radish	76.3	36.0	3.22
White mustard	74.4	34.4	2.91
Annual lupine	72.1	33.6	2.58
Oil radish + annual lupine	74.3	35.1	2.89

White mustard + annual lupine	72.9	34.4	2.69
Spring rape + annual lupine	76.7	36.4	3.29
Oats + annual lupine	75.8	37.2	3.13
Oats + spring vetch	72.8	35.0	2.68
White mustard + oats + winter vetch	69.0	32.4	2.22
Oil radish + oats + winter vetch	74.0	35.7	2.85
White mustard + oats + annual lupine	75.3	35.9	3.05

Another indicator of a good structural condition of the soil, often mentioned in the above scientific sources, is the sum of aggregates measuring 3.0-1.0 (sometimes 0.25) mm. In the meadow-soddy soil under the characterized by green manure, these structural units occupied a significant part of the entire aggregate of valuable aggregates (more than 30%). And according to this indicator, the leaders were already allocated green manure crops: oil radish and combinations of rapeseed, oats and mustard with annual lupine.

Table 2 shows more detailed results of the action of varietal green manure and their combinations on the formation of soil structural aggregates of different sizes. The data illustrated a higher accumulation of the blocky fraction (>10 mm) in the soil after plowing rapeseed and mustard with oats and vetch. In the variant with the spring rapeseed + annual lupine complex, the content of the silty-silty fraction is higher than in other variants.

Some explanations of the effectiveness of the selected options can be contained in tab. 3, which shows the calculated data on the possible accumulation of newly formed humus in the soil after the mobilization of the biomass supplied with green manure. We understand a certain conventionality of the proposed results, and nevertheless, they can contribute to the correct decision when choosing green manure, not only to ensure favorable agrochemical, but also optimal agrophysical properties of the soil, especially with a heavy particle size distribution. The amount of accumulation of newly formed humus of plants of different botanical composition is obviously dependent on the coefficient of humification. For cabbage crops, it is low [15], therefore, cabbage-legume combinations of green manure were inferior in terms of the amount of humus and manure created to options with the inclusion of oats as a supplier of carbon with a straw part.

Table 2.
Influence of varietal green manure on the formation of structural aggregates in meadow-soddy soil

Siderat	Structural aggregates, %							
	>10 mm	10-7 mm	7-5 mm	5-3 mm	3-2 mm	2-1 mm	1-0.25 mm	< 0.25 mm
Control (oats - summer sowing)	23.0	9.6	9.2	14.4	13.8	22.0	3.6	4.4
Spring rape	27.5	11.0	9.9	14.2	14.0	16.6	3.0	3.8
Oil radish	19.5	10.8	11.9	14.0	17.8	18.2	3.6	4.2
White mustard	22.2	10.8	11.8	14.4	15.4	19.0	3.0	3.4
Annual lupine	24.6	11.1	10.1	14.0	14.1	19.5	3.3	3.3
Oil radish + annual lupine	21.4	10.8	10.4	14.2	14.5	20.6	3.8	4.3
White mustard + annual lupine	23.0	10.3	10.0	14.7	16.1	18.3	3.5	4.1
Spring rape + annual lupine	17.4	10.5	10.1	15.0	16.3	20.1	4.7	5.9
Oats + annual lupine	20.6	10.5	10.1	15.0	18.3	18.9	3.0	3.6
Oats + spring vetch	23.0	9.8	9.9	14.7	18.1	16.9	3.4	4.2
White mustard + oats + winter vetch	27.0	10.2	9.2	14.1	16.0	16.4	3.1	4.0
Oil radish + oats + winter vetch	22.0	10.4	9.9	14.6	15.3	20.4	3.4	4.0
White mustard + oats + annual lupine	19.9	9.5	10.5	14.8	18.6	17.3	4.6	4.8
HCP_{05}	2.3	$F_{05} < F_t$	0.7	$F_{05} < F_t$	1.5	1.5	0.5	0.6

Table 3.
Influence of varietal green manure on the accumulation of newly formed humus and manure in the meadow-soddy soil (calculated data for one year)

