SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the International Conference

Date: December 30

Beijing, China 2021

上合组织国家的科学研究：协同和一体化国际会议

参与者的英文报告

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

Participants’ reports in English

2021年12月30日。中国北京
December 30, 2021. Beijing, PRC

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

(December 30, 2021. Beijing, PRC)

ISBN 978-5-905695-82-7

这些会议文集结合了会议的材料 – 研究论文和科学工作者的论文报告。 它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。
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ISBN 978-5-905695-82-7

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DOI 10.34660/INF.2022.67.94.001

中国社会主义的兴起
THE RISE OF SOCIALISM IN CHINA

Mazur Oleg Anatolevich
Doctor of Economic Sciences, Rector of the Nevinnomyssk Institute of Economics, Management and Law, Vice President of the Working Academy Foundation, scientific consultant of the Russian Committee of workers

在中华人民共和国，在社会主义国家，在无产阶级专政的状态下，社会主义作为共产主义的第一阶段正在形成，正在从资本主义向社会主义过渡，社会主义的主要矛盾正在形成。过渡期解决了——共产主义生活方式（部门）与非共产主义结构（部门）之间的矛盾。为积极解决这一矛盾，必须实现工人阶级的利益：保证社会全体成员的全面发展，缩短工作日，增加实际工资，制定和实施长期——中国发展的长期规划。矛盾的定义对立面——中国的共产主义部门正在加剧，这引起了非共产主义结构，特别是私人垄断的相应反应。因此，中国统治阶级——工人阶级，由执政党——中国共产党所表达和实施的内部经济政策，将成为解决中国运动主要矛盾、进一步发展的决定性因素。中华人民共和国，全人类的发展都依赖于它。

关键词：中国，社会主义，共产主义部门，无产阶级专政，矛盾，工人阶级，中国共产党，过渡时期，俄罗斯，美国

Abstract. *In the People's Republic of China, in a socialist country, a state of the dictatorship of the proletariat, the formation of socialism as the first phase of communism is taking place, the transition from capitalism to socialism is taking place, the main contradiction of the transition period is resolved - the contradiction between the communist way of life (sector) of the economy and non-communist structures (sectors). For a positive resolution of this contradiction, it is necessary to realize the interests of the working class: to ensure the all-round development of all members of society, reduce the length of the working day, increase real wages, and develop and implement long-term plans for the development of China. The defining opposite of the contradiction - the communist sector in China, is intensifying, which causes a corresponding reaction of non-communist structures, especially the private monopoly. Consequently, the internal economic policy of the ruling class of China - the working class, expressed and implemented by the ruling*

party - the Communist Party of China, will become a decisive factor in resolving the main contradiction in the movement of China, the further development of the People's Republic of China, on which the development of all mankind currently depends.

***Keywords**: China, socialism, communist sector, dictatorship of the proletariat, contradiction, working class, Chinese Communist Party, transition period, Russia, USA.*

A socialist revolution took place in China, which led to the establishment of the People's Republic of China, - a socialist state, on October 1, 1949. The dictatorship of the proletariat was established. The Constitution of the PRC says: "a democratic dictatorship of the people led by the working class and based on the alliance of workers and peasants, that is, in essence, the dictatorship of the proletariat" [1]. That is, the dictatorship of the proletariat is viewed and implemented as an alliance of workers and peasants, but under the leadership, of course, of the working class and the vanguard of the working class - the Communist Party.

The People's Republic of China is a socialist state. Many people confuse the socialist state and the socialist society, identify and say: “In China, there are capitalists, there are monopolies, there is not even just private property, as it was in the transition period in the Soviet Union from capitalism to socialism, there are large monopoly associations. What kind of socialism can we speak of there?".

A distinction should be made: first, a socialist state is created - the dictatorship of the proletariat is created, then a socialist society is created through the dictatorship of the proletariat. This building of socialism takes a long transitional period, which can last for many years. In the Soviet Union, it lasted for about 20 years: from 1917 to the mid-1930s. In 1917, the dictatorship of the proletariat was established, the task of which is to overcome the multi-structure, which is the content of the transition period from capitalism to socialism. We had five orders: the most primitive - the patriarchal order; the petty-bourgeois way of life is mainly the peasants, who are both workers and owners, working for the market; private capitalist structure; the state-monopoly structure is state enterprises that work for profit, that is, they are not yet subordinate to the goals of socialism: ensuring complete well-being and free all-round development of all members of society; the communist system is a collection of large state-owned enterprises working according to a single plan in the public interest. Its advantages make it possible in the period of transition from capitalism to socialism to oust other structures, to defeat all other structures by economically higher labor productivity, organization, and planning. It is impossible to simply take and destroy, "abolish" non-communist structures, since they are rooted in certain productive forces, production relations, which have a long history and tradition.

In Russia, during the period of the so-called "war communism" caused by the civil war, most of the enterprises were nationalized [2]. These enterprises did not work for profit, they worked for the production of a direct social product necessary for victory in the civil war. Some of them became communist enterprises to the extent that they began to work according to a single plan in the interests of the whole society. The rest, who during the period of the so-called "new economic policy" began to work for profit, constituted a state-monopoly structure.

In Soviet Russia and then in the Soviet Union, the private capitalist structure was strictly limited by the state of the dictatorship of the proletariat: only a few people could be hired. The bourgeoisie did not behave calmly, by no means all the owners of production were capitalists, they put up with this. It took about twenty years to create a socialist economy. That is, one structure won - the communist one. Thus, structures as such have disappeared. Thus, the transitional period was completed and socialism was created as the first phase of communism.

Socialism is communism, but communism in its first, initial, lowest phase, communism is still undeveloped. The development of socialism occurs through the resolution of the contradiction of the communist movement in its first phase - the contradiction of the communist nature and its denial in itself, associated with the exit from capitalism. On closer examination, it appears as a contradiction between the direct social nature of socialist production and the moment of marketability, which is resolved by the struggle for the planned implementation of the priority of public interests. This priority is ensured by resolving the contradiction between the classless nature of communism and the moment of class (class differences) in the first phase of communism. The resolution of these contradictions is carried out by resolving the contradiction between the planned nature of socialist reproduction and the moment of spontaneity in its organization and the contradiction of the socialist nature of the system of state planned centralized management and the moments of careerism and bureaucracy, departmentalism and localism [3].

In industry, the communist structure began to take shape earlier than in agriculture. After nationalization, according to the plan, large new enterprises were created in the interests of society: tractor, metallurgical, automobile, aviation, chemical and other plants. In agriculture, there was a very difficult and difficult struggle: in the late 1920s - early 1930s, tens of thousands of artels were created through cooperation, in fact cooperatives working according to a single plan in the public interest, that is, another form of a unified public property - cooperative. Artels, which were called collective farms, collective farms, were integrated into a single national economy, systematically acting in the public interest. Only by preparing the material base: having created hundreds of thousands of tractors, mowers, reapers, and other agricultural equipment, equipping state machine and tractor stations with this equipment, working for collective farms and receiving natural products

from collective farms for their work, it was possible to create a cooperative economy, integrated through contracting into a national economic whole and working in the interests of the whole society.

Thus, the creation in the Soviet Union by the mid-30s of a socialized industry, transport and agriculture, working according to a single plan in the public interest, was the creation of socialism in material production as the basis of a socialist society. That is, in 1917 - the establishment of the dictatorship of the proletariat, and in the mid-30s - the creation of a socialist society as the first phase of communism.

In China, the universal laws of the creation of a communist society are being implemented with the peculiarities caused by the conditions and prerequisites that developed by 1949. If in Russia the socialist revolution first took place, and then the defeated bourgeoisie and aristocracy, with the support of the imperialists, unleashed a civil war, then in China the dictatorship of the proletariat was established as a result of the victory of the organized communist party of the People's Liberation Army of China over the army of the bourgeois-feudal Kuomintang.

Unlike a number of Central European countries, which created socialism directly in the presence of Soviet troops, and whose bourgeoisie could not afford to do what it did in China, the Chinese communists went through a very difficult, difficult and bloody path of struggle for their revolution, for the dictatorship of the proletariat starting in the twenties. The most difficult struggle against both the bourgeois government and Japanese militarism forged the Chinese Communist Party as a very powerful political force with its own army.

A huge role was played by the victory of the USSR over the Japanese troops in 1945. After Japan's surrender, the communists did not have to fight on two fronts - against the Kuomintang and against the Japanese invaders. On the territory of Manchuria, the Communist army was strengthened, which received captured Japanese weapons and equipment from the Soviet Union.

From 1946 to 1949, battles were fought, which began with the offensive of the bourgeois army and ended with the victory of the People's Liberation Army of China. This was not the so-called "export of revolution". A revolutionary situation arose in China and continued for many years, a revolutionary crisis, which was resolved by the Chinese working class, led by the Communist Party, in alliance with the Chinese peasantry, with the support and assistance of the Soviet Union.

But there is another feature that is rarely paid attention to. In fact, the Chinese communists, in their struggle against Japanese militarism, helped to prevent Japan from attacking the Soviet Union. The army of many thousands of Chinese communists is a significant factor that was taken into account by the Japanese state when deciding on non-aggression against the USSR. Thus, the Chinese communists, by their struggle against Japanese militarism, helped the struggle of the Soviet people against fascism.

In 50-60 years in the PRC on the basis of nationalized enterprises and factories built with the help of the Soviet Union, the basis of the Chinese economy - the communist way of life - was created. Agriculture was dominated by communes working on state land with the help of the state irrigation system. The private capitalist, petty-bourgeois structures were seriously limited. The patriarchal structure was also preserved due to the backwardness of the productive forces. At the same time, the question arises to what extent those communes that were based on technologies with a predominance of manual, non-mechanized labor can be considered a form of socialized production. In the Soviet Union in the 1920s and 1930s, public ownership of the means of production was ensured both by state ownership of land and by the merging of cities and villages, industry and agriculture on the basis of the creation and operation of state machine and tractor stations, which ensure the mechanization of agriculture, the planned receipt through the contracting of collective farm products to the state, the work of collective farms in the public interest. In the case of non-mechanized, manual, even organized, collective labor of commune workers, these communes remain collective enterprises, not fully involved in a single social production.

In China, in the 1980s, as a result of reforms that allowed the creation of private enterprises, an expanded reproduction of non-communist structures took place. The patriarchal order has not disappeared anywhere, but now, due to the accelerated growth of productive forces, it is rapidly declining. There was a rapid growth of the petty-bourgeois way of life. The private capitalist structure also grew rapidly. But there is such a feature, in contrast to the Soviet Union in the 1920s and early 1930s: in China, not only a private capitalist structure developed, but a private monopoly structure also emerged. A monopoly is such a large capitalist organization that can significantly influence the course of processes in the market, can influence prices, lower purchase prices for itself, raise prices for what is sold. And this creates a peculiar situation. On the one hand, the private monopoly structure is a serious competitor for the communist structure, and, on the other hand, this structure is already monopolized, large-scale production prepared for socialization. And now, as well as in the future, everything depends on what policy the Chinese state, led by the Chinese Communist Party, is pursuing and will pursue.

Now in China there is a question that stood in the USSR in the 1920s and in the early 1930s: What kind of structure will prevail in the People's Republic of China, which is in the transition period from capitalism to socialism? The fate of China depends on this, and, given the importance and role of China in the world, the fate of the development of all mankind.

If ten years ago there was a strong tendency towards an increase in the share of the private capitalist structure, including the private monopoly structure, now a certain turn is taking place. It began with such external processes as putting things

in order in culture, weakening the ideological influence of the United States, putting television under control, and restricting individual entrepreneurship in education. These are seemingly obvious processes.

But deeper processes are also taking place. The leadership of the PRC is gradually putting under state control significant spheres of the economy, which are still dominated by private enterprises: housing construction, Internet companies, including Internet commerce.

More importantly, the role of directive planning is gradually increasing, aimed at achieving certain national economic tasks, such as: the creation of a system of high-speed railways connecting the whole country, space objects, the development of hydropower and the construction of nuclear power plants, the creation of the world's largest merchant fleet, modern systems weapons capable of withstanding the weapons of the United States and its allies. An indicative indicator such as GDP plays a less and less important role in the system of economic management, while the role of natural indicators is growing.

It is extremely important that the leadership of the PRC began to pay serious attention to a parameter that determines the development of workers and the entire country - the length of the working day. Requirements for compliance with labor laws providing for an 8-hour working day are being strengthened. This is important because so many organizations encourage overtime. In some offices, the so-called "formula" of the working day "996" is implemented, that is, work from 9 am to 9 pm 6 days a week. The authorities have begun to tackle these violations of labor laws. The struggle for normal working hours and their shortening is a strategic direction in the struggle for the socialist future of China. Neither worker nor employee can develop if he works 12 hours a day - this is a work of wear and tear. For the normal development of the working class and the country as a whole, it is necessary to normalize the length of the working day and ensure its reduction to 7, and then to 6 hours.

Is it possible that the capitalist structures will win? Yes, it is possible, provided the communist system weakened, the directional planning and the leading role of the Chinese Communist Party were abandoned. And, unfortunately, such a negative trend also exists in the development of China, which is reflected in the ideological sphere as well. Unfortunately, the most important documents of the CPC still use the term "socialist market economy." This is a phrase from the arsenal of the 1968 Czechoslovak counter-revolution and the counter-revolution in the USSR in the 1980s. The market is a sphere of exchange in commodity production, which is the basis of capitalist production. Commodity production, the market, spreading to the relations of reproduction of labor power, giving rise to the purchase and sale of labor power, gave rise to capitalist production as its universal form. Socialist production is the opposite of commodity, capitalist production. If

capitalist production is social production mediated by exchange (market), then socialist production is **directly social** production. And the fact that in the transition period from capitalism to socialism, as it is now in China, the capitalist way of life (with its inherent market) and the communist (socialist) way of life with its inherent planned economy coexist and fight, in no way leads to a "socialist market", but leads to the victory of the direct social economy.

As soon as the communist structure supplants the capitalist structure in the process of socialist creation, a single planned economy is created that works in the interests of society, realizing the goal of all-round development of all members of society, and the elements of the market that previously "served" the capitalist structure disappear.

In reality, there is not a symbiosis of "socialism" and "market", not a "fusion" of socialism (the first phase of communism) and capitalism, but there is a unity and struggle between the communist way of life and the capitalist way, that is, their **contradiction**. And how this struggle ends depends, of course, on the position of the Chinese Communist Party and the Chinese working class.

The working class of China is by no means a passive working class, complacent and conciliatory. In China, strikes are not uncommon. The Chinese working class, in its history, like the working class of Russia, has a huge revolutionary past, experience in the struggle for its interests and a revolutionary present. The Chinese working class shows that it knows its purpose and objectives, and its vanguard is the Communist Party, the ruling party in China. And the fact that at present the tendency of the development of the communist system in China is increasing is known to any objective researcher.

If the communist sector (in the PRC, structures are called sectors) of the economy is defeated, then China has no future. Based on the capitalist sector of the economy, China will never retain its sovereignty or win the economic struggle against the center of imperialism and its allies. The victory of the capitalist system in China would lead, as in the USSR, to the destruction of a single country and to a civil war with enormous casualties.

The fact that the People's Republic of China has the largest economy in the world cannot remain unanswered by the world imperialist center - the United States, the financial capital of the United States as the leader of the capitalist part of the world.

The main enemy of the US financial capital is the PRC. Capitalist Russia is also a rival to the United States, but for a different reason. Russia is independent, sovereign in many ways, but, unfortunately, not in all. In Russia, there is a struggle between the bourgeoisie, which is getting rich as a result of the development of the productive forces of Russia ("the domestic bourgeoisie") and the bourgeoisie, which is getting rich in processes beneficial to foreign capital (the "comprador

bourgeoisie"). The domestic bourgeoisie, which is strengthening as Russia develops, is interested in bringing Russia and China closer in the fight against the imperialist center of the capitalist part of the world - the United States, with the financial capital of the United States, which seeks to take away its property from the Russian bourgeoisie. Losing its dominance in the world economy, the United States of America is forced to look for ways and methods to preserve and increase the sources of exploitation - and above all, ways to restore its leadership in the world economy. Consequently, the United States is taking actions that impede the development of its main competitor, the PRC. It is these actions that make up the policy of the US leadership: setting high customs tariffs on goods from China, banning the export of technology to China, increasing the activity of the navy in the communications of the PRC, hindering China's cooperation with many countries, and first of all, with Russia.

The anti-Chinese policy of the United States, which aims to hinder the development of China, at the same time forms the preconditions for the strengthening of the communist structure (sector) of the economy of the PRC:

1. The confrontation with the United States requires the accelerated development of the military-industrial complex (MIC), based on the communist way. China's military-industrial complex cannot be based on a capitalist structure, since it requires huge investments, which only the state is capable of. The elements of the capitalist structure, involved in the execution of the state military order, are essentially subordinate to the planned economy, that is, the communist structure.
2. With the aim of influencing the PRC, the United States has introduced various sanctions, which will only increase. The capitalist sector is more vulnerable in a situation with sanctions, as it is more export-oriented and has less financial and organizational support from the state. Consequently, the communist sector will grow stronger as sanctions intensify.
3. The obstruction of China's exports to the United States necessitates a reorientation towards the development of domestic consumption, which requires strengthening state management of the economy and state financial, including budgetary support, which also contributes to the development of the communist system.
4. The US policy of "containing" China will inevitably intensify China's cooperation with countries not subordinate to the United States. Foreign economic relations are under the control, and often under the direct control of the Chinese state, which relies on the state, communist sector of the economy in foreign economic relations.
5. In the confrontation with the United States, the maintenance of social stability in China is of particular importance, which can be ensured if the working and living conditions of the majority of the country's population are improved.

This condition requires further dynamic development of China, high rates of economic growth, growth in real wages of most workers and employees, improvement of working conditions, accelerated development of the central, western and northern regions of the country.

Consequently, it is necessary not only to mobilize and use huge financial resources, but also state management of production processes, it is necessary to develop a systematic approach, the creation and implementation of medium-term and long-term development plans of the country. In solving this problem, the leadership of the PRC can rely and be based on the development of the communist sector of the economy, the natural form of movement of which is planning. Without planned mobilization, distribution and use of resources, China will not be able to withstand the confrontation with the United States. On the other hand, it is precisely the use of the advantages of planned economic management, which the United States does not have, that will ensure the success of China in the economic and political confrontation with the United States.

China has reached a technological level at which further import of technology and foreign investment will not give a rapid economic growth of 7-10% per year. The effect of technology imports is being exhausted. And China needs such growth. For rapid development, it is necessary to advance the development of production of means of production (Division I), and within this division - the production of means of production for the production of means of production. A structural reversal from the export orientation of the Chinese economy (which depends on the market conditions in the USA, the EU and other countries and in the structure of which consumer goods prevail) to an orientation towards the development needs of Chinese society, which are based on the accelerated development of the electric power industry and mechanical engineering (in particular, machine-tool industry) requires trillions of investments and planned management of the national economy.

The development of the electric power industry and mechanical engineering for agriculture creates conditions for the formation of large agricultural and agro-industrial enterprises, in which labor productivity and productivity will be several times higher than those in enterprises based on family contracts. Replacing manual labor with mechanized and automated labor will make it possible to recreate agricultural communes at a new, modern technical level, which is facilitated by the fact that state ownership of land dominates in the PRC. As communes and other forms of collective enterprises are re-established and subordinated to the public interest, public ownership in agriculture will be established. Only a socialist transformation of agriculture will ensure reliable food and raw material security for China, which is critically important in the face of the threat of stopping food imports from the United States and Canada.

So far, most Chinese people live worse than most people in the United States. But the growth rate of the Chinese economy is much higher than that of the United States. In addition, the United States is experiencing cyclical crises typical of capitalism. And China, even during a pandemic, is growing economically, in China there is a huge growth potential, provided that the central, western and northern regions are pulled up to the level of development of the southeastern regions. China is now shifting the center of gravity of its economic work to the development of domestic consumption. If (when) the standard of living of one billion four hundred million people reaches at least the world average, then the Chinese economy will exceed the production of the United States together with the EU countries.

Can the imperialist center stop China's development and reverse it?

Outwardly, by military means - it is impossible, it is obvious. So far, China is lagging behind in its nuclear rivalry with the United States. But the Chinese military potential and the military potential of Russia collectively exceed the military potential of the United States, including in nuclear weapons.

How can the development of the People's Republic of China be stopped?

Only on condition that the bourgeoisie wins in the class struggle waged by the Chinese working class against the bourgeoisie. That is, if what happened in the USSR happens - counter-revolution. This cannot be ruled out. But the Chinese Communist Party - the vanguard of the Chinese working class itself - must rule out counter-revolution. All the prerequisites and conditions for this have been created.

The CPC has its own rich experience in the struggle for socialism, the CPC has been enriched by the experience of its achievements and mistakes, the experience of the achievements and mistakes of the CPSU, it has studied the experience of the betrayal of Communist principles by Khrushchev and his entourage. In its struggle, the CCP relies on the world's largest working class in China, organizing the realization of the fundamental interests of the working class, which are the interests of all social development. The interests of the working class are realized in the process and as a result of the class struggle for the all-round development of all members of society, for reducing the length of the working day, working shift, for improving working conditions, for increasing the real wages of workers, for the development of domestic production, for the strengthening of the communist sector of production, for the development of directive medium-term and long-term planning of the country's development, for the development of the state-capitalist sector on this basis into the communist one and the gradual ousting of the private capitalist sector as a result of the successes of the communist sector, for the transformation of the petty-bourgeois sector into collective farms and communes working for the benefit of the whole community.

Such transformations inevitably meet with resistance from the bourgeoisie and its supporters in the system of government, including in the Communist Party it-

self. The emergence of supporters of the bourgeoisie among the leaders of the party is inevitable. There are significantly more than a billion people in the People's Republic of China who are interested in ensuring that the formation of socialism in China is completed successfully - the creation of a socialist society. There are also millions of those in China who are fighting for the capitalist path of China's development, that is, those who are the spokesmen for the interests of the capitalist system. The class struggle takes on a wide variety of forms: it is an open struggle against the bourgeoisie and petty bourgeoisie, it is also a struggle against careerism, bureaucracy, departmentalism and parochialism, and the struggle against corruption and crime in general.

In the Soviet Union, during the period of transition to socialism, the class struggle manifested itself clearly: it was a struggle against the kulaks, and against sabotage, against political opposition. In the Comintern, these contradictions were openly examined, exposed, shown to all communists, and not only to communists: what the opposition stands for, what harm will be done if this opposition wins. Such openness is not visible in China; the processes of class struggle are proceeding in more hidden forms.

Consequently, it is necessary to study not always obvious phenomena, to reveal the essence of the processes of struggle between private monopoly and state-monopoly corporations, to consider how the development of the communist sector is going on, what changes are taking place in ideology.

The leadership of the Chinese Communist Party again set the task of training party cadres, teaching Marxism-Leninism, studying the works of Mao Zedong, Xi Jinping. Serious state control is established over the content of television programs, and individual entrepreneurship in the field of education is limited. Communists from all over the world cannot help but be impressed by the position of the Chinese communists about the "community of the common destiny of mankind". The communists believe that this term means the communist future. At the same time, it is possible that this provision means peaceful coexistence, equality of countries, the absence of hegemony and the preservation of nature and life on Earth. And how can you reliably save life on Earth? Capitalism, especially in the form of imperialism, does a poor job of preserving life. Hundreds of millions have died and are maimed in world wars, hundreds of millions have died from hunger and disease caused by poverty. And only a communist society, the goal of which is the complete well-being and all-round development of all members of society, is fully capable of solving the problem of preserving and developing life on Earth.

And in the sphere of the Chinese economy, there are tendencies to strengthen the public sector. For example, the state control over the largest Internet companies is strengthening, the activities of large construction companies that receive super-profits on the sale of expensive housing are limited, and state support is

provided for state corporations working according to the state plan and programs.

Expanded reproduction of the communist sector of the economy is the law of the transition period from capitalism to socialism as the first phase of communism. It occurs as a result of the resolution of the contradiction between the communist economic structure and non-communist structures, which inevitably intensifies as one or both opposites become stronger. One of the opposites - the communist way of life in China, is strengthening, which causes a corresponding reaction of the non-communist way of life, especially the private monopoly. Consequently, the internal economic policy of the ruling class of China - the working class, expressed and implemented by the ruling party - the Communist Party of China, will become a decisive factor in resolving the main contradiction in the movement of China, the further development of the People's Republic of China, on which the development of all mankind currently depends.

References

1. Constitution of the People's Republic of China. URL: https://chinalaw.center/constitutional_law/china_constitution_revised_2018_russian (Appeal date: 17.10.2021).

2. The "New Economic Policy" is new only in relation to "War Communism". In reality, this "New Economic Policy" did not essentially differ from the policy pursued by the Bolsheviks from October 1917 until the counter-revolutionaries unleashed a civil war supported by the intervention.

3. See: Popov M.V. Planned resolution of the contradictions in the development of socialism as the first phase of communism. Leningrad. Leningrad University Publishing House,1986. P. 153-154.

DOI 10.34660/INF.2022.23.78.001

Dota 2 投注预测服务预览
DOTA 2 BETTING PREDICTION SERVICE PREVIEW

Stepanov Yuriy Aleksandrovich
Doctor of Technical Sciences, Full Professor
Grigorev Sergey Aleksandrovich
Master in Applied Informatics
Burmin Leonid Nikolaevich
Candidate of Technical Sciences, Associate Professor
Kemerovo State University

抽象的。随着电子竞技行业的发展，对电脑游戏比赛的投注量也在增长。这个方向同时结合了两个活动领域——博彩公司和电子竞技。对于每个投注者来说，预测的可靠性问题都会急剧出现。用于预测匹配的服务将根据使用 Breiman bagging 方法和随机子空间方法的既定算法进行计算，从而消除人在做出决定时的情绪成分。本文涉及基于机器学习方法开发用于预测电子竞技学科“Dota 2”中的比赛结果的服务。在决定使用该服务后，计划维护一个发布预测的 Telegram 频道。但是，建议的预测服务不提供任何获胜保证，最终决定权将始终留给冒着财务资源风险的人。

关键词：电子竞技、预测、投注、机器学习、Dota 2、神经网络。

Abstract. *Along with the growth of the esports industry, so too is the volume of bets on computer games competitions. This direction combines two areas of activity at once - bookmakers and e-sports. The problem of the reliability of the prediction arises sharply for every bettor. The service for predicting matches will remove the emotional component in making a decision from a person based on calculations according to a laid down algorithm using the Breiman bagging method and the method of random subspaces. The article deals with the development of a service for predicting match results in the eSports discipline "Dota 2" based on machine learning methods. After deciding to put the service into use it is planned to maintain a Telegram channel with the publication of forecasts. However, the proposed forecasting service does not provide any guarantees of winning, and the last word will always remain with the person who will risk their financial resources.*

Keywords: *esports, predictions, bets, machine learning, Dota 2, neural network.*

Every year the Internet sphere is actively developing. Previously it was believed that the main purpose of the Internet is access to information and the exchange of data between users. Following this, with the help of the Internet, the distribution of entertainment content began, as well as the development of the gaming industry. Online games began to appear, both individual and team, bringing together people from different cities and countries of the world. The increase in the audience of online games led to the emergence of the first tournaments. This marked the beginning of such a phenomenon as esports.

The most popular esports disciplines at present are such games as Dota 2 and Counter-Strike: Global Offensive.

At the end of 2021 the international sports organization International e-Sports Federation unites 109 national federations of different countries [1].

Initially, the e-sports audience was relatively small, but the increase in the number of disciplines, tournaments, the emergence of new teams and the further emergence of specialized lighting studios have significantly increased the influx of new audiences. The massive distribution of eSports attracts not only potential viewers, but also large international companies that actively fund eSports tournaments and teams to attract the attention of buyers to their products or services. It is enough to consider the Russian team Virtus.Pro. For more than four years, Virtus.pro has been sponsored by BenQ, a computer and electronics manufacturer. On May 18, 2017, a partnership between PepsiCo and ESforce was announced. Adrenaline Rush logo appeared on the uniforms of all Virtus.pro rosters [2]. On July 1, 2020, the car brand Haval became a sponsor of the Virtus.pro Dota 2 roster. This is not a complete list of all the partners that this team has changed from tournament to tournament.

Along with the growth of the esports industry, the volume of bets on computer games competitions also grows. This direction combines two areas of activity at once - bookmakers and e-sports.

Kemerovo Region ranks 54th in the ranking of regions in terms of population income, compiled by RIA Rating (published on July 8, 2021). Kuzbass is in the bottom half of the list of 85 regions. When compiling the rating, experts also assessed the share of the population below the poverty line and below the extreme poverty line. In the Kemerovo region it is 15% and 1.7% respectively. That is, more than 45 thousand Kuzbass residents do not just feel the need for money, but literally struggle financially for their survival [3].

In search of quick money, as well as without physical effort, more and more people are attracted to look for earnings on the Internet. Bookmakers seem to be one of the attractive ways to earn money. Young people (students) who have reached the age of 18 are ready to put "money for lunch" in the hope of making some profit.

To analyze the match correctly and make a profitable forecast for it is an extremely time-consuming job that requires in-depth analysis of the form and condition in which both teams are located. But even after doing such a job, there are no guarantees that "your team" will not make a mistake in choosing the strategy of the game and the selection of characters. In addition, it is very difficult to win systematically in psychological terms, when winning, the excitement and the feeling of "victory" dominates the calculated choice and the money is not just returned to the bookmaker, but he also earns from such players.

Bookmakers earn more and more every year. According to Forbes for 2019, the Fonbet betting company received 38.1 million rubles of profit. The publication noted that the ten leaders of the rating received 188.8 billion rubles in revenue for 2019, which is 67 billion rubles more than in 2018 [5].

But it's not just bookmakers who win. Former owner of the organization Virtus.pro Anton Sneg1 Cherepennikov won a record amount among all BC users from Russia and the CIS who made bets on esports. He earned 44 million rubles by betting 1.5 million rubles on the victory of Team Spirit at The International 10 (2021) Dota 2 with a coefficient of 29.00 in the betting company Parimatch. This was told by representatives of the BC.

In May 2020, a client of the betting company Parimatch collected an express of ten events in Dota 2 tournament matches. The total coefficient of his express was 435.00, which at a rate of 14.3 thousand rubles brought a gain of 6.2 million rubles [4].

Of course, such major victories are rare. Those people who make such successful predictions are either geniuses or lucky ones.

One of the ways to get forecasts on the Internet are cappers. They gather an audience around them, bribing people with huge winnings. They publish their successes, most often keeping silent about the real financial picture, most have several channels in telegram and on YouTube. They promise to double the capital in a month or even less. They offer unimaginable profits for small amounts. As a result, the saying "a miser pays twice" works. In defense of the cappers, it is worth saying that there are also "honest" ones who share their forecasts for free, without requiring any financial return from the audience.

The second method, more accessible, but just as effective, is forecasts from specific media personalities, former players or commentators.

And an option, the use of machine learning methods. Machine learning is a class of methods whose characteristic feature is not the direct solution of a problem but learning in the process of applying solutions to many similar problems. This method is considered both from the point of view of an interesting task in programming, and financial efficiency, increasing profitability with minimal risks.

To remove the burden of responsibility for decision-making from a person, to

remove the emotional component, which often harms decision-making, a neural network was chosen as the basis for development. An accessible neural network with a teacher will be taken as a basis, which will be trained using various algorithms to make a forecast for the outcome of one event. There will be a forecast based on several algorithms, including previous meetings, if there have been such over the past 18 months. One of the algorithms will be based on a mathematical model, which is based on the peak of the heroes at the beginning of the game at the draft stage, without considering the player's performance.

The aim of the work is to develop a service for predicting the results of matches in the esports discipline "Dota 2" based on machine learning methods.

The following machine learning methods are used in the work: logical regression, adaptive boosting and the k-nearest neighbors method [6].

The subject of the study is the peculiarities of using machine learning methods in solving the problem of predicting matches in the esports discipline "Dota 2".

The process of developing the service is divided into two parts: creating an algorithm for predicting results, as well as choosing a method for interacting with the end user.

The service will be divided into 5 modules (Figure 1):

- Data entry module, which teams and which characters are played, on which roles are filled. The draft stage is often crucial. No matter how well professional players play, the one who is stronger wins. The results of the draft are entered in a special form. After entering the data, it will be sent to the existing database for checking similar games:

- The module checks the database, checks the values of "GPM" and "XPM" for past matches, the average values of a certain player on a specific character, which are transmitted to the next module. This module will interact with a special database that will be parsed from the official games statistics collection site. The data in the database is not accumulated, matches are stored only for the last 18 months.

- The module for performing calculations by parameters performs calculations according to the embedded algorithm using the Breiman bagging method and the method of random subspaces. As a result, the digital values are passed to the next module.

- The decision-making module will compare the received digital values with the standard, and with minor deviations there will be a reliable forecast for data output, and with significant deviations, digital results will be transmitted.

-The forecast recommendation output module shows the solution that was obtained from the previous module in the form of a color image.

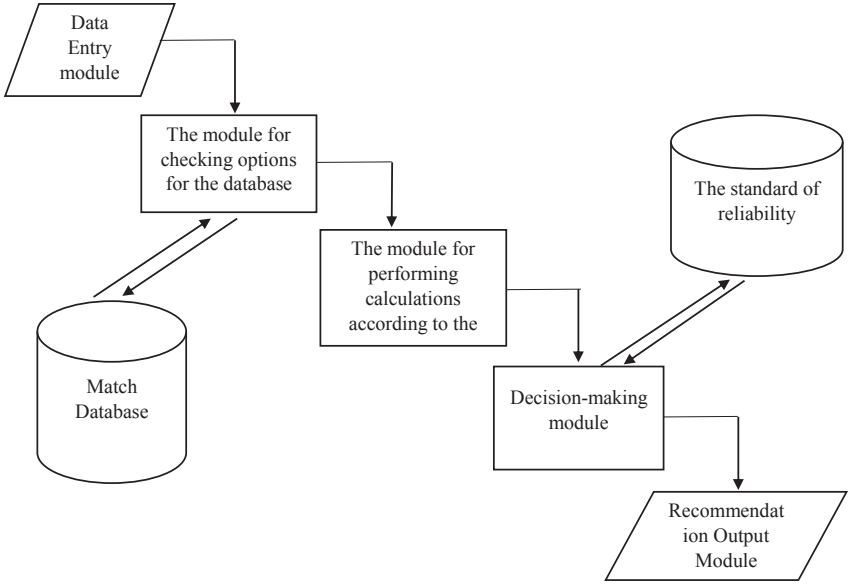


Figure 1. *Conceptual model of forecasting service*

The prediction algorithm assumes the use of 13 parameters for forecasting, of which "GPM" and "XPM" are the main ones, but they have different significance depending on the role of the character in the team. For example, "GPM" is more important on the main role than on the support role. Considering the first game of TSpirit vs PSG LGD for 07.10.2021, you can see that the difference between the "GPM" of the main role players in each team is 135, which was decisive in the outcome. The Ame player showed a higher result, which led his team to victory in this very game.

Considering the second game of the same day of these teams, you can notice an almost equal game of the characters of the support role, whose indicators for "XPM" are TSpirit 340 and PSG LGD 359. The parameter is important, but the characters of the support role of the game do not win, and even with the same indicators, PSG LGD won the game [7].

If the ratio of the values of the initial data processing by the algorithm is greater than 0.75, there will be a recommendation for a bet, in the case of indicators below, confidence in the forecast will decrease and there will be a warning about risks (Figure 2). The recommendation for the forecast is made in favor of the team with a value of 0.8.

Дата прогноза 19.12.2021	
Рекомендация на прогноз	
Natus Vincere	0,8
Unique	0,2

***Figure 2**. The result of making a decision on a successful forecast*

After the decision is made to put the service into use, it is planned to maintain the channel's Telegrams, with the publication of forecasts made by our service. Forecasts are not planned to be sold or profit from the channel's audience in any other way. All profits will be made only by betting on esports events within the framework of tournaments. Games played by teams not at official tournaments are not taken into account, because the teams have no motivation for a serious demonstration game. It should be understood that the proposed service for predicting winning heroes does not give any guarantees, and the last word will always remain with the person who will risk his financial resources.

References

1. International Esports Federation [Electronic resource] URL: https://iesf.org/

2. PepsiCo and ESforce announced a partnership - Industry on DTF [Electronic resource] URL: https://dtf.ru/gameindustry/

3. RIA Rating [Electronic resource] URL: https://riarating.ru

4. Dota 2 - news, updates, patches, guides, tournament, website, videos, heroes | Cybersport.ru [Electronic resource] URL: https://www.cybersport.ru/dota-2

5. Forbes.ru | The main thing about billionaires, business, finance and investments in Russia and the world [Electronic resource] URL: www.forbes.ru

6. Logistic regression [Electronic resource]. URL: http://statistica.ru/theory/logisticheskaya-regressiya/

7. Gioco PSG.LGD vs TSpirit. Partita 07.10.2021 at The International X Dota 2 [Electronic resource] URL: https://game-tournaments.com/dota-2/international-2021/group-stage/psg-lgd-vs-spirit-406369

DOI 10.34660/INF.2022.39.39.002

俄罗斯联邦轧管业通过国家经济安全的棱镜。 第 1 部分：战略规划
THE PIPE ROLLING INDUSTRY OF THE RUSSIAN FEDERATION THROUGH THE PRISM OF THE ECONOMIC SECURITY OF THE STATE. PART 1: STRATEGIC PLANNING

Malyutina Tatiana Dmitrievna
Candidate of Economic Sciences, Associate Professor
Volzhskiy Institute of Economics, Pedagogy and Law, Volzhskiy,
Commercial Director
LLC "Trading House "Seversnab", Volzhskiy

如今，俄罗斯经济在经济安全领域面临新的长期系统性挑战，体现在轧管行业发展的内部壁垒出现。 文章试图揭示通过执行现行的联邦法律、法令、决议、命令和俄罗斯联邦总统和总统的决议草案来确保经济安全的概念。 文章揭示了对国家的主要内部威胁与对行业经济安全的威胁之间的平行关系，这是国家经济整体的战略性重要系统形成环节。 提出的问题是关于行业战略规划的重要性，显然是基于政府实施战略和计划的计划。

关键词：经济安全，轧管企业，内部威胁，公共管理，战略规划

Abstract. *Today, the Russian economy faces new long-term systemic challenges in the field of economic security, which are reflected in the emergence of internal barriers to the development of the pipe rolling industry. The article makes an attempt by the author to reveal the concept of ensuring economic security through the implementation of the current Federal Laws, Decrees, Resolutions, Orders and Draft Resolutions of the Government and the President of the Russian Federation. The article reveals a parallel between the main internal threats to the state and threats to the economic security of the industry, which is a strategically important system-forming link of the country's economy as a whole. The question is raised about the importance of strategic planning for the industry, clearly based on government plans for the implementation of strategies and programs.*

Keywords: *economic security, pipe rolling enterprises, internal threats, public administration, strategic planning*

Introduction

In the face of new threats and challenges caused by political and economic instability and the unpredictability of an open world market with double standards

of a competitive environment, large manufacturing companies and entire industries are faced with ensuring their economic security. In this situation, almost all the risks of economic activity fall on the shoulders of the business, which has complete independence in making decisions in the field of determining the development strategy and other management decisions from organizing production and marketing products to choosing contractors and sources of financial resources. In this connection, before the industrial complex and the state, the solution of the problem of integrating the country's economic interests into all levels of economic entities is of primary importance, that is, state structures must use all the powers in their hands to ensure the effective functioning of industrial enterprises.

Challenges and threats to the pipe rolling industry in the light of the economic security of the state

The problems of economic security and sustainable development of not only enterprises, but also industries in general, identifying factors (Figure 1) that affect their condition are reflected in the scientific works of domestic and foreign researchers, namely, they are considered in the works of the following authors: T.N. Agapova, N.V. Artemieva, S.V. Bank, V.I. Barilenko, N.S. Bezuglaya, S.Yu. Glazyev, S. Yu. Grunin, A.K. Djordiu, A.A. Dynkin, A. Yu. Evseeva, O. V. Efimova, A.V. Ivanova, L.K. Ivanova, V.V. Kovalev, G.V. Kozachenko, T.E. Kochergina, A.N. Litvinenko, M.N. Pavlenkova, V.L. Pozdeev, M. Porter, Yu.A. Salikov, A.E. Suglobov, V.L. Tambovtseva, A.V. Kharlamov, A.I. Khoreva, A.D. Sheremet, M.V. Shiryaev, J. Schumpeter et al.