Siderat	Dry matter (vegetative part + roots)	Newly formed humus	Manure
	t/ha	kg/ha	t/ha
Control (oats - summer sowing)	-	-	-
Spring rape	5.1	412.5	8.2
Oil radish	5.4	440.1	8.8
Mustard white	5.0	405.6	8.1
Annual lupine	4.9	657.9	13.2
Oil radish + annual lupine	5.1	557.2	11.1
White mustard + annual lupine	4.9	501.1	10.0
Spring rape + annual lupine	5.1	534.1	10.7
Oats + annual lupine	5.3	732.9	14.6
Oats + spring vetch	5.7	649.3	13.0
White mustard + oats + winter vetch	5.7	684.9	13.7
Oil radish + oats + winter vetch	5.2	658.9	13.2
White mustard + oats + annual lupine	5.5	618.1	12.4

Conclusion. The analysis of the influence of different green manure crops and their combinations made it possible to conclude that they all contributed to a good level of structure formation in the meadow-soddy old-arable soil with a heavy granulometric composition. A higher effect in the formation of the structural units most valuable in the agronomic sense was characterized by the effect of the mono-sowing biomass of oil radish, spring rape and oats in mixtures with annual lupine, mustard in combination with oats and lupines. The presented results make it possible to make a choice in favor of a certain green manure option and its purposeful use in order to improve the agrophysical properties of the soil.

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DOI 10.34660/INF.2021.93.15.025

ANTECOLOGICAL FEATURES AND HONEY-BEARING VALUE OF MEDICINAL PLANTS IN THE CONDITIONS OF THE NORTH-WEST OF THE RUSSIAN FEDERATION

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Abstract. The article describes the morphological features of flowers of 9 species of medicinal plants. The nature of the adaptation of their flowers to pollination by insects, the composition of insects that pollinate these plants and collect nectar and pollen have been studied. The terms of flowering of plants in years with different conditions, the duration of flowering have been determined. Pollen productivity and sugar productivity of plants have been established and the efficiency of pollination is shown, expressed by the coefficient of seed productivity.

Keywords: flowering, pollination, sugar productivity, pollen productivity, flower, inflorescence, medicinal plants

Introduction

The economically valuable properties of plants are very diverse. A rational attitude towards plants allows them to be applied simultaneously in two or more directions. The cultivation of many agricultural crops is associated with their pollination by bees; therefore, plants during flowering are used as honey plants [1]. Medicinal plants, in which the medicinal raw materials are fruits, seeds, roots, rhizomes, tubers, can also serve as a food source for pollinating insects. The efficiency of pollination of entomophilous plants depends on the intensity of visits to pollinators and leads to an increase in the yield of seeds and fruits. Bees, in turn, create bee products: honey, bee bread, pollen, royal jelly, wax, etc. Thus, the condition of pollinators and their food availability, plant productivity and the production of beekeeping products are closely interrelated.

Purpose of the study – to study the antecology and melliferous value of some types of medicinal plants in the conditions of the North-West region of Russia.

Materials, methods and objects of research

The observations of the flowering of medicinal plants were carried out in the collection nursery of medicinal and essential oil plants of the St. Petersburg State Agrarian University (St. Petersburg-Pushkin, Northwestern region of the RF).

The objects of the study were the following types of medicinal plants: *Rhodiola rosea*, *Bergenia crassifolia, Symphytum officinale*, *S.asperum, Lithospermum erythrorhizon, Cichorium intybus*, *Echinacea purpurea*, *Inula helenium, Sylibum marianum*.

The soil of the plot is soddy-podzolic, highly cultivated. The content of humus is 3.5-3.9%. The dynamics of species flowering, determination of entomofauna, extraction of nectar and determination of sugars, calculation of pollen and seed productivity were carried out according to generally accepted methods [2, 3, 4, 5, 6].

Summer 2017 was cold and rainy, average temperatures were significantly lower than the average long-term values (table 1).

Table 1.
Temperature regime of the growing season 2017-2019

Month	Year	Decade of the month, ºC			Average for the month, ºC	The long-term average,ºC	Deviation from the long-term average, +/-
		1	2	3			
April	2017	6.3	0.8	4.9	4.0	5.9	– 1.9
	2018	5.8	8.2	7.2	7.1	5.9	+1.2
	2019	6.3	6.0	7.7	6.7	5.9	+0.8
May	2017	6.4	10.4	13.0	10.0	11.8	–1.8
	2018	11.7	16.1	14.7	14.2	11.8	+2.4
	2019	9.4	13.7	11.5	11.5	11.8	–0.3
June	2017	12.0	15.6	14.6	14.1	15.8	–1.7
	2018	14.1	17.9	16.3	16.1	15.8	+0.3
	2019	19.6	17.5	18.3	18.5	15.8	+2.7
July	2017	15.4	17.3	17.7	16.8	19.1	–2.3
	2018	15.8	22.0	20.2	19.3	19.1	+0.2
	2019	15.6	15.4	16.2	15.7	19.1	– 3.4