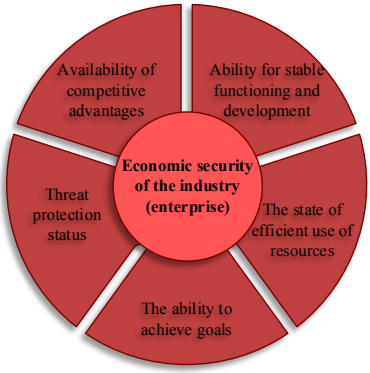


Figure 1 – Generalized Factors Determining Economic Security

Source: compiled by the author based on the data [1, p. 12], [2, p. 24], [3, p. 172]

The economic stability of the industrial complex is due to the creation of an active part of fixed capital, the use of the latest technologies, methods of manage-

ment and management. The pipe rolling enterprises included in its structure are considered the foundation for generating innovative development and are one of the strategically important components for the Russian Federation, their financial and economic activities are reflected in the level of sustainability of state development as a whole [4].

The instability of the external economic environment, tough competition in the domestic and foreign sales markets, price volatility in the world pipe market, the effect of international anti-dumping measures, as well as internal production issues are just some of the factors that confirm the fact that pipe rolling enterprises are functioning and management decisions in the face of constant uncertainty. But all these conditions are only a projection of the most important criteria of the country's economic security, which consist of ensuring its competitiveness, scientific and innovative potential, the state of infrastructure, the quality of human capital, as well as the effectiveness of the management system as a whole (Figure 2). Achievement of these criteria is possible by increasing the efficiency of state forecasting and planning, resistance to the impact of systemic threats and challenges to economic security.

Figure 2 – Main internal threats to the Russian Federation

Source: [5]

In modern conditions, for the pipe-rolling industry, it is possible to provide adequate actions to respond to the entire range of challenges and threats, providing

guarantees of economic security, only through the determination of business development priorities with the joint intervention of state authorities.

Having considered the entire range of challenges and threats in the light of the economic security of the state, the pipe industry can be monitored through SWOT analysis to identify its strengths and weaknesses, as well as opportunities and limitations to expand the presence of Russian companies in the domestic and global markets (Table 1) [6].

Thus, based on monitoring the economic security of the pipe rolling industry in 2021 through SWOT analysis, it can be concluded that the industrial complex of Russia today faces an acute economic problem of import substitution in the field of modernization of production and wear of the transport system (oil pipelines, gas pipelines, water pipelines, etc.). To solve it, it is necessary to launch a mechanism for the innovative development of pipe-rolling production with the use of high technologies. The state, together with business, should pay close attention to the rational distribution of investments not only for the introduction and development of domestic special equipment that is not inferior to Western counterparts, but also for the production of pipeline transport technological systems, which should ensure the reliability of all those. processes of modernized enterprises and be carried out taking into account the possibility of their high-quality management and maintenance [6].

Today, during the lockdowns of the COVID-19 pandemic, which became a catalyst for economic problems, when numerous sanctions and the West's line of "containment of Russia" force many foreign partners to show growing restraint in matters of business cooperation, especially in the implementation of new joint projects, requires the state to play a more active role in promoting innovation, science, etc., that is, conducting a policy in the field of ensuring economic security on the principle of "security through development".

The development of certain trends in ensuring economic security is always based on the highest long-term national-state interests, that is, on state strategic planning. Therefore, this process is inextricably linked with the future of the country, with the ideas of the socio-economic model that should be formed as a result of the ongoing internal and external economic changes. Consequently, priority areas of economic policy should be developed in the area of the pipe-rolling industry, which is strategically important for the state as a whole.

Russia should not allow its economy to be critically dependent on imports of the most important types of products, the production of which can be organized at the required level in the country. At the same time, it is necessary to develop its economy, taking into account foreign economic cooperation, international cooperation of production. The most important requirement of the economic security of the Russian Federation is the preservation of state control over strategic resources, and the prevention of their export in amounts that may harm the national interests of Russia.

Table 1. SWOT analysis of pipe rolling companies for 2021

Strengths, S	**Weaknesses, W**
S1. A streamlined production process by building vertical integration of the infrastructure necessary for the operation. S2. Significant investment resources and rich experience in the implementation of projects of various levels and significance. S3. Availability of potential to develop and improve the efficiency of production processes. S4. Significant scientific and technical, research and production potential. S5. Built our own sales network (to the end user) in Russia and export terminals. S6. Variety of the assortment produced with minimal costs for its manufacture relative to foreign competitors. S7. Extensive experience of working with partners abroad, as well as a reputation as a reliable and high-quality supplier of pipe products. S8. High qualification of employees, continuous training of personnel and improvement of their qualifications with minimal financial costs S9. The strategic importance of the industry for the state.	W1. Small consolidation of pipe rolling companies in relations with sheet metal producers W2. Unequal conditions when concluding government orders (protectionism) W3. Lack of import substitution in the production of equipment for pipe rolling production W4. Uneven capacity utilization at enterprises for the production of large diameter pipes (LDP) due to the lack of investment in the laying of trunk pipelines W5. Imbalance of supply and demand in pipes of small and medium diameter (SMD) in the construction sector W6. Lack of the required production volumes of stainless pipes due to the shortage of sheet metal and pipe billets W7. Significant lag in the production of high-quality innovative tubular products for mechanical engineering, oil and gas and chemical industries from foreign competitors
Opportunities, O	**Threats, T**
O1. Merger of large companies leading to production efficiency, lower production costs and improved quality O2. Development of green energy in Russia, through the production of hydrogen and its transportation. O3. Increased demand for tubular products for oil and gas production, mechanical engineering, construction and agricultural industries. O4. Construction of Russian factories for deep processing of raw materials. O5. Import substitution through the production of new generation pipe-rolling products O6. Use of domestic tube-rolling products in the implementation of foreign projects by Russian companies. O7. Development of projects for the transfer of water resources to regions in need	T1. Negative changes in the structure of foreign trade associated with the sanctions regime and lockdowns from the second wave of the COVID-19 pandemic. T2. Instability of prices and energy consumption in the world market T3. Increase in the dynamics of movement of factors of production abroad T4. Protectionist policy of the states of the Anglo-Saxon world T5. Monetary relations and speculative games in stock markets T6. Protracted recession in the domestic and global financial markets T7. Lack of protectionism in the domestic policy of the state. Uncontrolled export of raw materials in the form of scrap and other resources abroad.

Source: Compiled by the author

The state, represented by ministries and departments, should set tasks for the implementation of the necessary measures to ensure the economic security of the industrial complex both at the current moment and in the future [7], [8].

Thus, the substantive part of the function of public administration is the process of developing an appropriate solution, its practical implementation, including

through the development of conceptual and program-targeted strategic planning documents, and control of the actual results obtained.

In light of this, for pipe-rolling enterprises an important task in the direction of the formation of a modern architecture of their activities on the basis of the current strategic planning documents of the state aimed at the economic development and security of the country is their systematization for their expert assessments, the choice of priorities and "brainstorming" to form their own strategic plan for future activities (Table 2).

Table 2. Legislative framework in force for December 2021 for the implementation of the strategic national priority "Economic Growth"

Main directions, decrees, laws	– **Main directions of activities of the Government of the Russian Federation for the period up to 2024** (approved by the Chairman of the Government of the Russian Federation on 09.29.2018) – **Decree of the President of the Russian Federation of May 7, 2012 № 596 "On long-term state economic policy"** – **Fundamentals of the state policy of the Russian Federation in the Arctic for the period up to 2035** – (approved by the Decree of the President of the Russian Federation of March 5, 2020 N 164) – **Decree of the President of the Russian Federation of May 7, 2018 № 204 "On national goals and strategic objectives of the development of the Russian Federation for the period up to 2024"** – **The main directions of state policy in the field of increasing the energy efficiency of the electric power industry based on the use of renewable energy sources for the period up to 2024** (approved by the Order of the Government of Russia dated January 8, 2019 № 1-r) – **Fundamentals of state policy in the field of using the results of space activities in the interests of modernizing the economy of the Russian Federation and the development of its regions for the period up to 2030** (approved by the President of the Russian Federation on January 14, 2014 № Pr-51) – **Decree of the President of the Russian Federation of May 7, 2018 № 204 "On national goals and strategic objectives of the development of the Russian Federation for the period up to 2024"** – **On the rates of export customs duties on goods exported from the Russian Federation outside the customs territory of the Eurasian Economic Union** (Resolution of the Government of the Russian Federation dated November 27, 2021 № 2068) – **On Amending the Rates of Export Customs Duties for Goods Exported from the Russian Federation outside the States Parties to Agreements on the Customs Union** (Decree of the Government of the Russian Federation dated October 27, 2021 № 1833) – **Federal Law "On Customs Regulation in the Russian Federation and on Amendments to Certain Legislative Acts of the Russian Federation" dated 03.08.2018 N 289-FZ (last edition of 02.07.2021 N 343-FZ)** – **Decree of the President of the Russian Federation of August 16, 2021 № 478 "On the National Anti-Corruption Plan for 2021 - 2024"**

Concepts	– **Concept of long-term socio-economic development of the Russian Federation for the period up to 2020** (approved by the Order of the Government of Russia of November 17, 2008 № 1662-r, as amended by the Resolutions of the Government of the Russian Federation of 10.02.2017 N 172, of 28.09.2018 N 1151) – **Concept for the development of hydrogen energy in the Russian Federation** (approved by the Order of the Government of the Russian Federation dated August 5, 2021 № 2162-r)
Strategies	– **The strategy of economic security of the Russian Federation until 2030** (approved by the Decree of the President of the Russian Federation dated May 13, 2017 № 208). – **Strategy for the development of the Arctic zone of the Russian Federation and ensuring national security for the period up to 2035** (approved by the Decree of the President of the Russian Federation of October 26, 2020) – **Strategies for the socio-economic development of Siberia until 2020** (Approved by the Order of July 5, 2010 № 1120-r as amended on December 26, 2014) – **Strategy of socio-economic development of the Far East and the Baikal region for the period up to 2025** (approved by the order of the Government of the Russian Federation dated December 28, 2009 № 2094-r.) – **Strategy of socio-economic development of the North Caucasian Federal District until 2025** (approved by the Order of the Government of Russia dated September 6, 2010 № 1485-r) – **Energy Strategy of the Russian Federation until 2035** (approved by the Decree of the Government of the Russian Federation dated June 9, 2020 № 1523-r) – **Strategy of environmental safety of the Russian Federation for the period up to 2025"** (approved by the Decree of the President of the Russian Federation of 19.04.2017 № 176) – **Draft Order of the Government of the Russian Federation "On Approval of the Strategy for the Development of the Financial Market of the Russian Federation until 2030"** (Date of publication: 09.13.2021) – **Strategy of scientific and technological development of the Russian Federation until 2035** (approved by the Decree of the President of the Russian Federation of 01.12.2016 N 642) – **Draft Strategy for innovative development of the construction industry in the Russian Federation until 2030.** (Developed by the Ministry of Construction and Housing and Utilities of the Russian Federation, 2016) – **Strategy for spatial development of the Russian Federation for the period up to 2025** (approved by the order of the Government of the Russian Federation dated February 13, 2019 № 207-r) – **Strategy for the development of additive technologies for the period up to 2030** (approved by the Government of the Russian Federation dated July 14, 2021 № 1913-r) – **Strategy for the development of competition and antimonopoly regulation in the Russian Federation for the period up to 2030** (approved by the Protocol of the Presidium of the FAS Russia – from 03.07.2019 № 6)

State programs	– **State program "Social and economic development of the Arctic zone of the Russian Federation"** (Approved by the Government Decree of March 30, 2021 № 484) – **State program "Social and economic development of Kaliningrad Oblast"** (Approved by the Decree of the Government of the Russian Federation of 15.04.2014 № 311 with amendments dated 14.04.2021, approved by the Resolution of the Government of the Russian Federation of March 31, 2021 No. 500) – **State program "Social and economic development of the Republic of Crimea and the city of Sevastopol"** (Approved by the Resolution of the Government of the Russian Federation of January 30, 2019 N 63, as amended on March 31, 2021) – **State program "Social and economic development of the Far Eastern Federal District"** (approved by the Decree of the Government of the Russian Federation of 15.04.2014 № 308 with amendments of October 30, 2021) – **State program "Development of the North Caucasian Federal District"** (approved by the Decree of the Government of the Russian Federation of 15.04.2014 № 309 (as amended on March 31, 2021) – **State program "Development of federal relations and creation of conditions for effective and responsible management of regional and municipal finances"** (approved by the Government Decree of May 18, 2016 № 445, as amended on September 22, 2021) – **State Program "Energy Development"** (approved by the Decree of the Government of the Russian Federation dated April 15, 2014 № 321., as amended on July 31, 2021) – **State program "Reproduction and use of natural resources"** (approved by the Government Decree of April 15, 2014 № 322., The passport has been changed from April 18, 2021 by the Russian Government Resolution N 515 of March 31, 2021) – **State program "Environmental Protection"** (approved by the Government Decree of April 15, 2014 № 326. The name has been changed since April 13, 2019 - Resolution of the Government of the Russian Federation of March 29, 2019 N 362) – **State program "Development of the nuclear power and industrial complex"** (approved by the Government Decree of June 2, 2014 № 506-12, as amended on September 29, 2021) – **State Program of the Russian Federation "Economic Development and Innovative Economy"** (approved by Decree of the Government of the Russian Federation dated April 15, 2014 № 316 as amended by decrees of the Government of the Russian Federation dated 20.11.2021 № 1998) – **State program "Effective involvement of agricultural land in the turnover and development of the reclamation complex"** (approved by the Government Decree of May 14, 2021 №731) – **State program "Public finance management and regulation of financial markets"** Approved by the Decree of the Government of April 15, 2014 № 320, the Passport was changed from January 8, 2021, approved by the Decree of the Government of Russia of December 30, 2020 N 2386) – **State program "Development of foreign economic activity"** (approved by the Government Decree of April 15, 2014 № 330, as amended on March 31, 2021) – **State program "Development of shipbuilding and equipment for the development of shelf deposits"** (approved by the Government Decree of March 31, 2017 № 374, as amended on October 18, 2021)

	– **State program "Development of the aviation industry"** (approved by the Government Decree of April 15, 2014 № 303., as amended on March 29, 2021) – **State program "Development of the military-industrial complex"** (approved by the Government Decree of May 16, 2016 № 425-8., as amended on March 29, 2021) – **State program "Development of industry and increasing its competitiveness"** (approved by the Government Decree of April 15, 2014 № 328., Passport changed from April 17, 2021 - Russian Government Resolution N 505-20 of March 31, 2021) – **State program "Scientific and technological development of the Russian Federation"**(approved by the Government Decree of March 29, 2019 № 377.)
Forecasts and plans	– **Forecast of long-term socio-economic development of the Russian Federation for the period up to 2030** (Approved by the Prime Minister of Russia on March 23, 2013 № DM-P13-1795) – **Action plan for the implementation of the Fundamentals of State Policy of the Russian Federation in the Arctic for the period up to 2035** (approved by the Order of the Government of the Russian Federation of April 15, 2021 № 996-r) – **List of initiatives for the socio-economic development of the Russian Federation until 2030.** (approved by the Order of the Government of the Russian Federation of 06.10.2021 N 2816-r) – **Action plan for the implementation of the Strategy of Social and Economic Development of Siberia until 2020** (approved by the Order of the Government of Russia dated June 17, 2014 № 1069-r in the current edition of October 13, 2017) – **Action plan for the implementation of the Energy Strategy of the Russian Federation for the period up to 2035** (approved by the order of the Government of the Russian Federation dated June 1, 2021 № 1447-r) – **Detailed schedule for the implementation of the state program of the Russian Federation "Development of foreign economic activity" for 2020 and the planning period 2021-2022** (approved by Order of the Ministry of Economic Development of the Russian Federation of June 23, 2020 N 366) – **Implementation plan for the Spatial Development Strategy for the period up to 2025** (approved by the order of the Government of the Russian Federation dated December 27, 2019 № 3227-r.) – **Plan to achieve the national development goals of the Russian Federation for the period up to 2024** (approved in order to implement the Decree of the President of the Russian Federation of May 7, 2018 № 204 "On national goals and strategic objectives of the development of the Russian Federation for the period until 2024") – **Anti-corruption plan in the Ministry of Economic Development of Russia for 2021-2024** (approved by order № 570 of the Ministry of Economic Development of Russia on September 24, 2021)

Source: Compiled by the author based on data from [9], [10], [11].

Conclusion

The legal framework for the implementation of the state strategic national priority "Economic Growth" should be the main tool for the formation of expert assessments for the correct choice of priorities and further "brainstorming" on the

development of a strategic plan for the development and ensuring the economic security of Russian pipe-rolling enterprises. A clear balance of the relationship between the pipe rolling business and government authorities is the key to achieving intensive economic growth and an overall improvement in the quality of life of the country's population. Consolidation of efforts is impossible without ensuring the planning of strategically important areas at the state level. For this, the Government of the Russian Federation should use all the resources in its hands aimed at the development and effective functioning of enterprises: improving the regulatory legal framework, improving relations between business and government, monitoring, control, financing, coordination of development strategies and programs, preferential taxation, etc. The time has come for urgent, radical and comprehensive decisions.

References

1. Suglobov A.E., Khmelev S.A., Orlova E.A. Economic security of the enterprise: textbook for university students studying in the specialty "Economic security"– Moscow: UNITY-DANA, 2013. 217 P.

2. Senchagov V.K. Economic security: geopolitics, globalization, self-preservation and development (book four)/Institute of Economics, RAS. Moscow: CJSC "Finstatinform", 2002. 128 P.

3. Oleinikov E.A. Fundamentals of economic security (state, region, enterprise, personality). Moscow: CJSC Business School "Intel-Sintez", 1997. 288 P.

4. Malyutina T.D. Threats and their impact on the sustainable development of pipe-rolling enterprises // "INNOVATIONS AND INVESTMENTS" – 2019. № 10. P. 354-359. [Electronic resource] // URL: https://www.elibrary.ru/download/elibrary_41369642_65693490.pdf

5. World 2035: Global Forecast / ed. A.A. Dynkin. – M.: Master, 2017. – 352 P.

6. Malyutina T.D. 基于SWOT分析的俄罗斯轧管企业经济安全性分析 *Analysis of the economic security of pipe rolling enterprises in Russia using SWOT analysis //* 上合组织国家的科学研究：协同和一体化 *International Conference "Scientific research of the SCO countries: synergy and integration"/ Proceedings of the International Conference / Beijing, China: 2021 Part 1: P. 20-32 // URL:DOI: 10.34660/INF.2021.52.89.003*

7. Suglobov A.E., Dreving S.R. Socio-economic aspects of economic security and clustering of the economy // National interests: priorities and security. 2009. V. 5. № 9 (42). P. 18-24., № 10 (43). P. 66-74.

8. Suglobov, A.E. Malyutin, T. D. Economic, social and environmental

safety of pipe-rolling enterprises: relationship, purpose and objectives / A.E. Suglobov, T. D. Malyutina // "SCIENTIFIC VECTOR BALKAN". Ed. "Scientific chronograph" EOOD (Plovdiv) – 2020. V.4. № 1(7). P. 102-105. [Electronic resource] // URL. https://www.elibrary.ru/item.asp?id=42591457

9. Government of Russia: [website]. URL: http://Russian government official website (government.ru) // appeal date – December 2021.

10. Ministry of Economic Development of the Russian Federation: [website]. URL: http://Ministry of Economic Development of the Russian Federation (economy.gov.ru) // appeal date – December 2021; 7 GARANT.RU: information and legal portal: [website]. URL: http:// GARANT - Legislation (codes, laws, decrees, decrees) of the Russian Federation, analytics, comments, practice. (garant.ru) // appeal date – December 2021.

11. ConsultantPlus: reference and legal portal: [website]. URL: http:// "Consultant Plus" - legislation of the Russian Federation: codes, laws, decrees, decrees of the Government of the Russian Federation, regulations (consultant.ru) // appeal date – December 2021]

DOI 10.34660/INF.2022.83.40.003

俄罗斯联邦轧管业通过国家经济安全的棱镜。 第 2 部分：完善法律和监管框架的先决条件

THE PIPE ROLLING INDUSTRY OF THE RUSSIAN FEDERATION THROUGH THE PRISM OF THE ECONOMIC SECURITY OF THE STATE. PART 2: PRECONDITIONS FOR IMPROVING THE LEGAL AND THE REGULATORY FRAMEWORK

Malyutina Tatiana Dmitrievna
Candidate of Economic Sciences, Associate Professor
Volzhskiy Institute of Economics, Pedagogy and Law, Volzhskiy,
Commercial Director
LLC "Trading House "Seversnab", Volzhskiy

文章列出了俄罗斯国家经济安全面临的主要内部威胁（例如：公共行政体系效率不足，战略规划机制在实践中执行缓慢；联邦和地区政策不完善，地区分化加剧；公共管理体系不完善。 发展和保障国家安全领域的现行立法；缺乏长期的国家产业政策，支柱产业、技术发展和科学的衰退；对俄罗斯主权和领土完整的内部威胁——恐怖主义和极端主义 、有组织犯罪）及其对国内管道行业的影响。 监管框架中的漏洞暴露出来，需要进一步改进。

关键词：经济安全，轧管厂，内部威胁，公共管理，监管框架

Abstract. *The article lists the main internal threats to the economic security of the Russian state (such as: insufficient efficiency of the public administration system and slow implementation of strategic planning mechanisms into practice; imperfection of federal and regional policies, growth of regional differentiation; imperfection of the current legislation in the field of development and ensuring the country's security; lack of long-term state industrial policy, the decline in the backbone industries, in technological development and science; internal threats to the sovereignty and territorial integrity of Russia - terrorism and extremism, organized crime) and their impact on the domestic pipe industry. Vulnerabilities in the regulatory framework are revealed that require further improvement.*

Keywords: *economic security, pipe rolling mills, internal threats, public administration, regulatory framework*

Introduction

The stability of the economic development of the Russian Federation directly depends on the economic security of the industrial complex, the structure of which

includes pipe-rolling enterprises, as a foundation for generating innovative development, creating an active part of capital, using the latest technologies, economic methods and management of the country as a whole [1]. In this regard, it is fundamentally important to identify real threats to the state and draw a parallel between them and economic threats to the pipe rolling industry. The topic of economic security is becoming increasingly relevant and, as a result, the characteristics of its most important threats, such as unfair competition, corruption, bureaucracy, an increase in property differentiation of the population, deformation of the structure of the Russian economy, an increase in the unevenness of socio-economic development of regions, criminalization of society [2]. An urgent task today is to reveal the essence of this problem and related issues, to identify real threats, in order to find reliable and effective methods of solving them in the future.

Parallel between internal threats to the economic security of the Russian Federation and threats to the pipe-rolling complex

Let us consider how the main internal threats affecting the Russian Federation affect the pipe-rolling complex.

The imbalance of the financial system, continued dependence on the energy sector, weighed down by the coronavirus pandemic, led the fuel and energy complex to a situation where the economic recovery gave way to a critical recession and the survival of many companies is under threat. The situation is further complicated by a possible long-term decline in oil demand. For the pipe rolling industry, this, first of all, led to the fact that in 2020-2021 the segment of oil and gas pipes (OCTG, line pipes and LDP) was most affected, and the segment of industrial pipes - to a lesser extent. After a record high reached in 2019, the global market for all steel pipes declined by 10% and for threaded OCTG pipes by 31%. [3] Thus, the unfavorable global macroeconomic situation caused by COVID-19 lockdowns, volatility in oil prices and restrictions on oil production by OPEC+ countries led to the destruction of foreign economic partnerships between pipe exporters, i.e. to the end of the supply chain, both internal and external. Moreover, the interruption of external supplies, which, unfortunately, has nothing to replace in the domestic market, has become especially painful [4]. The decline in prices and consumption of energy resources in the world market led the pipe-rolling industry to a decrease in the flow of investments and negatively affected the financial activities of enterprises. As a result, there are losses in tax payments, which negatively affects the budgetary funds of the Russian Federation.

The solution to this problem can be the adoption of systemic decisions by the state for the modernization of the Russian energy sector by moving away from the raw material development model, i.e. implementation of projects for deep processing of oil and gas with the receipt of chemical and petrochemical products with high added value, which, in turn, will contribute to an increase in demand for Rus-

sian pipe products. Deep processing of hydrocarbon resources within the country, requiring the implementation of strategic projects in the field of technology, research and development, should be provided with state guarantees for the safety of long-term investments of investors in the oil and gas and chemical industries, as well as a decrease in the interest rate on loans, the transformation of lending for business into available source of investment. At the same time, the emphasis was placed on a clear relationship between the strategies for the development of the petrochemical industry and the Russian pipe-rolling industry. In the development strategy of the state, it is necessary to tighten control over illegal financial activities for the withdrawal of funds abroad: to conduct constant financial monitoring of compliance with currency and customs legislation, as well as to strengthen the responsibility of the inspection authorities [4].

In turn, corruption, excessive bureaucratization of state structures, redundancy of licensing powers have led to the fact that the Russian industrial business, not seeing clear guidelines and transparent state policy, is forced to engage instead of the true implementation of various innovative developments aimed at reducing the cost of production and increasing profits under the laws commercial competition, but empty and meaningless bureaucratic "innovations" for society, which increase the importance of the streams of official documents with mandatory procedures for approvals, endorsements, etc.

This leads to the fact that the share of budgetary funds is spent on the maintenance of the bureaucratic nomenclature, which is constantly growing, outstripping the growth of income from the total volume of production (Wagner's law has acquired a hypertrophied form) [5]. That is, the bureaucracy has turned into a separate "industry", which is characterized by work to increase its own income, divorced from the interests of society and taking control of all the leading levers of government in the country, thereby slowing down its economic growth. This system, like an octopus, can eventually paralyze the economy, suppressing by administrative methods any resistance from business and creating fertile soil for corruption to flourish, showing complete indifference to the living standards of the population and the national interests of the country.

What, if not a manifestation of a corruption component and imperfection of state regulation of industries, could, for example, create an opportunity for the construction in Surgut, Khanty-Mansiysk Autonomous Okrug, a new pipe-rolling plant within the framework of an investment project to create a joint venture that produces welded oil pipes, implemented by the Italian by Tenaris SA (The company's production facilities are located in Argentina, Brazil, Canada, China, Colombia, Italy, Japan, Mexico, Romania, the USA and Venezuela, in 2020 additional facilities in the USA - the former American division) and the Russian transnational company PJSC "Severstal" (Production the company's facilities are located

in Russia, Latvia, Poland, Italy, Canada, Guinea and the USA) [6]? The share of Severstal in the joint venture will be 51%, Tenaris will control the remaining 49%. We repeat that there is an overproduction of oil and gas pipes in the Russian pipe market amid restrictions on the OPEC+ deal, oil price volatility, sanctions measures and numerous lockdowns from COVID-19. Domestic production capacity for OCTG, line pipes and LDP is only 58% utilized. And the capacity of the plant under construction will be 300 thousand tons of pipes per year and it is planned that the supply of products for the oil and gas infrastructure will be carried out in Russia and the CIS. This speaks of another seizure of the domestic market by a foreign investor and "capital flight" abroad. The next aspect is that, although the share of the Khanty-Mansiysk Autonomous Okrug in the all-Russian oil and gas production amounted to 40.9% and for the period of 2021, 2,029 new production wells were commissioned [7], [8], but for the construction and the further operation of the pipe rolling mill requires a large number of workers, which, as you know, is a deficit in the northern regions, as well as the lack of infrastructure for their residence. All this leads to an increase in the cost of the final product and is the result of an inconsistent policy between pipe manufacturers and the lack of a regulatory role for government agencies.

Corruption is observed in the lobbying of narrow vested interests of individual companies, as well as in the conduct of unfair tenders. The legislative base with excessive bureaucratic "subtleties" makes it possible to find illegal loopholes and the customs authorities.

An equally important problem for the economic security of the industrial complex and the successful conduct of business is the unpredictability of tax policy and the lack of a clear definition of non-tax payments.

The most acute moment has come, requiring an urgent set of organizational and institutional measures to create a rational bureaucracy, that is, to increase the efficiency of the civil service and establish a public legal status for civil servants of the Russian Federation. That is, a kind of optimization of executive authorities, their structures and divisions, taking into account real needs, avoiding negative impact on socio-economic processes and ensuring the rational distribution of human and material resources.

To do this, from January 1, 2021, by order of the President of the Russian Federation Vladimir Vladimirovich Putin and the Government of the Russian Federation, a new system of control and supervisory legislation was launched, the so-called "Regulatory Guillotine", created to take stock of all current and mandatory business requirements in order to understand whether they comply to modern realities. This reform is carried out by abolishing all irrelevant regulatory acts in the field of supervision and control, as well as building a new, modern, effective system of state control (supervision) aimed at reducing socially significant risks. "The

work is carried out in two directions: first - building a new system of mandatory requirements corresponding to the modern level of technological development and a risk-oriented approach; the second is the establishment of detailed rules related to the organization of control and supervisory activities [9]. The implementation in practice of this reform in the system of state and municipal services will also help to reduce the field for manifestations of corruption: increasing the transparency of the civil service for civil society, deep implementation of ethical standards. The problems of excessive bureaucratization of state structures, redundancy of licensing powers and anti-corruption in the Russian Federation should become part of the practice of regular parliamentary hearings and socio-political discussions in the media so that in the process of their discussion the opportunity is realized to solve one of the most difficult tasks of implementation of anti-corruption policy. Indeed, back in 500 BC, the great Chinese philosopher Confucius, in his teaching on public administration, said: "All the problems in this world arise from the fact that things are not called by their proper names <...> ... from that and fight or greet them - not even a wise man can decide".

This internal threat smoothly flows into another, causing economic damage both to the national interests of the Russian Federation as a whole, and to all economic sectors separately, destroying social and economic stability in society. This is the lack of efficiency of the public administration system and the slow introduction of strategic planning mechanisms into practice. The Government of the Russian Federation, having the opportunity to prepare the consolidated part of the Strategic Forecast and further planning of the economic development of the industrial complex of the state, in strict subordination with the territorial scheme of the distribution of productive forces, which is the responsibility of the Ministry of Economic Development of the Russian Federation, consisting of 37 departments with a total number of more than 2,000 people, does not provide a positive effect. The methodological recommendations of the Ministry of Economic Development are formed in such a way that they mainly reflect the needs of the Ministry and do not solve the urgent problems of the industrial complex. The strategy of the state should be a clearly verified package of documents, which, like a high-precision tool, should be developed by specialists who will have to implement it, while all state institutions should be directly involved in this. The Bulletin of the Accounts Chamber of the Russian Federation of 2020 № 1 (Public Administration), presented by the Chairman of the Accounts Chamber of the Russian Federation, Alexei Kudrin, presents a report covering the entire system of goal-setting of the Government and subordinate state bodies, on the results of the expert and analytical event "Strategic audit of the formation and achievement of performance indicators of federal bodies executive power, the activities of which are led by the Government of the Russian Federation, in 2017-2018 and the past period of 2019 ", which

made a very disappointing conclusion: "...The system of strategic planning of the activities of the Federal Executive Bodies is currently unbalanced and ineffective, insufficiently regulated and methodically provided, with a low level of control and executive discipline. In this state, it does not contribute to the achievement of national goals and requires improvement ... <...> ... The system of strategic planning in the Russian Federation is practically absent, the goals of the authorities are not linked with each other and with the requirements of the President and the government and do not coincide with the project activities of the Government, are determined formally, but their achievement is not monitored" [10]. All this undermines the desire of large industrial business to think about its economic growth in an alliance with state institutions of power and rely on the ineffectiveness of decisions of the Ministry of Economic Development of the Russian Federation, whose tasks are essentially indicated in the name itself. Thus, PJSC "Pipe Metallurgical Company" together with the innovation center "Skolkovo", relying on the Strategy for the Development of Additive Technologies for the Period up to 2030 and the State Program of the Russian Federation "Economic Development and Innovative Economy" at the end of 2021 completed the costly process of the first stage of the automation project systems of operational management of production, including the planning and execution of production at its enterprises, which are part of the Russian division of the company, launched in 2018, designed to provide flexibility in behavior in a rapidly changing market through continuous planning, timely input of up-to-date data on the market, orders and existing restrictions [11]. The project is being implemented by specialists from one of the 10 largest American IT companies, Digital Business Services. At the same time, do not forget that the service bases of the software product introduced at PJSC TMK are located on US-owned platforms. In today's political situation, the most acute question arises about the expediency of invested funds and ensuring information security of a strategically important industry for our state.

In the light of even such a single example, the state is required to urgently improve the existing system for managing the country's scientific and technological development in order to overcome the critical external dependence on the import of foreign technologies and equipment, that is, large-scale import substitution programs aimed at modernizing the economy based on a new technological order. Namely, urgent reform of the strategic planning system with the centralization of key functions at the level of the President of Russia. So the RF Government Decree of 15.04.2014 № 316 (revision of 20.11.2021) "On approval of the state program of the Russian Federation" Economic development and innovative economy ", namely the Passport of subprogram 8" Improvement of the system of state strategic management "of the state program Of the Russian Federation "Economic development and innovative economy" (as amended by the Decree of the Govern-

ment of the Russian Federation of 31.03.2021 N 513) and issued the Decree of the President of the Russian Federation of November 8, 2021 № 633 "On the approval of the Fundamentals of state policy in the field of strategic planning in the Russian Federation", where the latest developments of leading countries such as Japan, China, USA, etc. were taken into account and adapted to the Russian reality in the field of economic security.

From here follows an internal threat (Figure 2): imperfection of federal and regional policies, as well as the current legislation in the field of development and ensuring the economic security of the country, which inevitably lead to an increase in the differentiation of regions. The inconsistency of their development, unfortunately, already laid down at the upper legislative level, seriously impedes the normal socio-economic development of regions and leads both to financial losses, losses of labor and natural resources, and to the accumulation of interregional imbalances. Moreover, these problems cannot be eliminated by the own efforts of regional and municipal authorities, they are characterized by their brutal stability and are repeated from year to year. And from the federal level, they, within the framework of modern macroeconomic policy, are insufficiently taken into account, significantly reducing the effectiveness of the state policy itself and giving rise to the destruction of natural economic and social ties between Russian territories, creating great difficulties for the regions.

There are many factors leading to the imbalance that has formed over the years. As an example, consider JSC "Volzhsky Pipe Plant", designed, built and started producing its first products back in 1970, when all the feasibility studies were taken into account for this, which ultimately influenced the cost of the final product. In particular, the Volzhskaya HPP supplied electricity to the plant with minimal losses during transportation. (The hydroelectric power station was put into operation on September 10, 1961 for the development of regional industry, and the excess capacity could be successfully transmitted over distances of more than 2000 km. The construction of the Volzhsky city began in 1954 as a large industrial center of the Lower Volga region (the satellite city of Volgograd), in parallel with the construction of a hydroelectric power station). Today, expensive electricity for the most powerful energy-intensive innovative JSC "Volzhsky Pipe Plant" comes from Volzhskaya CHPP-2 by burning fuel, which, in turn, is accompanied by CO_2 emissions into the atmosphere. And there are many such examples that affect the competitiveness of the pipe-rolling industry with a simultaneous economically unfavorable climate for the entire region.

The unsettledness of the spheres of regional, municipal and federal responsibility is also manifested in the insufficient accuracy of strategic documents on the long-term spatial development of Russia and the influence of large investment projects of national importance on the development of regional economies, which

further affect the outflow of capital from the country. An example is the same construction of a pipe-rolling plant in Surgut. And if we consider the construction and commissioning of the "Eastern Siberia - Pacific" Ocean oil pipeline with a length of the Russian part of the transport system of almost 5 thousand kilometers, passing through 6 regions (the Republic of Sakha (Yakutia), Irkutsk, Jewish Autonomous and Amur Oblasts, Khabarovsk and Primorsk Krais) , then its impact on the economy of these regions is extremely insignificant compared to the amount of investments made, that is, for example, the number of permanent jobs in the "Transneft-Vostok" company serving the pipeline is only 0.12% of the total number of employees in the indicated regions. This entails a massive outflow of the population from depressed territories to prosperous regions, the country's economic and social space is being torn apart, and labor resources for the economic development of both regions and, naturally, industries located in these territories are reduced.

The COVID-19 pandemic has made negative adjustments to the habitual way of life of the citizens of our country and, of course, significantly influenced the structure of the economy: incomes of citizens and the manufacturing sector have decreased, unemployment has increased, the form of employment and work organization formats have been modified, circumstances have been created to search for additional sources of income in order to maintain solvency. Social support, not included in health care costs demanded from the state a redistribution of budgetary funds. Numerous lockdowns were not just a random factor that caused a change in the behavior of government bodies and business, but became the final transition to the final stage of the systemic crisis of the global economy model. And the most difficult thing in these circumstances for business was the development of a sectoral policy that would help fit into the process of innovative development of the industrial complex. Not to capitalize on the problem, but to ensure that pipe-rolling production meets the ever-growing social requirements. It is the correct understanding of the desires of society that becomes the key to success in business, and not only for pipe manufacturers.

The introduction of innovative solutions and the development of scientific potential are becoming critically important for the development of the entire economy of the country and, in particular, for the domestic pipe-rolling complex. But today Russia is seriously lagging behind the world leaders in the scientific, scientific, technical and innovation spheres of the domestic economy, which is due to a number of problems. This group includes problems caused by the lack of a unified management and regulatory system in terms of resolving the issue of integrating scientific, technical and industrial policies, providing state benefits, corruption and bureaucratic components, etc. The key document that determines the vector of development of science in the country is the "Strategy for the Scientific and Tech-

nological Development of the Russian Federation", approved by the decree of the President of the Russian Federation dated December 1, 2016 № 642 (As amended by the Decree of the President of the Russian Federation dated 03.15.2021 № 143). At the same time, the goal of scientific and technological development is defined as ensuring the independence and competitiveness of the Russian Federation by creating an effective system for building up and using the intellectual potential of the nation [12].

The pipe rolling business, along with other domestic industries, clearly understands that the gap with developed countries in terms of scientific and technological development will increase significantly from year to year, and this threatens to lose markets for Russian products. Although large pipe-rolling companies (PJSC TMK) today occupy leading positions in Russia in introducing digital technologies into administrative processes, unfortunately, they are not directly related to production.Understanding the need to invest in the creation of new technologies to ensure their competitiveness, pipe enterprises are interested in switching to innovative technological production processes that are not inferior to world leaders, but in practice it is difficult to only focus on commercial technologies that have long been tested in the world and, at least, maintain the already achieved positions. For this, the pipe metallurgical company, for example, develops and improves pipe products, conducts experimental tests, evaluative tests and advanced scientific research on the basis of the TMK scientific and technical center in Skolkovo (Moscow) and the Russian Research Institute of the Pipe Industry (RusNITI) (Chelyabinsk) [3]. Positioning itself as a company at the peak of high technologies, PJSC TMK, along with all others, faces key barriers to the innovative transformation of the industry, caused by ineffective interconnection between federal executive authorities, business and science. Although the state allocates huge funds for the implementation of the "State Program of the Russian Federation" Scientific and Technological Development of the Russian Federation ", approved by Decree of the Government of the Russian Federation № 377 dated 29.03.2019, which includes a number of subprograms (Development of national intellectual capital, Ensuring the global competitiveness of Russian higher education , Fundamental scientific research for long-term development and ensuring the competitiveness of society and the state, Formation and implementation of complex scientific and technical programs according to the priorities of the Strategy of Scientific and Technical Development of the RF, as well as scientific technological and innovative development in a wide range of areas, Infrastructure of scientific, scientific, technical and innovative activities) [13], but the Russian pipe-rolling industry is faced with an imperfection of the regulatory framework, which has problems of a huge bureaucratic nature, the presence of corruption and difficulties in the dialogue between industry and science, sometimes thinking in terms of theories,

placed by the state in harsh conditions for earning money for its self-existence divorced from life. Also, a serious threat to the economic security of enterprises, if their innovative development is necessary in a highly competitive environment, is an acute shortage of young specialists, to whom most universities do not provide the competencies necessary for the industry, since the curricula of specialties do not correlate with the modern needs of the industry, university teachers are sometimes very far from practical knowledge, and the race for "degree of gravity" dictated by the Ministry of Science and Higher Education, ousted qualified production specialists from the educational process.