August	2017	18.6	19.7	15.6	17.9	17.2	+0.7
	2018	21.8	19.0	19.2	20.0	17.2	+2.8
	2019	14.4	17.1	16.5	16.0	17.2	–1.2
September	2017	13.4	14.5	11.1	13.0	12.4	+0.6
	2018	17.7	15.7	14.8	16.1	12.4	+3.7
	2019	12.7	11.5	12.5	12.2	12.4	–0.2

Precipitation in April, August and September exceeded the long-term average values, and in the remaining months were close to the multiyear average. Summer 2018 turned out to be favorable and warm, average monthly temperatures were above normal. Such weather conditions adversely affected the state of plants, they lagged behind in growth and development from the indicators of previous years.

The growing season of 2018 was very warm, the average monthly air temperatures were higher than the average long-term values. The amount of precipitation exceeded the norm only in April and September, the sum of active temperatures amounted to 2643.0ºC, effective temperatures - 2397.1ºC. Temperatures were unevenly distributed in 2019: in April and May, the average monthly temperature was close to the norm, in June it exceeded it by 2.7°C, and in July - below the norm by 3.4°C. Sufficient moisture fell in April and September, the rest of the months were dry. the sum of active temperatures was 2191.1 ºC, and effective temperatures were 1682.9ºC.

Analysis of weather conditions during the research showed that in terms of temperature and the amount of precipitation, 2018 was the most favorable for the growth and development of plants. 2019 was less favorable, 2017 was cool and rainy.

Research results

It is known that the relationship of plants with pollinating insects is established using the primary attractants - nectar and pollen. Secondary attractants are the color and shape of flowers, smell, nectar indicators - specks, stripes, dots. Flowers of entomophilous plants have special morphological and physiological adaptations that eliminate or limit autogamy and contribute to xenogamy [1]. Such mechanisms include herkogamy - the spatial separation of the stigma of the pistil and anthers, and dichogamy - the maturation of the anthers and stigma of the pistil at different times [2].

The flowers of most of the species studied by us have a bright color: crimson, pink, yellow, blue, etc. The inconspicuous whitish corollas of

Lithospermum erythrorhizon during the period of mass flowering stand out effectively against the background of green leaves and are noticeable to insects. *Symphytum asperum* changes its corolla color from red to blue during flowering. Observations have shown that pollinators are more attracted to blue flowers to collect nectar and pollen.

Small and medium-sized flowers of medicinal plants are usually collected in elementary and complex inflorescences of various types. Such inflorescences make them well visible to pollinating insects. So, bright inflorescences of the basket - in *Cichorium intybus*, *Echinacea purpurea*, *Inula helenium*, *Sylibum marianum*; double curls in thyrsus - in *Symphytum officinale*, *S. asperum* attract the attention of insects. An important feature of an entomophilous flower is the shape of the corolla: tubular-bell-shaped flowers are preferred by bees and bumblebees, and open ones - by hover flies. Tubular, ligulate, and pseudo-lingual corollas are found in species from the *Asteraceae* family, tubular-bell-shaped corollas are found in *Boraginaceae* and *Saxifragaceae*. The flowers of the studied species have nectar and pollen indicators in the form of specks and stripes [1]. The corollas of some medicinal plants are densely covered with short papillae, which help pollinators to stay on the flower (*Symphytum officinale, S. asperum, etc.*). Herkogamy was noted by us in most of the studied plant species [1]; they are also characterized by dichogamy in the form of protandria (earlier maturation of anthers).

A comparative analysis of the beginning of flowering of medicinal plant species by years showed that in the 1st and 2nd decades of May, *Rhodiola rosea* bloomed, bloomed for 2-3 weeks (tab. 2). *Rhodiola rosea* is a perennial succulent dioecious herb with a large horizontal rhizome. Unisexual yellow flowers are collected in corymbose inflorescences. Medicinal raw materials are rhizomes and roots [7]. The study of the flowers of *Rhodiola rosea* showed that the flowers are morphologically bisexual and functionally staminate. Androeum consists of 9-14 stamens, from 4 to 9-10 carpels are formed in the gynoecium, the ovules are underdeveloped, so there are no fruits and seeds. The double perianth is 4-5-membered. Sugar and pollen productivity is low.