The development of the country's economic and political life is directly dependent on such extremely negative and socially dangerous phenomena as terrorism, extremism and organized crime, which threaten the sovereignty and territorial integrity of Russia, enterprises of the country's industrial complex, which includes the pipe industry.

The national security of the Russian state was affected by such a dangerous social phenomenon as the rampant organized crime associated with corruption at all levels of government and leading to such manifestations as raider seizures of enterprises, leading to negative consequences in the economic and social spheres of society.

Of particular concern is also the most dangerous threat - a negative and very complex social phenomenon - extremism, specifically its manifestations on the territory of the Russian Federation, union states, and in general in the post-Soviet space, which poses a threat to security, both for the economy of our country, and and for the Russian society. Its vivid demonstration in our country was the events known as the first and second Chechen wars, which led to a complete collapse with the subsequent restoration of the economy and infrastructure of the republic. Extremism and all its types are constantly transforming, acquiring very sophisticated and even more dangerous for society and the state. So terrorism, as one of the manifestations of extremism, is also not something stable, but is constantly mutating like malicious viruses. At the same time, in the course of its modification, for example, such a "newfangled" course as Green terrorism, which entered our representation in the late 80s, was formed. It is expressed in the actions of the so-called environmental "green" groups aimed at undermining the economic security of the industrial complex of Russia and the state as a whole, sponsored from abroad by competitors and special services of hostile countries. A striking example of recent days is the actions of the "green" to ban the construction, and now the operation of Nord Stream 2, which allegedly affects the ecology of the Baltic Sea.

Conclusion

The global financial crisis makes one think about the formation of a new concept of economic security, which guarantees the country's independence, the sta-

bility of its development and territorial integrity, an improvement in the quality of life of people, the development of science and technology. This requires a process of continuous improvement of the state's regulatory framework in connection with the very dynamic, contradictory trends and events in the modern world, which are reflected in the internal threats of our state. It is necessary to create and implement conditions that will ensure the economic security and independence of our state, which poses serious challenges for the pipe-rolling industry, since the production of pipe products manufactured with the intensive use of the latest technologies is associated with the successful development of all related industries of the Russian economy. It is necessary to consolidate the efforts of domestic business and government agencies to ensure joint planning of strategically important areas for economic growth. For this, the Government of the Russian Federation should use all the resources in its hands aimed at the development and effective functioning of enterprises: improving the regulatory legal framework, improving relations between business and government, monitoring, controlling, financing, coordinating development strategies and programs, preferential taxation, etc.

References

1. Malyutina T.D. INFLUENCE OF GLOBAL TRENDS ON FORMATION OF ENERGY SECURITY STRATEGY ON THE EXAMPLE OF THE PIPE-ROLLING INDUSTRY OF THE RUSSIAN FEDERATION // RUSSIAN JOURNAL OF MANAGEMENT/ Volume 8, № 3 , 2020 [Electronic resource] // URL: https:// doi.org/10.29039/2409-6024-2020-8-3-46-50

2. Decree of the President of the Russian Federation of May 13, 2017 № 208 "On the Strategy of Economic Security of the Russian Federation for the Period up to 2030" // Collected Legislation of the Russian Federation. 15.05.2017. № 20. Art. 2902. Www.garant.ru. [Electronic resource]. URL: http://www.garant.ru/ products/ipo/prime/doc/71572608/ // appeal date – December 2021.

3. Pipe Metallurgical Company: [official website]. URL: http:// Pipe Metallurgical Company :: TMK (tmk-group.ru) // appeal date – December 2021

4. Malyutina T.D. The impact of restrictions on the OPEC + deal and the COVID-19 pandemic on the energy security of Russia in terms of the pipe industry // Collection of articles following the results of the VII international interuniversity scientific and practical conference dedicated to the memory of Professor M.I. Bakanov and Professor V.I. Petrova., Moscow: Publishing house "KnoRus" – 2021. P. 228-237. [Electronic resource] // URL: eLIBRARY ID: 45787466

5. Shevtsov Yu.G. Socio-economic consequences of the bureaucratization of the Russian state // PROBLEMS OF ACCOUNTING AND FINANCE// № 27. – 2017. P. 3-8 // DOI: 10.17223/22229388/27/1

6. Tenaris-group: [official website]. URL: http:// Tenaris (techintgroup. com) // appeal date – December 2021.; 16 Severstal: [official website]. URL: http:// Severstal (severstal.com) // appeal date – December 2021.

7. Department of Subsoil Use and Natural Resources of the Khanty-Mansiysk Autonomous Okrug – Ugra (Depnedra and Natural Resources of Ugra): [website]. URL: http:// Department of Subsoil Use and Natural Resources of the Khanty-Mansiysk Autonomous Okrug – Ugra (admhmao.ru) // appeal date – December 2021.

8. The results of the socio-economic development of the Khanty-Mansiysk Autonomous Okrug – Ugra for January-September 2021. Report of the Service for Control and Supervision in the Sphere of Environmental Protection, Fauna Objects and Forest Relations of the Khanty-Mansiysk Autonomous Okrug – Ugra : [website]. URL: http:// Service for Control and Supervision in the Sphere of Environmental Protection, Fauna Objects and Forest Relations of the Khanty-Mansiysk Autonomous Okrug – Ugra (admhmao.ru) // appeal date – December 2021.

9. Control and supervisory and licensing activities: [website]. URL: http:// Regulatory Guillotine — Reform of Control and Supervision Activities (ac.gov.ru) // appeal date – December 2021.

10. Portal Strategy 24. State Management System: [website]. URL: http:// Strategy of the Russian Federation (strategy24.ru) // appeal date – December 2021.

11. Tkachenko D.D. Financial planning of enterprises in the context of the development of digitalization of the economy / DIGEST FINANCE/ V.26: № 2 (258). 2021 P. 126-147 / DOI: 10.24891/df.26.2.126

12. Onishchenko G.G., Kablov E.N., Ivanov V.V.Scientific and technological development of Russia in the context of achieving national goals: problems and solutions // G.G. Onishchenko, E.N. Kablov, V.V. Ivanov // STRATEGIC PLANNING: INNOVATION.– № 6 (260). 2020, P. 3-16. [Electronic resource] // URL: https://www.doi.10.26310/2071-3010.2020.260.6.001

13. Ilyina I.E., Lapochkina V.V., Dolgova V.N., Klypin A.V., Kalyuzhny K.A., Belov F.D., Plekhanova E.A., Shkilev I.N., Emelyanova E E. Scientific and technological development of the Russian Federation. Tools. Financing. Current state. Perspectives. – M.: IMG Print, 2020. – 52 P.

DOI 10.34660/INF.2022.94.92.002

后贝加尔边疆区“PIMCU”PJSC 可持续城市形成企业的安全由铀矿开采活动的生产资料和经济模型企业

SECURITY OF A SUSTAINABLE CITY-FORMING ENTERPRISE OF ZABAYKALSKY KRAI "PIMCU" PJSC BY MEANS OF PRODUCTION AND ECONOMIC MODELING OF THE ACTIVITIES OF URANIUM MINING ENTERPRISES

Mikhaylovsky Aleksandr Aleksandrovich
Head of a branch, "ARMZ" Uranium Holding Co. ("Atomredmetzoloto" JSC)

抽象的。文章分析了跨贝加尔湖地区经济的主要指标，在此基础上得出结论，需要进一步发展以采矿为主要活动的企业。

本文考虑了在与天然铀市场价格不稳定相关的经济风险、现有矿山高度开发、生产多样化的需要。为解决确保跨贝加尔地区铀矿企业可持续发展的主要任务，建立了铀矿经济部门企业创新活动经济效益评估机制。提出了一种使用金融和经济模型来评估经济效率，随后使用因子分析在创新项目生命周期的所有阶段做出管理决策的变体。

关键词：区域经济，城市形成企业，因素分析，社会经济发展，金融和经济模型，经济效率，矿产资源综合体，创新。

Abstract. *The article analyzes the main indicators of the economy of the Trans-Baikal Territory, on the basis of which it is concluded that there is a need for further development of enterprises whose main activities are aimed at mining.*

The article considers topical problems and promising directions for sustainable development of the city-forming enterprise of the Trans-Baikal PJSC "PIMCU" in conditions of economic risks associated with unstable prices in the natural uranium market, a high degree of development of existing mines, the need to diversify production. To solve the main tasks aimed at ensuring sustainable development of uranium mining enterprises in the Trans-Baikal Territory, a mechanism has been implemented for assessing the economic efficiency of innovative activities at enterprises of the uranium mining sector of the economy. A variant of using financial and economic models for assessing economic efficiency with the subsequent use of factor analysis for making managerial decisions at all stages of the life cycle of innovative projects is proposed.

Keywords: *regional economy, city-forming enterprises, factor analysis, socio-economic development, financial and economic modeling, economic efficiency, mineral resources complex, innovations.*

Currently, the main share of self-produced goods of the Trans-Baikal Territory is mining in the period from 2018 to 2020, it takes 54-67%, and by 2024 it reaches 75% (table №1).

It should be noted that the issue of developing an effective strategy for the development of uranium mining enterprises, which will ensure the sustainable development of city-forming enterprises in conditions of economic risks associated with unstable prices in the natural uranium market, is gaining increasing relevance and significance for the regional economy. The need to solve this problem is associated with both economic and social risks, since uranium mining in this region is city-forming.

In addition to the sensitivity to prices, it should be noted that there is a high degree of development of existing mines and the need to accelerate the commissioning and reaching the design capacity of new ones.

Table №1.

Forecast of socio-economic development of Zabaykalsky Krai for 2022 and the planning period 2023 and 2024 [2]

Indicators	**Unit of measurement**	**report**	**report**	**report**	**report**	**forecast**		
		2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
The volume of shipped goods of own production, works and services performed on their own, total, incl.:	**mill. rub.**	**164 109**	**198 654**	**222 424**	**261 003**	**316 429**	**364 634**	**379 220**
Mining	mill. rub.	104 393	132 800	154 596	188 423	239 030	273 134	284 059
Manufacturing industries	mill. rub.	24 242	28 895	28 651	31 089	33 162	43 895	45 651
Electricity, gas and steam supply; air conditioning	mill. rub.	32 705	33 972	36 059	38 232	40 825	43 986	45 746

Krasnokamensk is the second largest city of Zabaykalsky Krai, located in the southeastern part of the Krai and is the regional center of the municipal district "City of Krasnokamensk and Krasnokamensk District" of Zabaykalsky Krai.

Table №2.

Forecast of socio-economic development of the urban settlement "City of Krasnokamensk" for 2022 and the planning period 2023 and 2024 [2]

№	Indicators	Unit of measurement	report	report	report	report	forecast		
			2018	2019	2020	2021	2022	2023	2024
1	Resident population (average annual) - total	thous. people	51,65	51,39	51,45	50,94	50,88	50,82	50,83
		in% to the previous year	*99,0*	*98,1*	*100,1*	*99,0*	*99,9*	*99,9*	*100,0*
2	Natural increase (+), decrease (-)	thous. people	-0,150	-0,143	-0,186	-0,114	0,076	0,086	0,086
		in% to the previous year	*227,27*	*95,33*	*130,07*	*61,29*	*-66,67*	*113,16*	*100,00*
3	Migration gain (+), decrease (-)	thous. people	*-0,501*	*-0,118*	*-0,900*	*-0,498*	*-0,132*	*-0,146*	*-0,076*
		in% to the previous year	*91,09*	*23,55*	*762,71*	*55,33*	*26,41*	*111,03*	*52,05*
7	The average number of employees (without external part-time workers) in full circle	people	15 879	15 419	15 085	15 055	15 537	15 988	16 483
		in% to the previous year	*98,28*	*97,10*	*97,83*	*99,80*	*103,20*	*102,90*	*103,10*
8	The average number of employees of the city-forming organization	people	5 306	5 187	5 074	5 053	5 124	5 155	5 183
9	The number of employees expected to be dismissed from the city-forming enterprise	people	669	604	569	654	0	0	0
10	Working-age population (considered to be between 15 and 72 years old)	people	28 351	28 859	28 895	29 039	29 214	29 389	29 683

11	Total number of unemployed	people	3 987	3 921	2 470	2 418	2 367	2 367	2 367
12	The number of unemployed registered with the state employment service	people	179	164	2 366	1 145	1 150	1 200	1 250
13	The volume of shipped goods of own production, works and services performed on their own, by type of activity related to industrial production for large and medium-sized enterprises	mill. rub.	9 589,80	11 873,10	13 259,00	14 509,90	12 591,90	14 612,20	14 699,50
		in% to the previous year	*62,74*	*123,81*	*111,67*	*109,43*	*86,78*	*116,04*	*100,60*
	including:								
	mining	mill. rub.	7 271,10	9 458,40	10 874,80	11 364,30	9 586,00	10 582,50	10 505,50
		in% to the previous year	*241,36*	*130,08*	*114,98*	*104,50*	*84,35*	*110,40*	*99,27*
	manufacturing industries	mill. rub.	879,40	958,30	944,60	1 475,20	1 286,60	2 208,50	2 302,90
		in% to the previous year	*9,19*	*108,97*	*98,57*	*156,17*	*87,22*	*171,65*	*104,27*
	provision of electricity, gas and steam; air conditioning	mill. rub.	1 370,40	1 385,30	1 368,60	1 595,80	1 641,30	1 740,50	1 807,70
		in% to the previous year	*59,50*	*101,09*	*98,79*	*116,60*	*102,85*	*106,04*	*103,86*
	water supply; sewerage, organization of waste collection and disposal, activities for pollution elimination	mill. rub.	68,90	71,10	71,00	74,60	78,00	80,70	83,40
		in% to the previous year	*17,34*	*103,19*	*99,86*	*105,07*	*104,56*	*103,46*	*103,35*

Based on the data presented in table № 2, the following should be noted:

1. The main reason for the decline in the population is the migration outflow (decline) of the population associated with the attraction of workers from other regions by the city-forming enterprise to work on a rotational basis or on the basis of fixed-term employment contracts; implementation of the PJSC "PIMCU" program for headcount optimization in order to break even by reducing costs and eliminating losses in all areas of activity.

2. The index of industrial production for large and medium-sized organizations of the city of Krasnokamensk in 2020 amounted to 111.67%, including by type of economic activity (mining - 114.98%; processing industries - 98.57%; provision of electricity, gas and steam; air conditioning - 98.79%; water supply; sewerage, waste collection and disposal, activities to eliminate pollution - 99.86%).

The economy of the urban settlement "City of Krasnokamensk" is largely dependent on the city-forming enterprise PJSC "PIMCU n.a. E.P. Slavsky ". The total mineral resource base of PJSC "PIMCU" as of 01.01.2021 is 96.5 thousand tons of uranium. The volume of coal production in 2020 amounted to 2.94 million tons (less by 16.1% compared to the same period of the previous year) [2].

It should be noted that the deterioration of the financial position of PJSC "PIMCU" and, as a consequence, the inclusion of the reduction of production personnel in the "revitalization" program of the enterprise compared to 2011 is associated with a sharp drop in prices for natural uranium (see Figure № 2). However, at present there is a positive upward trend, which, according to experts, should continue (see Figure № 1).

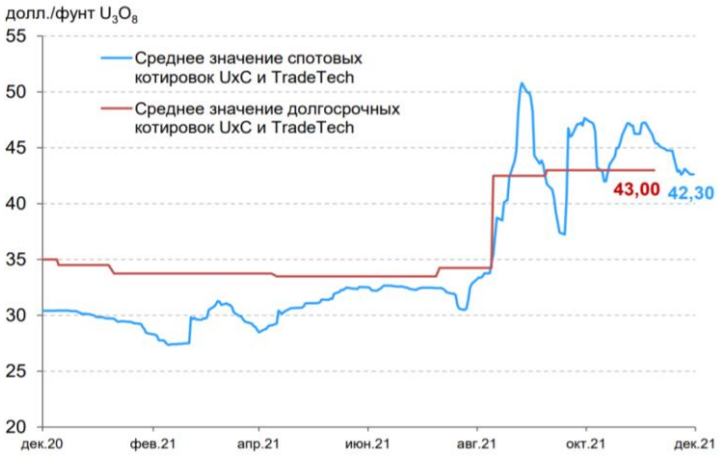


Figure 1. *Dynamics of spot quotes for 2021*

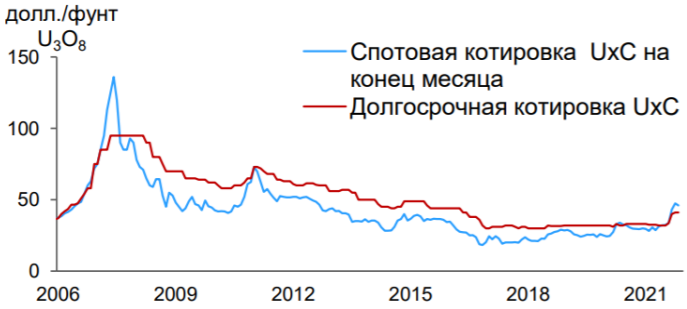


Figure 2. *Dynamics of spot quotations from 2006 to 2021*

Based on the above, we can conclude that despite significant improvements in the global uranium market (growth in spot adjustments), PJSC "PIMCU" also needs to implement a set of technological measures to support the sustainable development of Krasnokamensk and the economy of Zabaykalsky Krai as a whole.

In addition to the above, it is also necessary to note the main problems of the development of the mineral resource complex Zabaykalsky Krai:

1) Solving the problem of balanced and simultaneous development of the Krai as a mining region.

2) Insufficient development of infrastructure, which hinders the creation of mining capacities.

3) Poor knowledge and readiness of known deposits for exploitation

4) The problem of the outflow of the population and the lack of qualified engineers and workers.

To solve these problems at the enterprise level and, as a consequence, to ensure the sustainable development of the economy of Zabaykalsky Krai, specialists from the uranium mining sector (accounting for 29.6%) proposed a system for assessing the economic efficiency of innovative projects at each stage of the life cycle, adapted to the specifics of their innovative activities.

The innovation program should be aimed at achieving the main strategic goal of uranium mining enterprises, which is to maximize the value of the mining business for the shareholder by realizing the potential of the growing market. It should be noted that this goal is the basis for formulating specific financial, economic and market goals, which include: achieving revenue growth rates corresponding to or exceeding the market growth rate; taking a leading position in the uranium market; increasing production efficiency. The tasks set in the framework of the innovative development program should ensure the achievement of its main goal. Since the main goal of the program is to improve production efficiency, it is necessary to

focus on the following tasks: cost reduction; increasing labor productivity; reducing the amount of losses at all stages of the technological chain; increasing the efficiency of capital expenditures for field development.

There are several ways to improve production efficiency:

1. Improving operating activities. This path also provides for changes in current activities, but is associated with more significant costs and - in some cases - with longer implementation times. At the same time, the risk level ranges from low to moderate.

2. Search, development and implementation of innovative solutions. It is to this path that the most attention should be paid when solving the assigned tasks. Activities affect both current and future activities; costs range from medium to significant, implementation time - from moderate to long. The level of risk is usually quite high.

The effect of successful implementation of innovations is to strengthen positions in existing markets, as well as in the development and creation of new markets.

Thus, in the context of the implemented program, innovations are new products or approaches to doing business, the use of which can significantly increase the financial efficiency of a company or significantly reduce the consequences of possible risks.

In the uranium mining industry, there are two main areas of innovation - management innovation and technology innovation. Examples of innovations in management include an innovative approach to organizing business processes (procurement, repairs, etc.), innovative performance management systems and the introduction of continuous improvement mechanisms. In the field of technology, which is the main component of the process, innovation can cover geological exploration, design and construction, mining and processing technologies, automation of production processes, environmental protection, industrial safety and health, and other aspects.

To substantiate the adoption of management decisions in the process of current work and on the basis of an analysis of implemented and planned innovative projects at uranium mining enterprises, a methodology for assessing the economic efficiency of innovative projects has been developed.

This methodology is based on recommendations for building financial and economic models of projects (FEM) that make up the innovative activities of uranium mining enterprises. The model simulates the production processes of the technological chain and thereby allows assessing the effectiveness of one or another innovative solution by means of monitoring key financial and economic indicators: cost price, revenue, NPV, IRR, etc.

Depending on the specified target conditions (volumes of natural uranium con-

centrate production by years) and restrictions (sequence of mining units, throughput of processing capacities, year of putting mining units into development), the model allows calculating the production profile, resources required for its implementation (operational and capital costs), and determines the main indicators of the effectiveness of this scenario.

Comparison of various scenarios in terms of performance indicators allows us to determine the best innovative solution from the point of view of the economy for the long term, which is subsequently used to form the business plan of the enterprise.

It should be noted that monitoring of economic efficiency is carried out at each stage of the life cycle of an innovative project, which in turn is necessary for making operational management decisions, for example: allocating money for a project at the initiation stage, this issue is most relevant in a limited budget. Under this condition, it is impossible to make an effective decision based solely on the positive NPV of the project. It is necessary to have an idea of how this NPV is obtained (cost reduction or increase in finished product output, etc.). To solve this problem, a ranking scheme has been developed, which is part of the business process for assessing the economic efficiency of innovative projects (Figure 3).

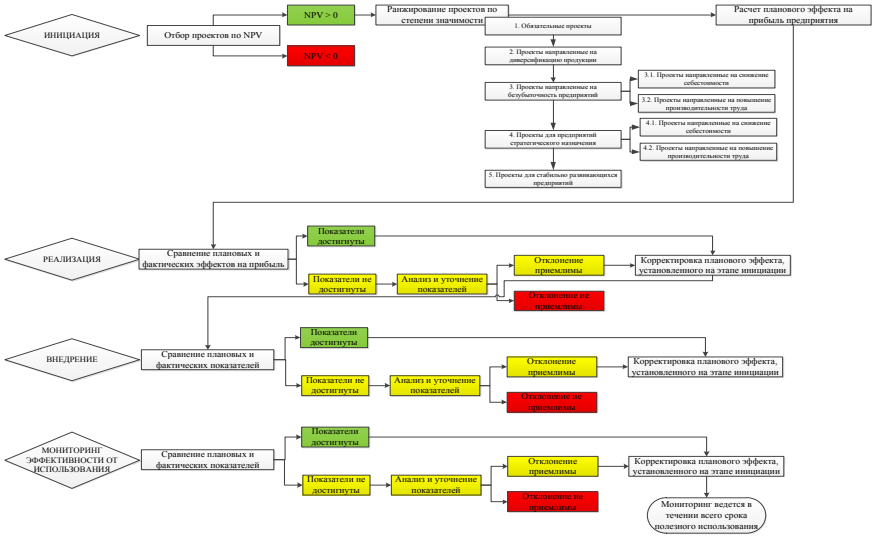


***Figure 3**. System for assessing the economic efficiency of innovative projects at each stage of the life cycle*

An important component of the methodological approach is the analysis of planned and actual indicators of economic efficiency based on factor analysis, which is a necessary component of the process of assessing economic efficiency, presented in Figure 3, for making managerial decisions on a particular project (closing a project, increasing funding, suspending a project, etc.).

To carry out the factor analysis of the cost, it is necessary to collect and systematize the primary analytics and the subsequent calculation of the cost of the analyzed objects.

The value factor should be understood as any internal or external elements and causes affecting the value of the value, causing positive or negative changes in its dynamics. The criteria for recognizing processes or phenomena as cost factors can be their significance in terms of the nature of the impact on the cost indicator and controllability, i.e. the ability to provide targeted impact on them. [4]

Thus, to assess the economic efficiency of innovative projects and determine key performance indicators and subsequent management decisions, it is proposed to use financial and economic models with a subsequent analysis of planned and actual indicators. This approach solves both operational problems, which are especially relevant for the city-forming enterprise PJSC "PIMCU", and long-term ones (efficiency of commissioning new fields, the ability to see periods of failures and the need to diversify production).

References

1. https://rosstat.gov.ru/storage/mediabank/fimgAF33/Region_Pokaz_2020.pdf

2. The reference has been prepared by BSBI "VSEGEI" as part of the implementation of the State Assignment of the Federal Agency for Subsoil Use dated 14.01.2021 №049-00016-21-00

3. Resolution of the administration of the urban settlement "City of Krasnokamensk" dated 30.09.2021 № 1004

4. Grishkovskaya S.V., Drachev A.A., Isyanov O.A. "Creation of technical and economic models for production planning", Mining journal №8 (2), 2013, P. 52

5. Suglobov A.E., Zharylgasova B.T., Savin V.Yu. "Information support of economic analysis", Audit and financial analysis № 1, 2017, P. 137-140

6. Suglobov A.E., Kurnosova V.V. "Methodological and applied problems of cost management in the automotive industry: Russian experience" Audit and financial analysis № 1, 2016, P. 323-327

DOI 10.34660/INF.2022.61.33.003

ESG 方法的关键方面和概念
KEY ASPECTS AND CONCEPTS OF THE ESG APPROACH

Zhukova Elena Vladimirovna
Plekhanov Russian University of Economics

概括。近年来，世界各地对可持续发展原则的承诺已成为社会和各国社会经济发展的一个组成部分。为响应客户和监管机构不断变化的需求，俄罗斯乃至整个世界的经济实体的商业模式将越来越注重环境、社会和管理责任的原则（E － 环境，S － 社会，G － 治理，以下简称 － ESG），在竞争激烈的俄罗斯环境中，这正成为个体经济实体的重要差异化因素。 ESG 转型发生在所有领域。俄罗斯也不例外：最大的经济实体正在逐步引入 ESG 标准。然而，ESG 举措的实施对许多人来说可能是一个严峻的挑战。一些经济主体还没有沉浸在ESG话题中，一些经济主体正在形成进一步推进的方向，更充分地评估自身风险，确定可持续发展目标的未来实施前景。如此大规模的不同层次的管理转变——从企业到国家需要国家的支持，制定平衡的政策，为各种经济实体创造有效的商业激励措施。

关键词：ESG 方法； ESG转型； ESG标准；负责任投资的原则。

Summary. *In recent years, commitment to the principles of sustainable development around the world has become an integral part of society and the socio-economic development of countries. In response to the changing demands of customers and regulators, the business models of economic entities in Russia, as well as in the world as a whole, will be increasingly focused on the principles of environmental, social and managerial responsibility (E – environmental, S – social, G – governance, hereinafter – ESG), which is becoming an important differentiating factor for individual economic entities in a highly competitive Russian environment. ESG transformation takes place in all spheres. And Russia is no exception: the largest economic entities are gradually introducing ESG standards. However, the implementation of ESG initiatives can become a serious challenge for many. Some economic entities are not yet immersed in ESG topics, and some are forming an idea of the directions in which they should move further, more fully assessing their risks and determining the future prospects for the implementation of the Sustainable Development Goals. Such a large-scale transformation in management at different levels - from corporate to national needs the support of the state, the development of a balanced policy, the creation of effective business incentives for various economic entities.*

Keywords: *ESG approach; ESG transformation; ESG standards; principles of responsible investment.*

At the moment, despite a rather deep conceptual elaboration of the understanding of the need to take into account ESG factors in the activities of economic entities, many theoretical management issues within this agenda remain open. In this article, it is proposed to consider the content of currently widely used terms related to ESG, clarifying their formulations and noting the specifics.

The ESG approach in management consists of three main components: consideration (and in many cases priority) of environmental factors in the company's core business, social responsibility and the organization of effective corporate interaction with all stakeholders. In the Russian Federation, it is at the stage of formation, the scientific definition remains unformed.

The Principles of Responsible Investment (PRI) are a set of voluntary rules developed and adopted by international investors in order to minimize the risks of long-term investment by including social, environmental and managerial factors in investment strategies. Developed by large institutional investors with financial support from the United Nations Environment Programme (UNEP). The result was the creation of the PRI Responsible Investment Association, whose mission is to introduce the principles of sustainable development into the daily activities of companies.

ESG factors into the investment decision-making process for better risk management and sustainable and long-term return on investment.

1. Environmental: climate change, greenhouse gas emissions, depletion of natural resources (including lack of drinking water), waste and pollution, deforestation.

2. Social: working conditions (including slavery, child labor), local communities, health and safety, gender composition

3. Managerial: remuneration of top management, bribery and corruption, political lobby and donations, structure and gender composition of the board of directors, tax strategy, interaction with stakeholders, etc. (for more details, see Agenda for the XXI Century, UN, 1992) [1].

ESG factors are only partially regulated by law. Most of them are advisory in nature and act as guidelines for the sustainable development of economic entities. Management mechanisms, in particular, identification and accounting in the process of activity, are absent for many.

ESG risks are risks related to environmental protection, social problems and corporate governance, as stated in the Principles of Responsible Investment, 2006 [2]. The management's disregard for environmental and social factors, the lack of consideration of the opinions of stakeholders often entail risks that lead to irreversible consequences for the company's activities. Moreover, they can be both

exogenous and endogenous in nature. Companies should regularly analyze the information disclosed by competitors. This helps to detect additional risks in the ESG area. At the same time, the results obtained should be provided to the boards of directors. As risk profiles expand and ESG risk assessment becomes more effective, companies need to take a step back and analyze their risk management process as a whole. Indicators such as the probability and impact of ESG risks should be taken into account in the overall risk management system. As a result, management will have a structured system that it can use to manage these risks and reduce their level [3].

The top 5 ESG risks include:

- corporate governance;
- cybersecurity;
- climate;
- occupational safety and industrial safety;
- new technologies (according to the Accounting Standard in the Field of Sustainable Development, 2011) [4].

ESG initiatives include:

1. Principles of Responsible Investing UN - A group of more than 1,700 asset owners, investment managers and providers voluntarily signed the PRI, focusing on 6 principles;

2. The Global Sustainable Investment Alliance is an association of the 7 largest responsible investment organizations in the world:

- Association for Sustainable & Responsible Investment in Asia (ASrIA);
- European Sustainable Investment Forum (Eurosif);
- Responsible Investment Association Australasia (RIAA);
- Responsible Investment Association (RIA) in Canada;
- UK Sustainable Investment and Finance Association (UKSIF);
- US Forum for Sustainable and Responsible Investment (US SIF);
- Vereniging van Beleggers voor Duurzame Ontwikkeling (VBDO) in Netherlands.

3. The Global Impact Investing network is an American non-profit organization that unites the leading players in the impact investment market. It was created with the aim of developing a methodological framework and standards, a joint strategy, coordination of activities, increasing its scale, effectiveness of impact and reducing transaction costs of members of the organization.

4. Institutional Investors Group on Climate Change. The main goal of the Group is to raise capital to help reduce carbon emissions. IGC is a platform for investors to interact on remuneration of government policies, investment and corporate behavior practices that take into account long-term risks and opportunities associated with climate change [5].

The environmental components of the initiatives received the most thorough scientific study due to the urgency of their solution and the importance of the planetary scale. Social factors remain poorly balanced, acutely contradictory and unresolved on many issues. The corporate component also needs deep theoretical study at the level of mechanisms, strategies and tactics for managing socio-economic systems of different levels and scales.

General, "unwritten" **ESG standards**:

1. Stop spoiling the environment - at least actively. As an example, minimizing emissions into the atmosphere, stopping the use of natural fur in production can be cited.

2. Have a positive impact on society — or reduce the negative. For example, a clothing factory can get extra points on the "social" rating if it stops buying cotton in Uzbekistan, because involuntary labor is used there. Harvard Business School is already learning to evaluate companies not by business metrics, but by "contribution to society and influence on it.

3. Improve the quality of company management. This is an ultra-wide category, which includes both measures to improve the quality of accounting and transparency of company management, as well as relations within the company [6].

The Global Reporting Initiative (GRI) has developed ESG standards that establish the procedure for disclosing information about those aspects of the company's activities that are significant from a social point of view and affect the company's stakeholders. GRI requires companies to identify issues that are significant in consultation with stakeholders.

GRI helps businesses and governments around the world to understand how they can influence sustainable development, in particular in such critical areas as climate change, human rights, corporate governance effectiveness and the well-being of society, and to talk about their work to address these issues. This makes it possible to take real actions to improve the environmental situation and create social and economic benefits for all citizens. GRI sustainable development standards have been developed with the active participation of numerous stakeholders, taking into account the interests of society.

The Sustainability Accounting Standards Board (SASB) has developed recommendations on reporting sections and indicators for 77 industries on all three aspects of ESG. These standards show how organizations can take into account the needs of investors when compiling their reports, and also provide recommendations for collecting standardized data.

SASB sees its mission in the development and improvement of industry standards for disclosure of information on environmental, social and managerial issues that are significant from a financial point of view, ensuring the exchange of information necessary for decision-making between companies and investors.

With regard to the scientific development of ESG standards, we can say that they exist at the level of understanding of management and management of economic entities.

ESG reporting can be called in different ways - reporting in the field of sustainable development, reporting in the field of corporate social responsibility, as well as reporting on ESG risks and opportunities. Market participants want to know how companies assign weights to ESG risks and take ESG factors into account when formulating their business strategy. Providing information on ESG factors allows you to confirm the company's reputation, while failure to disclose it may negatively affect the company's market value, access to capital and brand reputation in the market. In short, ESG reporting is the disclosure of information about significant risks and opportunities in the field of ESG in qualitative and quantitative terms. It also explains how and in which directions information about ESG risks and opportunities is taken into account when developing a company's business strategy.

Thus, the main terms of the Russian ESG sphere at the moment were analyzed, and the degree of their scientific development was determined. The ESG approach to sustainable development management is one of the most relevant topics worldwide. The Russian Federation, as a member of the international community, is directly involved in most initiatives in this area, but the solution of the tasks set for the sustainable development of economies has a planetary scale and is possible only with the joint actions of all stakeholders in this process.

References

1. Agenda for the XXI Century, UN, 1992. [electronic resource]. - Access mode: https://www.un.org/ru/documents/decl_conv/conventions/agenda21.shtml (accessed 24.12.2021)

2. Principles of responsible Investment, 2006. [Electronic resource]. - Access mode: https://www.unpri.org/pri/about-the-pri (accessed 25.12.2021)

3. Climate Disclosure Standards Council, 2007. [electronic resource]. - Access mode: https://www.cdsb.net/sites/default/files/cdsb_framework_2.1.pdf (accessed 21.12.2021)

4. Council on Accounting Standards in the Field of Sustainable Development, 2011. [electronic resource]. - Access mode: https://www.sasb.org/standards/download/ (accessed 15.12.2021)

5. Directive on Non-financial Reporting, 2014. [Electronic resource]. - Access mode: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0095&from=EN (accessed 25.12.2021)

6. Sustainable Development Goals, 2015. [electronic resource]. - Access mode: https://www.un.org/sustainabledevelopment/ru/ (accessed 20.12.2021)

DOI 10.34660/INF.2022.16.46.004

公私伙伴关系作为发展有偿医疗服务的机制
PUBLIC PRIVATE PARTNERSHIP AS A MECHANISM FOR DEVELOPMENT OF PAID MEDICAL SERVICES

Mashninova Yuliana Vladimirovna
External doctorate student for the Russian Presidential Academy of National Economy and Public Administration

抽象的。 文章讨论了该算法在医疗保健领域实施公私合作的特点，反映了所提出的组织和经济机制的优缺点，并概述了在俄罗斯医疗组织中应用的成功实践。

本文面向医疗保健领域的组织负责人、经济学家以及所有对社会领域部门重组问题感兴趣的人。

关键词：公私合营，卫生保健系统，医疗机构，卫生保健管理。

Abstract. *The article discusses the features of the algorithm for the implementation of public private partnership in the field of healthcare, reflects the weak and strong sides of the presented organizational and economic mechanism, and outlines the successful practices of application in Russian medical organizations.*

The article is aimed at the heads of organizations in the field of health care, economists, as well as all those interested in the issues of reorganizing the sectors of the social sphere.

Keywords: *public private partnership, health care system, medical organizations, health care management.*

The Russian economy is an integral part of the global economic system, but it is in a difficult financial and economic situation now.

Interest in the interaction between the state and private business, in the field of health care, is strongly associated with a change in the angle of view on market relations, with the methods of state regulation and the urgent need for the implementation of long-term investment projects in the social sphere.

In this regard, the social concept of public private partnership (PPP) is applied in the national economy, which is an alternative to the privatization of socially significant objects of state property. PPP in health care can be considered as an effective tool in terms of solving the strategic objectives set for the health care system, such as improving the quality, accessibility and comfort of medical services

provided, and the effectiveness of managing organizations in this area.

PPP issues in the social sphere are increasingly discussed at scientific conferences at various levels, and are also raised in publications of researchers such as D. L. Yershova, D. V. Piven, I. P. Ruyga, N. V. Syutkina, Tappaskhanova Y. O., Titova A. I., Yudina T. N., Balashova A. M. [5,7,8,10,11,12,13]. Issues related to the theory and practice of PPP are reflected in the scientific publications of M. Deryabina, A. Kamensky, V. Kogalovsky, O. Goncharov and A. Alpatov, L. Kostyak, V. Ryazanov. [3,6,9,14].

In the total number of implemented PPP projects, social infrastructure is in the first place. However, in terms of the total cost of projects, the leader is transport.

Currently, 240 projects have already been implemented in the social sphere in 60 regions with a total funding of 400 billion rubles, and the healthcare sector is the leader in the number of initiated and implemented investment projects based on PPP principles in the social sphere. Next is social services - 46 projects and education - 36, respectively. According to the monitoring results of the Ministry of Health of Russia at various stages, from initiation to operation, there were 178 infrastructure projects of this type with a total investment of about 77 billion rubles, providing for the creation, (reconstruction, overhaul) and subsequent operation of healthcare facilities (of which 67 projects - at the operation stage, 52 - at the investment stage, 59 - at the pre-investment stage).

Figure 1 shows the dynamics of PPP projects in the social sphere in 2020-21.

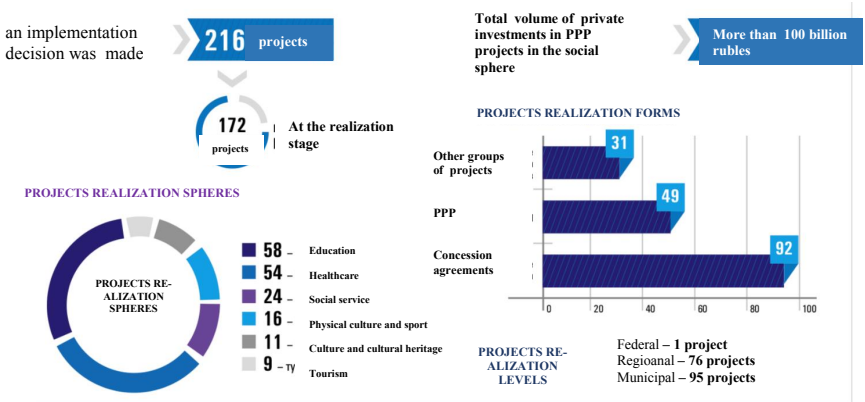


Figure 1. *Dynamics of PPP projects in the social sphere*

It is drawn up by the author based on the source [1]

The main direction of these projects in the social sphere can be construction, reconstruction of social and infrastructure facilities.

Based on the analysis, it can be concluded that PPP in the social sphere makes it possible to increase the efficiency of the use of resources and management, to invest in the construction and renovation of infrastructure, as well as to improve the quality and types of services provided by ensuring their customer centricity (Fig. 2)

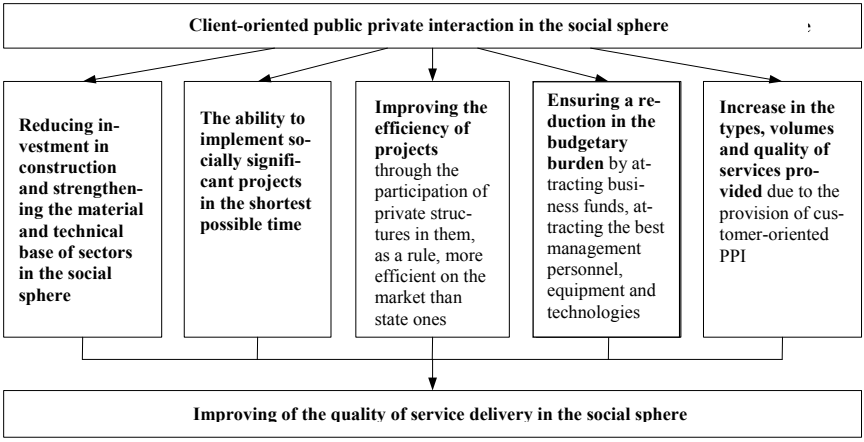


Figure 2. *Block-diagram of the benefits of interaction between government and business in the social sphere*

However, PPP for a public partner and for a private business is of varying degrees of interest. If the main task for the state is the implementation of the intention to improve the social and economic situation and reduce the budgetary burden, then the commercial structure, along with the main goal of making a profit, plans to receive certain preferences and benefits regarding the sales market for products or services, as well as the possibility of obtaining credit financial resources with minimal costs. The state must share the benefits and risks with them to attract entrepreneurial structures into the social sphere.