Bergenia crassifolia – usually begins to bloom in the 1st half of May. It is a perennial herb with a thick rhizome. Medicinal raw materials are rhizomes and leaves [7]. The flowering stem is leafless and glabrous, the inflorescence is paniculate-corymbose. The flowers are regular, 5-6-membered, 10-16 mm long. Androecium consists of 10-12 stamens, and the gynoecium consists of 2-3 accrete carpels [1]. The color of the flowers is bright pink, so they are clearly visible to insects. Bumblebees and bees ac-

tively visit flowers. Sugar productivity and pollen productivity of this species are low. However, early flowering plants are very important to pollinators because are the very first food sources.

Early summer flowering plants include *Symphytum officinale* and *S. asperum*. *Symphytum officinale* is a perennial plant with a winged stem. Medicinal raw materials are roots, less often leaves. Used in folk medicine and homeopathy. It is included in the pharmacopoeias of some countries. *Symphytum officinale* blooms in late May - early June, mass flowering occurs in 7-15 days. The bright flowers of *Symphytum officinale* are collected in double curls that form the main and lateral thyrsus, and those form the combined inflorescences - synflorescences.

The color of the corollas is bright lilac, the flowers are 15–20 mm long, the nectaries are thickened at the base of the ovary. Each flower blooms for 2-3 days. During the growing season, in *Symphytum officinale*, reproductive shoots of two generations form, bloom and bear fruit. Depending on weather conditions, the break in flowering shoots of the first and second generation is 3-10 days. Honey productivity from 1 hectare of solid planting *Symphytum officinale* ranges from 150 to 630 kg [1].

Table 2.
Features of flowering and melliferous properties of some types of medicinal plants in 2017-2019.

Species	The beginning of flowering	Flowering duration, days	Pollen productivity of 100 flowers, mg	Sugar productivity of 100 flowers, mg	Seed productivity rate,%
Rhodiola rosea L. C*rassulaceae* *	15.05.2017 08.05.2018 10.05.2019	25 12 16	9.9 11.5 10.4	23.1 25.7 24.8	- - -
Bergenia crassifolia (L.) Frinsch Saxifragaceae	15.05.2017 10.05.2018 10.05.2019	12 10 11	10.7 13.7 13.5	15.2 18.5 16.7	25.7 29.3 29.5
Symphytum officinale L. *Boraginaceae*	01.06.2017 18.07.2017 27.05.2018 15.07.2018 30.05.2019 16.07.2019	33 25 27 20 31 22	195.1 183.7 198.8 196.5 195.7 193.9	150.0 147.8 165.1 164.8 151.6 153.5	51.7 45.3 55.8 60.1 48.4 47.9

S.asperum Lepech. *Boraginaceae*	01.06.2017 27.05.2018 30.05.2019	34 30 32	168.3 176.2 174.3	160.3 172.1 165.8	29.1 37.2 32.7
Lithospermum erythrorhizon Sieb.et Zucc. *Boraginaceae*	10.07.2017 23.06.2018 28.06.2019	44 25 35	85.8 94.1 85.4	10.5 12.6 11.2	66.2 68.6 70.3
Cichorium intybus L. *Asteraceae*	15.07.2017 20.06.2018 05.07.2019	41 45 42	29.6 32.3 32.5	9.9 12.6 8.9	74.8 75.3 74.5
Echinacea purpurea (L.) Moench *Asteraceae*	20.07.2017 10.07.2018 15.07.2019	60 65 63	19.8 26.7 25.1	52.4 61.1 54.6	71.4 78.3 79.2
Inula helenium L. *Asteraceae*	20.07.2017 10.07.2018 18.07.2019	37 55 45	15.8 20.5 19.4	8.5 28.3 19.6	81.2 82.7 83.2
Sylibum marianum (L.) Gaertn. *Asteraceae*	21.07.2017 15.07.2018 15.07.2019	15 15 14	11.4 19.7 13.6	25.9 48.1 32.6	70.5 75.2 72.4

*- plants with staminate flowers were studied

Symphytum asperum is a perennial herb, roots are used as medicinal raw materials [7]. Pink-blue tubular-bell-shaped flowers are collected in double curls. The structure of the complex inflorescence is the same as in the previous species. *S. asperum* is also an excellent nectar and pollen plant. Its honey productivity varies from 150 to 1000 kg/ha [1]. The flowering of these plant species provides food for bees and bumblebees in June-July. The duration of flowering of plants of this group in different years with different weather conditions ranged from 3 to 5 weeks.