In recent years, more and more forms of PPP have appeared that meet various tasks facing the economies of different countries and the areas of application of various forms of their interaction are actively expanding. The importance of partnership between the state and business structures in Russia is increasing every year and is already creating the necessary effect in all areas of economic and social policy, as well as stimulating the direction of support for the social sector.

It should be noted that at the federal level, basically, a legislative framework has already been created for the implementation of various forms of PPP, and various institutional mechanisms for its implementation have been organized. All

relations between the state and the private sector are regulated by the Federal Law of No. 224-FZ dated 13.07.2015 "On public private partnership ..." resources in the Russian economy in order to improve the quality of goods and services.

At present, as the analysis of scientific sources has shown, a sufficient number of PPP projects are already being implemented and operated in the constituent entities of the Russian Federation. However, the level of development of the regions is not unambiguous. In this regard, the Moscow and Leningrad regions are leaders. It should be noted the interesting practice of implementing projects in the field of health care in Tatarstan, Ingushetia, Samara, Omsk and Ulyanovsk regions, as well as in Udmurtia and Bashkiria. One of the most developed regions of the Russian Federation for the implementation of PPP projects in health care is the Samara Oblast [2].

Further, the largest projects in the healthcare sector in 2015-20 are presented in Figure 3.

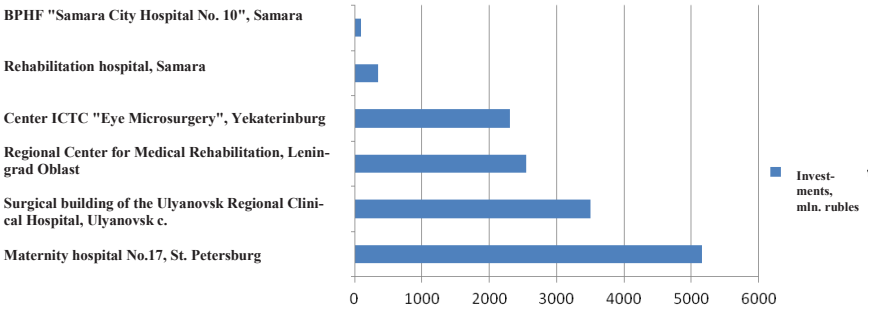


Figure 3. *Large PPP projects in the healthcare sector in 2015-20*

The Leningrad Oblast carried out the necessary transformations in order to improve the regulatory framework and introduce new projects in the healthcare sector, thereby improving its place in the ranking of regions for the development of PPP. These are such projects as the construction in the Leningrad Oblast (Kommunar s.) of a rehabilitation center with a capacity of 200 beds, and physical culture organizations (8 swimming pools).

Today in most cases projects of public private interaction in the field of healthcare are represented by a mixed capital structure with the involvement of public and private structures, which allows us to consider them as institutional public private partnerships.

In the healthcare sector, concession agreements and PPP agreements were concluded, including those given in Table. 1

Table 1.

PPP projects in healthcare in the regions of the Russian Federation

Project	Level	Form	Status	Investment volume (million rubles)
Reconstruction and operation of a laboratory complex on conducting laboratory research. (Volgograd Oblast)	Regional	Concession agreement	There is no data	740,85
Reconstruction of the facility for the implementation of activities in the field of health care and social and cultural purposes, Cherepovets c. (Vologda Oblast)	Municipal	Concession agreement	Operational	25,0
Creation and operation of the building of the radiological building of the East Siberian oncological center, Irkutsk	Regional	Concession agreement	There is no data	5 194, 698
Creation and operation of a healthcare facility for the implementation of forensic medical examination, in the city of Togliatti (Samara Oblast)	Municipal	Concession agreement	There is no data	230
Creation and operation of an inter-municipal complex for the processing and disposal of solid municipal waste, eco-technopark of the Lysva urban district of the Perm Krai	Regional	Concession agreement	Operational	426

The practical implementation of effective PPP projects is impossible without an appropriate level of corporate culture, which gives managers the necessary preferences, namely, how to make management decisions related to the provision of affordable and high-quality medical services with minimal costs and as efficiently as possible, thus maintaining the life and health of the population of the Russian Federation [4].

Thus, to date, private business is not ready to invest actively in projects with

state participation, especially when it comes to the health care system, where the risks for a commercial structure are especially high, due to the complexity of the return of invested financial resources due to low tariffs for compulsory medical insurance, which does not allow for a return on investment in a clearly scheduled date.

PPP projects have all the prerequisites for large-scale implementation in the Russian Federation, since healthcare is interested in them. Attraction of business allows not only to use non-state financing, but also to help to achieve the completion of the project on time and in accordance with the planned business plan. It also allows ensuring efficient operation and maintenance of the technical condition of assets throughout their life project cycle.

References

1. "ROSINFA", access code: www.p3week.ru (2020-2021)

2. A European-level dialysis center opened in Samara (access code: https://doctor.rambler.ru/news/40292564-v-samare-otkrylsya-dializnyy-tsentr-evropeyskogo-urovnya/)

3. Alpatov A. A. Public private partnership. Implementation mechanisms / A. A. Alpatov, A. V. Pushkin, R. M. Dzhaparidze. - M.: Alpina Publishers, 2010. - 200 p.

4. Yermakova S. E., Kozyreva N. I. Effective corporate culture in healthcare organizations as an anti-crisis management tool. - RISK. - 2021. - No. 1. - P. 74-82. 1.1 p. s.)

5. Yershov D. L. Experience in the implementation of partnership between the state and business in health care [Text] / D. L. Yershov // Young Scientist. - No 11 (58). - November, 2013. - P. 331–334.

6. Kamenskiy A., Kogalovskiy V., Goncharova O. Brave partners: forms of life of PPP in health care / A. Kamenskiy, V. Kogalovskiy, O. Goncharova // Business magazine about the health care industry Vademecum. - 2014. - No. 03.

7. Piven D. V., Kitsul I. S., Ivanov I. V. Criteria for assessing the quality of medical care: what needs to be taken into account and how to ensure their observance in a medical organization // Health Manager. 2017. No. 10.

8. Ruyga I. R. Methods for assessing the region's innovative sustainability // KE. 2017. No. 10.

9. Ryazanov V. T. New technologies in the economy and the coronavirus pandemic: preliminary conclusions. Economic revival of Russia. 2020; (2): 93-103.

10. Syutkin M. V. Public private partnership in health care in the regions of Russia / M. V. Syutkin // Eurasian international scientific-analytical journal. - 2011. - No. 4 (40).

11. Tappaskhanova E. O. Public private partnership in health care / Tappaskhanova E. O., Mustafayeva Z. A. // Russian Entrepreneurship. - 2012. - No. 13 (211). - P. 112-118.

12. Titova A. I. Implementation of projects in the field of healthcare in Russia [Electronic resource] / A. I. Titova // electronic scientific and practical journal "NAUKA-RASTUDENT.RU". - 2015. - Access mode: http: // nauka- rastudent. ru/16/2539/

13. Yudina T. N., Balashov A. M. Coronavirus is a catalyst for digitalization and public private partnership in medicine // World of a new economy. 2021. No. 1.

14. Kostyak L., Shaw D. M., Elger B., Annaheim B. A means of improving public health in low- and middle-income countries? Benefits and challenges of international public-private partnerships. Public Health. 2017; 149: 120–129.

DOI 10.34660/INF.2022.76.87.004

我国小学教师职业培训形成的具体情况
THE SPECIFICS OF THE FORMATION OF VOCATIONAL TRAINING OF PRIMARY SCHOOL TEACHERS IN CHINA

Huang Yanan
Postgraduate
Lomonosov Moscow State University
Moscow, Russia.

我国小学教师职业培训体系在教师教育发展的现阶段，分析了我国小学教师职业培训形成的主要阶段和国家特点。 对我国小学教师职业培训形成的历史和教育学分析，使我们能够全面分析现代教师职业培训的趋势和导致小学教育质量提高的条件。 老师。

关键词：小学，教师，教学教育，教师专业培训，教育体系。

Abstract*. The system of vocational training of primary school teachers in China at the present stage of development of teacher education provides for an analysis of the main stages and national specifics of the formation of vocational training of primary school teachers in China. The studied historical and pedagogical analysis of the formation of vocational training of primary school teachers in China allows us to conduct a comprehensive analysis of modern trends in the professional training of teachers and conditions that lead to an increase in the quality of pedagogical education for primary school teachers.*

Keywords*: primary school, teacher, pedagogical education, professional training of teachers, education system.*

The history of education in China goes back several thousand years, but its own system of pedagogical education began to take shape only at the end of the XIX century, under the influence of the experience of pedagogical education in Western countries. The pedagogical system of China, its axiological aspects, was formed under the influence of national values and traditions. The philosophical and ethical features of the culture of China, which have a great influence on the value and target orientations, the content and forms of the educational system of China at different stages of its development, include the key categories of strategic thought of Confucian philosophy: (path (*tao*); strength or strategic power (*shi*); softness (*zhou*) and victory (*sheng*)), developed over millennia [9, p. 14].

In China, there were other models of ethical culture that contributed to the formation of a special type of personality. Taoism is the second most important ethical teaching, which is often viewed as the opposite of Confucianism. In Taoism, the ideas about the naturalness of human behavior and the unnaturalness of any rules that limit the natural principle in a person are important. Taoism cultivates ideas about fatalism, contemplation, escape from the realities of life [1, p. 98-99].

Chinese culture is built on the priority of knowledge. And this was laid down since the time of Confucius in the VI-V centuries BC. Confucian is a scientist, intellectual who, having passed the system of examinations, became an official and statesman. Confucianism traditionally devoted a great deal of attention to the question of ideal relations between the people and the authorities. Restraint, the ability to leisurely comprehend what is happening is a feature of the national character and of the entire culture of China as a whole. Among the factors that ensure the stable development of the ethnos, it is necessary to name the constant concern for the education of citizens and the maintenance of historical memory, national culture and language. Order should be based not on force and coercion, but on internal self-discipline based on virtue, for if "if order is maintained by the threat of punishment, then the people will lose their sense of shame." The listed unique features of Chinese culture provide, on the one hand, resilience, and, on the other hand, a high ability to adapt to challenges in a foreign cultural environment.

The Confucian ideal of the cultural development of the individual determined the mainstream development of both the education system and the entire Chinese culture. Under the direct influence of Confucianism, a special type of personality arose in Chinese culture – a person with a high ability for self-control. Special attention of scholars was drawn to the image of the teacher as an ethical bearer of the values and norms of Chinese culture. Confucius believed that it was not so much the transmission of knowledge that was important for the teacher, but assistance in the formation of moral qualities ("Li Ji"); the teacher must first correct his own words and deeds, become a good example for students ("Lun Yu: Izy Lu"); must respect and love his profession ("Study without satiety, educate tirelessly"). Confucius said: "Anyone who, turning to the old, is able to discover new things, deserves to be a teacher", that is, a teacher must have pedagogical abilities and skills, possess heuristic methods that allow exploring the cultural heritage of the past in close connection with discoveries in the present. Confucius described the image of a teacher: the teacher should be moderate, strict, but not ferocious, respectful and calm ("Lun Yu: Shu Er") [8, p. 98]. The philosopher Wang Chun of the Eastern Han dynasty believed that the knowledge of teachers could not be limited to the Confucian classics, the teacher should have both knowledge based on the heritage of the past and modern knowledge [8, p. 99].

In the works of modern Chinese teachers, the issues of the professional qual-

ities of teachers are also investigated. Tao Xingzhi (1891-1946) presented the requirements for the professional moral and personal qualities and skills of a teacher. He believed that a teacher should have higher moral qualities, a teacher should have a striving for truth, democracy, have a sacrificial attitude to his work, the ability to maintain good relations with students [4, p. 49-51]; the teacher must have a systematic and broad knowledge of theory and practice, gain knowledge not only through books, but on the basis of life experience and practice; to promote the development of research and creative skills in solving problems [2, p. 30-36].

Describing the professional and personal qualities of a teacher, the writer and teacher E. Shengtao (1894-1988) noted that a modern teacher should have social responsibility, ideal morality, should be a person who is devoted to education, sincerely and equally treats students, and improves his personality. The scientist's interest was also directed to the analysis of the professional and pedagogical skills and abilities of the teacher. A modern teacher must master special knowledge, basic skills and abilities, the ability to connect his subject with other subjects. A modern teacher must be able to creatively use innovative methods and teaching aids, carry out individual training, have the ability to self-study and self-development [3, p. 52-56].

Comparing the ethical and professional requirements for the personality of a teacher in Western countries and China, it should be noted that their differences are reflected in the priority of the spiritual and moral values of the teacher's personality in Chinese pedagogical thought, according to which the leading are the professional understanding, morality and spirit of the teacher as a carrier of cultural values of education.

Until the end of the XIX century, there were no educational institutions specializing in the training of teachers, and the role of teachers was usually retired officials and the intelligentsia. Analysis of studies on the history of teacher education in China (G.I. Zubkova [5, p. 114-118], Li Jun [7, p. 13-19], etc.) made it possible to identify three main stages of its development: and the formation at the end of the Qing dynasty (1897-1911); development and ordering during the period of the Republic of China (1912-1948); restructuring and transformation after the establishment of the People's Republic of China (1949 – up to the present).

Next, we will characterize each of the named stages:

The first stage (1897-1911): origin and formation. At the end of the Qing dynasty, Western imperialist powers invaded China, and at the same time Western educational ideologies entered the country. In 1897, Sheng Xunhuai founded the Nanyang Academy in Shanghai, which became the first pedagogical educational institution in China. In January 1904, the Qing government issued a "Prescribe for School Education," in which teacher training institutions were divided into two categories: primary and secondary teacher training schools. Also, the tasks

of preparation, the terms of training, the age of admission to schools were determined. From now on, teacher education has become an independent part of the entire education system in China.

The second stage (1912-1948): Development and ordering. In 1913, the government of the Republic of China published the "Statute on Higher Pedagogical Institutes," which was the first special decree on teacher education in China. The document indicated the goal, disciplines, terms of teacher training. Primary pedagogical schools were replaced by pedagogical colleges, secondary – by higher pedagogical institutes. This symbolized the formation of a new Chinese teacher education system. Further, in 1915, at a national conference on education in China, opinions were expressed that it is not necessary to specially train teachers, and it is also not worth spending 3 years of students on studying. In addition, it was required to liquidate pedagogical educational institutions [14].

During the named period, they began to teach mathematics, chemistry, physics, biology and other specialized disciplines in pedagogical educational institutions. Pedagogy, psychology and teaching methods were compulsory subjects for all students. Translated Japanese manuals became one of the first teaching aids in China. The Qing government demanded that schools, which would be used as a practice base for the training of future teachers, should be established at some important teacher training institutions. During this period, there were three types of schools: government schools, which were created by government funds; public schools – by public funds; private schools – by individuals [5, p. 115].

In 1922, following the example of America, the Chinese government developed and promulgated the "Procedure for the introduction of teacher education", and the "six-three-three" educational system was proposed. It prescribed the unification of pedagogical educational institutions with common universities, the transformation of some of them into common universities [11, p. 20]. Later, in 1932, the Ministry of Education of China in the document "Directions of the educational reform of the state and methods of implementation" stated that "the current teacher education will be canceled" [10]. Of course, the named period was not easy for pedagogical education in China, but it was improving: the goal of training teachers was more clearly defined, a scientific and practical interest in the methodological training of teachers appeared, and teaching aids began to be developed taking into account the realities of Chinese education. It is important that it was during this period that a solid foundation was laid for further modernization, transformation, and openness of the pedagogical education system.

Third stage (1949 – up to the present): Restructuring and transformation. After the founding of the People's Republic of China, guided by the example of the education system of the USSR, the Chinese government invited many teachers from the USSR to participate in the development of the teacher education system.

In 1956 it was decided to restore primary and secondary pedagogical education. A Chinese three-tier system of pedagogical education (primary, secondary and higher pedagogical education) has taken shape.

In order to improve the quality of teacher training, the Ministry of Education of China called on scientists and specialists to translate the teaching materials of the USSR, thus many Soviet teaching aids appeared, which contributed to the development of pedagogical training of Chinese teachers. The ten-year rebellion during the "cultural revolution" in China (1966-1976) led to a certain chaos, including in the teacher education system. In 1980, at the state national conference on teacher education, the lessons and experience of its implementation were summarized and analyzed, the goals of the activities of pedagogical educational institutions were revised – the restoration and creation of a more reliable system of teacher education.

At the end of the XX century, in China, as in the rest of the world, a restructuring of the structure of teacher education begins. In 1999, the Ministry of Education of China published the document "Opinions on the regulation of the structure of pedagogical educational institutions", which presented the requirements for reforming the network of pedagogical institutions, improving the level of teacher training, and moving from a three-tier system of teacher education to a two-tier one. Thus, China began to regulate the structure of teacher education in two directions: the reduction, even the abolition of secondary teacher training schools; expansion of higher pedagogical universities and institutes. In 2001, the Ministry of Education of China drew up a plan, which indicated that until 2003 the number of teacher training institutions will decrease from 1353 to 1000, including 300 teacher training universities, 500 secondary teacher training schools, until 2010 secondary teacher education will be abolished.

Secondary teacher education has played an important role in the development of education in China, has trained many teaching staff for schools, and contributed to the popularization of compulsory education in China. From 1949 to 1978, secondary teacher education experienced several shocks, but generally showed an upward trend, regardless of the number of graduates, the number and scale of schools, and the number of teachers. In general, from 1978 to 1998 the number of secondary pedagogical schools decreased slightly, but the number of students in them increased 6 times [13]. Since 1999, while implementing the idea of creating an open system of teacher education and raising the level of teacher training in China, secondary teacher education has undergone a reform unprecedented in its history. Many provinces have started to gradually close secondary teacher training schools, for example, in Shandong province at the end of 2006, a document was issued that announced the abolition of secondary teacher training schools by the end of 2011. The regulation of secondary teacher training schools proceeds in two

ways:

a) "Internal increase", i. e. the transformation and merger of secondary pedagogical schools into pedagogical universities (universities, institutes and higher specialized educational institutions), while they still remain in the pedagogical education system; “Internal improvement” can not only raise the level of training in secondary pedagogical schools, but also preserve a rich experience in educational activities and an excellent cultural heritage;

b) external transformation, while many secondary pedagogical schools were transformed into non-pedagogical educational institutions or merged with non-pedagogical universities; the transformation radically changed the nature of schools, led to the loss of resources for teacher education; Usually, schools as branches of complex universities can continue to train teachers, but, of course, teacher education is not the main task.

In 1999-2005, a total of 565 secondary pedagogical schools were reorganized, including 56 schools turned into higher pedagogical special educational institutions, this is 7%; 71 schools were reorganized into complex institutions (9%), 35 schools were reorganized into complex universities – 4%, 36 schools were reorganized into teachers' institutes – 4%, 85 schools were reorganized into professional universities – 10%; 56 schools became institutions for retraining and advanced training of teachers – 7%; 228 schools turned into secondary schools and another – 29% [12]. Further, the number of secondary pedagogical schools decreases every year, until 2013 there are only 110 secondary pedagogical schools left in China, i.e., it has decreased to 56% compared to 2007, 7 times compared to 1999, 10 times compared to 1978.