Lithospermum erythrorhizon is a perennial plant found in the Far East, China and Japan. The roots contain a natural dye, shikonin, which is used in the cosmetic industry. *Lithospermum erythrorhizon* is cultivated in Korea and Japan as a medicinal plant and is used in traditional medicine [7]. In Northwest Russia, *Lithospermum erythrorhizon* blooms in the third decade of June. Five-membered whitish flowers 5-6 mm long have bilobate scales in the throat. Scales and a protective ring at the bottom of the corolla, which covers the nectaries, restrict access to the nectar. The pistil column

is not protruding from the corolla and is located at the same level with the anthers. Flowers are pollinated by honey bees, bumblebees and ants.

A group of medicinal plants from the *Asteraceae* family is an important source of nectar and pollen for pollinators in the second half of summer: *Cichorium* intybus, *Echinacea purpurea, Inula helenium, Sylibum marianum.* The beginning of their flowering is usually observed in July, and ends in autumn. The inflorescences of the basket of various shapes, colors and sizes consist of many flowers. The nectars are located in a receptacle around the ovary. The considered *Asteraceae* species are actively visited by bees, bumblebees and other pollinators, which ensures a high coefficient of seed productivity.

Cichorium intybus is a perennial herb, herb is a medicinal raw material. *Cichorium* roots are used in traditional medicine and food industry [7]. Even 20 years ago, this plant was quite rare in the Northwest, now it is found very often in yards and along roads. In our experience, *Cichorium* started blooming in June-July and bloomed for a long time. The bees actively collected nectar and pollen.

Echinacea purpurea is a perennial herb native to North America. Herbs, rhizomes and plant roots are used as medicinal raw materials [7]. Baskets of *Echinacea purpurea* form 150-200 tubular flowers. The marginal flowers are false-lingual, morphologically female, with underdeveloped ovules, therefore sterile, their purple color attracts bees and bumblebees.

Inula helenium is a perennial herb that has been growing in the medicinal plant nursery for 12 years. Baskets are large, fertile tubular flowers are yellow, marginal - pseudo-ligate bright yellow, do not form fruits.

Sylibum marianum is an annual herb, mature fruits are used as medicinal raw materials. Globular baskets contain tubular crimson flowers with hard, spiny leaves of the envelope. The plant is actively visited by bees and bumblebees, contributing to pollination and fruit formation.

Observations of the pollinators of medicinal plants showed that the flowers were visited by: honeybees - *Apis mellifera* L., gray Caucasian bees - *Apis mellifera caucasicus* L. and bumblebees - *Bombus hortorum* L., *B.*lucorum L., *B. lapidarius* L. and *B. derhamellus* Kirby., belonging to the order *Hymenoptera*. Small open flowers are visited by hoverflies from the order *Diptera*, family *Syrphidae*. From the order of the butterfly *Lepidoptera*, visitors were: the butterfly Admiral *Vanessa atalanta* L. and the day peacock's eye *Inachis io* L.

Conclusion

In conclusion, it should be noted that the studied species of medicinal

plants have morphological adaptations of flowers to pollination by insects that carry out xenogamy. The flowering of medicinal plants lasts from May to September and provides pollinators with nectar and pollen. The beginning of flowering of plants depended on the temperature conditions of the growing season. The low temperature regime of 2017 led to late blooming of all plant species. The favorable growing season of 2018 contributed to earlier flowering of plants. *Echinacea purpurea, Cichorium intybus, Inula helenium* had the longest flowering time. The highest sugar productivity and pollen productivity were observed in the *Symphytum* species. High seed productivity is characteristic of species from the *Asteraceae* family.

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NOTES

Scientific publication

International Conference
“Process Management and Scientific Developments”

Birmingham, United Kingdom
(Novotel Birmingham Centre, October 13, 2021)

Signed in print 19.10.2021 r. 60x84/16.
Ed. No. 1. Circulation of 500 copies.
Scientific publishing house Infinity, 2021.