In December 1996, at the fifth national conference on teacher education, a new educational policy was proposed, recognizing the priority status of teacher education, focused on improving its quality and efficiency, and optimizing its structure. In order to raise the level of education of teachers, in 1999, by order of the Ministry of Education of the PRC, teacher education switched from a three-tier system to a two-tier one, and primary teacher education was canceled.

To comprehensively improve the quality of teacher training, the PRC Ministry of Education, together with other government departments, has developed the Action Plan to Revitalize Teacher Education (2018–2022) and the "Ministry of Education's Opinion on the Implementation of the Outstanding Teachers Training 2.0 Program". The key qualities of outstanding teachers were named: the ability to organize and manage educational activities, excellent knowledge of the subject, practical wisdom, reflective competence, research competence.

The modern system of teacher education in China is influenced by the educational ideology of "lifelong learning", and today a system of integration of teacher education before and after employment has been created: 1) teacher education in

educational institutions; 2) postgraduate pedagogical education, that is, a system of advanced training for teachers. Modern pedagogical educational institutions in China are represented at two levels: secondary and higher pedagogical education. The level of secondary pedagogical education includes colleges and schools, which are now significantly reduced [15].

Secondary pedagogical educational institutions with a three-year duration of study train kindergarten teachers and primary school teachers. The training of primary and secondary school teachers is carried out by pedagogical universities and classical universities, which are the leading bases for teacher training.

In the modern system of higher pedagogical education, three models of teacher training are implemented: a 4-year bachelor's program, a 2- or 3-year master's program, a 3- or 4-year postgraduate program (from 2019, the duration of postgraduate studies in China is 4 years, but early completion of training is acceptable). According to the 2015 Chinese Education Yearbook [6], in 2014 there were 173 higher teacher training institutions and 125 secondary teacher training institutions. Another 338 general higher educational institutions implemented teacher education programs. Thus, the total number of graduates in the specialty "Pedagogical education" in 2014 amounted to 617.8 thousand; 47.1% of them were trained by general higher education institutions. Postgraduate teacher education is a teacher training system organized by pedagogical and classical universities, colleges created by community forces or administrative departments of education. This can also include regional schools and teacher training colleges, distance learning institutions. Postgraduate pedagogical education offers teachers the latest teaching methods and educational technologies, helps them to continue to improve their qualifications and adapt to the conditions of reforming and developing education, the requirements of the time, and ensures a close relationship between the theory of education and educational practice. For more than 100 years of development, the Chinese teacher education system has studied and adapted the Japanese, American and Soviet models, while simultaneously being in constant search for its own model of education "with a Chinese character".

It should be noted that frequent changes in the policy of teacher education in China have sometimes led to its destabilization. The significant influence of external political forces on the development of teacher education in China can be characterized as ambiguous: it either facilitated or hindered this development. Nevertheless, China's modern teacher education system is already showing significant progress, serving as an important part of the global education system.

Thus, an analysis of the scientific, scientific, methodological and regulatory literature on the history of the development of vocational training for primary school teachers in China allows us to draw the following conclusions:

- the professional training of primary school teachers is mediated by axio-

logical and pedagogical ideas that form the pedagogical paradigms of education: in China, along with the modern humanistic paradigm of education, the national ideas of Confucianism retain their significance; by now the ideas of "life-long education" are important;

- vocational training of primary school teachers is associated with the development of pedagogical educational institutions, which went through three stages: the period of the teacher training college, the period of the teacher training college, the period of the educational institute and postgraduate studies at classical universities, which reflects the basic trends for the teacher education system in China.

References

1. Avhodeeva, E.A. Preservation of national and cultural identity in an open cultural space: the example of China: dis. ... candidate of philosophical sciences / E.A. Avhodeeva. – Volgograd, 2016. – P. 98-99.

2. Doo, Haiping. Reasoning about the quality of the teacher Tao Xingzhi / Du Haiping // Bulletin of the Shaoxing Pedagogical College. – 1992. – № 3. – P. 30–36.

3. Ren, Sumin. On the ideas of teacher quality and teacher education / Ren Sumin // Education Research. – 1996. – № 8. – P. 52–56.

4. Zee, Zhen. Tao Xingzhi's views on teacher quality / Zi Zhen // Bulletin of Nantong University (pedagogical science).– 2006. – № 4. – P. 49–51.

5. Zubkova G.I. The history of the formation of pedagogical education in China / G.I. Zubkova // Kazan Pedagogical Journal. − 2007. − № 3. − P. 114−118.

6. Chinese educational yearbook 2015 // Ministry of Education of China. URL: http://www.moe.edu.cn/jyb_sjzl/moe_364/zgjynj_2015/201711/t20171102_318252.html

7. Li Jun. Chinese model of teacher education – experience and enlightenment leading to global reform / Jun Li, Tian Xiaohong, Chen Paypei, etc. // Fudan Educational Forum. − 2017. − №15(2). − P.13–19.

8. Liu Nan. Comparative analysis of the teacher education system in Russia and China: diss. ... cand. ped. sci: 13.00.08 / Liu Nan. – M., 2018. – P. 98-99.

9. Raspertova, S.Yu. Modern cultural strategies of the People's Republic of China in the practice of international interaction: diss. ... cand. philos. sci: 24.00.01 / Raspertova Svetlana Yurievna. – M., 2011. – P. 14

10. Huo, Iping. Higher education in modern China / Huo Iping. − Shanghai: East China University Press, 1999. − 314 P.

11. Zhang, Chang. Evolution and features of teacher education policy in

China over a century / Zhang Chang // Journal of Hebei ped. un-ty. −2001. − № 4. − P. 20.

12. Zhou Yutong. History of Chinese modern education / Zhou Yutong. – Xiamen: Fuizian ped. publishing house, 2007.

13. Zhu, Xudong. Study of the development of a teacher training institution in China / Zhu Xudong. – Beijing: Beijing ped. un-ty, 2017. – 439 P.

14. Zhu, Yuwei. History of the modern Chinese academic system (part III). / Zhu Yuwei. − Shanghai: Publishing house of the East China ped. un-ty, 1990. − 844 P.

15. Jun, L. I. The Chinese model of teacher education: Retrospects and prospects over a century / Jun L. I. //Frontiers of Education in China. − 2012. − № 7(3). − P. 428.

DOI 10.34660/INF.2022.74.25.005

资源中心的传播是高等教育包容性发展的必要条件
THE SPREAD OF RESOURCE CENTERS AS A NECESSITY FOR THE DEVELOPMENT OF INCLUSION IN HIGHER EDUCATION

Zhang Tianxu
Postgraduate
Lomonosov Moscow State University
Moscow, Russia

在现代条件下，大学的全纳教育，例如盲人学生，由于缺乏各种教育资源，面临着专业教育狭隘的困境。因此，盲人教育的高校难以融合发展，势必影响盲人高等教育的质量。 2000年，北京联合大学特殊教育学院开设了盲人高等教育，时至今日，已培养了数以百计的毕业生，两个专业。近年来，高校为加强教育支持，为盲人提供更舒适的学习条件，纷纷设立培训资源中心。它们的功能基于为盲人克服学习困难提供各种支持。在大学的这种支持过程中，盲人在与健康学生平等的基础上，成功地获得了适合其发展、满足需要和要求的各类专业知识和技能。

关键词：高等全纳教育，盲人学生，学习，发展，资源中心，盲人，特殊学习条件。

Abstract*: In modern conditions, inclusive education at a university, provided, for example, for blind students is faced with the dilemma of narrow professional education due to the lack of various educational resources. As a result, it is difficult for universities for teaching the blind to integrate and develop, and this inevitably affects the quality of higher education for the blind. In 2000, the School of Special Education of Peking Unified University opened higher education for the blind, and to this day, tens of hundreds of graduates have been trained in two majors. In recent years, universities, in order to strengthen educational support and provide more comfortable learning conditions for the blind, have created training resource centers. Their functionality is based on the provision of various support to the blind in overcoming learning difficulties. In the process of such support at universities, blind people successfully acquire all types of professional knowledge and skills suitable for their development, satisfaction of needs and requirements on an equal basis with healthy students.*

Keywords*: higher inclusive education, blind students, learning, development, resource centers, the blind, special learning conditions.*

The implementation of barrier-free vocational training for students with disabilities in higher education for the blind in China should be counted from the beginning of the last century. However, the creation of special faculties in universities, the use of a separate admission for training and passing exams, separate professional areas and specializations in the field of teaching methods began in the 1980s [5]. Currently in China, according to preliminary statistics, the number of colleges for blind students in which they receive higher education is less than 1000 people. In them they acquire such specialties as: "master of acupuncture and massage", "piano tuner", "specialist in computer technologies".

They cannot compile complete statistics on visually impaired students, therefore there is no exact data. However, according to the current situation and expert estimates, there are no more than 2,000 students with visual impairments. Most of the majors they study are related to the humanities such as literature and education. There are many reasons for this situation, since due to visual impairment, blind students cannot study all types of visual teaching materials on a par with sighted students, because they cannot use all types and means of educational tools in which vision should be involved. In addition, it is difficult to find different educational installations and equipment to support blind students. This is one of the important reasons for the slow development of higher inclusive education for the blind: a small number of specialties to choose from and their narrow coverage. Although, "today, inclusion is becoming an integral importance of modern education at any of its levels, and in universities, model samples of special educational conditions for technical and organizational equipment are being created" [2, p. 147], and yet:

– **The creation of training resource centers is required.**

The main goal of the creation of *training resource centers* is to provide students with visual impairments with educational equipment, materials and aids to acquire advanced professional knowledge and skills so that students with disabilities do not impede their learning. At the same time, with the support of teaching aids, blind students can choose a wider range of higher education majors. Students do not need to devote too much time to thinking about personal physical problems and obstacles in vocational education, and they will be able to generally more calmly follow social needs and personal hobbies in order to choose their individual path and pursue a specialty.

– **There is a need to improve the quality of higher inclusive education for the blind.**

Currently, there is a large gap between the teaching requirements and the preparation standards for higher inclusive education for the blind and regular higher education. With the support of *training resource centers*, students can learn without obstacles, increase their academic performance and motivation. At the same

time, the choice of specialties, adapted to the educational interests and individual needs of students with disabilities, can be expanded, which is an important guarantee of improving the quality of higher inclusive education for blind students.

– **It is necessary to use the potential of educational technologies in existing training resource centers.**

Establishing *training resource centers* for blind college students could also enable special higher education institutions to better utilize the potential of existing educational technologies. Generally speaking, the basis of special education lies in the characteristics of educational objects, and there are large differences between individuals and groups [6]. A.G. Asmolov offers "variable, developmental, semantic education, the purpose of which is to form such a picture of the world in joint activities with adults and peers, which would provide a person's orientation in various kinds of life situations, including in situations of uncertainty" [1]. And "after all, we often meet with special educational needs that are of a sociogenic nature, and they differ in children of different categories, since they are set by the specifics of their psychophysical development, which determines the special logic of building the educational process, which are reflected in the structure and content of education" [4, p. 148]. In keeping with the concept of inclusive education, how to achieve effective classroom learning is a topic that teachers in special education institutions should carefully study. Special colleges and universities providing education for people with disabilities have established several specialties according to the characteristics of people with disabilities, but the correlation between these specialties is relatively small, resulting in an ineffective waste of professional resources (for example, little use of professional experimental equipment).

Establishment of *training resource centers, firstly,* will help to concentrate some general vocational training facilities and prepare equipment, reduce re-investment and increase efficiency; *secondly*, it will help to use for further development, thinking and testing how to increase the versatility of existing resources and upgrade equipment to resolve the contradiction between high cost and low education for disabled people by providing a theoretical and practical basis for achieving the goal and increasing the functionality of educational tools.

What are the **functions** of training resource centers?

1. Providing an individual approach to training, solving theoretical and practical problems of individual training.

In fact, when it comes to teaching students' knowledge and skills, each individual student has differences in ability, style, preferences and learning habits. This leads to the need for educators to offer students appropriate ways to resolve these problem areas in learning. Individual programs and measures to improve learning are required. Of course, the provision and implementation of such programs and measures should be carried out through continuous testing of methods

of interaction between teachers and students, as well as constant accumulation of experience, which is not at all easy. The above problems are faced by blind college students as well as in the process of obtaining higher education. It is worth remembering that inclusive "education lies in human humanity: - every person is able to feel and think; - everyone has the right to communicate and to be heard, and his value does not depend on his abilities and achievements; - all people need support and friendship; - true education is carried out in the context of real relationships; - making progress in what people can do, and not in what they cannot; - the diversity of the world strengthens a person comprehensively"[4, p. 150].

In connection with this understanding and all the challenges that exist, the purpose of the *training resource centers* will be to provide learners with a variety of complementary learning materials, teaching aids and teaching aids. *Training resource centers* will also be able to discuss practical learning requirements based on student differences and generalize learning theory that can be tailored to the individual needs of students. Likewise, at *training resource centers* for the Blind, students can first seek help from teachers or others to develop customized curricula and interventions that are right for them. In addition, students can use the "equipment" for one-to-one and self-study. For this, the *training resource centers* will have individual mentors who will help blind students in the selection and study of professional courses. Teachers can advise students on their challenges in taking vocational courses, and can help and advice students on the use of equipment and materials from the *training resource centers*.

Due to differences in residual vision and learning ability, visually impaired students need personalized attention and support throughout the learning process. Teachers should formulate and provide recommendations for individualized study programs based on the psychological characteristics and individual abilities of the students. After all, "the leading principle of inclusive educational activity is the willingness to adapt to the individual needs of various categories of students through the modernization of the educational system, that is, in its structural, content and technological links. In this connection, the practical implementation and theoretical scientific base of inclusive education is constantly updated with new information, is intensively developing in all directions, being one of the most important innovative strategies in the processes and achievements of man and society" [3, p. 140].

2. Improving the autonomous learning abilities of blind students.

This function of *training resource centers* is to support students with disabilities and ultimately aims to enhance their self-study abilities.

Learning to teach is the goal. Instructional support for *training resource centers* focuses primarily on educating students and their use of special instructional tools to overcome physical learning disabilities. While *training resource centers*

provide learning support, they are ultimately designed to help improve self-study ability. Most importantly, blind college students at *training resource centers* must learn to select learning tools and aids that are appropriate for their learning abilities, in order to ultimately achieve the goal of improving their self-study skills [7]. Consequently, the hardware part of the *training resource centers* must have equipment suitable for blind students. In the functional setting of the resource center, it must meet the requirements for improving the skills and abilities of blind students. When giving assignments, the teacher's task will be to improve students' self-study skills. The ability to achieve the goal of learning to the fullest extent possible is the main task of a blind student. In every work, you need to pay attention to the observance of this principle.

3. Create an environment and environment for networked learning to expand the learning opportunities for blind students.

Technological equipment and conditions of computer networks are important means and equipment of *training resource centers,* because they are certainly used in teaching blind students.

First, learning resource centers need to create a good environment and environment for networked learning, for example: offline and networked use of the computer must have a "screen reader" function so that students can view, edit, share and output various data to the machine. At the same time, the equipment for converting and printing to braille must be complete so that blind college students can use these tools and equipment to obtain educational information and materials like ordinary people - without obstacles. Overcome your "invisible" barriers and truly maximize the use of the networked environment in learning.

Second, learning resource centers should provide a variety of teaching aids and materials to facilitate the learning of blind learners. Such as: special voice recorder, CD recording equipment, various large print books, Braille, CDs, etc. *Learning resource centers* should also be equipped with some visual aids to meet the needs of visually impaired students so that they can “see” while learning. At the same time, they should be equipped with printing equipment for the production of text materials for "large characters", i.e. provide assistance, support and learning services for visually impaired and blind students.

What will the **proliferation and expansion** of *training resource centers* give?

1. Expanding the area of expertise and building a good hardware infrastructure. Expanding the functions of training resource centers will provide support for blind students in the study of various specialties.

It is necessary to take measures to use the vast professional resources of colleges and universities with the gradual attraction of blind students to study in a wide range of areas, such as: computer, all educational specialties of the humanitarian cycle, including jurisprudence and foreign languages. The broadening of the

choice of educational professions for blind students must first of all correspond to their diverse vocational training needs for the blind and reflect their fair approach to the right to education.

2. Develop the various functions of training resource centers

The hardware that makes up the *training resource center* is very important. Equipment Needed: Braille dot display, computerized braille conversion system, braille copying equipment, braille printing equipment, computer networked voice guidance system for the blind, etc. In addition, a special room and a computer class should be opened for the *training resource center*. And for the blind, a convenient and well-equipped - built-in networked learning environment should be provided.

3. Provision of full-time staff for research and teaching work.

Schools should recommend and refer to *training resource centers* dedicated, interested teachers and administrators to support the education of blind students and their correct use of equipment.

4. Services. Among the teachers in the *training resource centers*, it is best to have practitioners who have been teaching the blind for many years. They will be able to quickly and easily learn and master various equipment and educational technologies. Based on the results that have been achieved in research and teaching for the blind, such as different braille fonts, the use of a braille display, the use and maintenance of braille printing equipment, etc., these teachers can provide students with a variety of effective guidance and assistance. At the initial stage of the creation of *training resource centers*, it is necessary to actively conduct research on the amount of support in order to lay a solid foundation for the functioning of the training resource center.

5. The effect of creating a training resource center.

- Students will show enthusiasm and initiative in learning, and their learning abilities and skills will continually improve.

Expanding the scope of training in specialties, and supporting the *training resource center* will help increase the learning enthusiasm and motivation of blind students. The main thing that the training resource center can provide is equipment, teaching materials and manuals, and together with instructions and accompaniment of teachers will help to solve many difficulties in teaching blind students, as well as increase the motivation, interest and initiative of students in studying various professions. Using the training resource center, blind students can choose their own methods of support, interaction with teachers in accordance with their interests and problems in learning [7]. Hence, the ability to perceive learning will gradually improve, and plans to improve the quality of learning are improved.

- Creation of practice bases for training teachers of special education.

The creation and operation of a training resource center for blind college students will not only contribute to the vocational training and career development of

blind students, the integration of higher education for the blind, but also provide high theoretical and practical opportunities for obtaining higher specialized vocational education. Specialists from higher special education institutions prepare and send students and graduates of special education colleges each year to mainstream and special education schools. These students should understand and master the theoretical and practical skills learned at the Learning Resource Centers for students with disabilities. Learning Resource Centers for Blind College Students - Provides a good base for research in teaching theory and teaching practice. The school can arrange for teachers and special education students to regularly visit training resource centers for internships, as well as provide practical support to *centers* with blind college students, their professional development and practical abilities of each other. In addition, special education teachers can also use the opportunity to practice at *training resource centers* to understand the psychological activity of students with disabilities in learning activities and provide psychological counseling.

- *Promoting the integration of higher education for the blind.*

In terms of trends in the historical development of education in the world, the development of higher education for persons with disabilities should be integrated into general higher education.

Worldwide higher education is coming together to ensure the integration of learning for people with disabilities. In this kind of integrated education, people with different learning abilities and learning styles come together and their learning goals are the same, but they need to use different learning resources. This is inseparable from the support of the *training resource center.* The creation and operation of a *training resource center* for blind students is precisely aimed at achieving and promoting the integration of higher inclusive education for the blind and general higher education. From the practice of creating an *training resource center* for blind students, it is clear that insufficient physiological function does not mean the absence of a learning function and a decrease in the ability to learn. The key point is whether society can provide them with assistance and compensation for physiological function. In the absence of environments and conditions, healthy people can provide support in the form of learning resources. The learning support provided by the *training resource center* to blind students not only allows them to gradually overcome learning disabilities caused by a lack of physical function, but more importantly, it will play an active role in fostering the integration of inclusive higher education for the blind and higher education throughout society.

References

1. Gasanova R.R. Motivational determinants of conscious self-regulation of educational and professional activities of a university student: diss. cand. psy. sci. / R.R. Gasanova. – Nizhny Novgorod, 2010. – 214 P.

2. Zhang T., Gasanova R.R. Semantic understanding of inclusive education // National health. – 2019. – № 4. – P. 146–149.

3. Zhang T., Gasanova R.R. Goals and objectives of inclusive practice in China (on the example of working with the blind) // Modern science: topical problems of theory and practice. Series: Humanities. – 2020. – № 9. – P. 139-144. DOI 10.37882/2223-2982.2020.09.36

4. Zhang Tianxu. Semantic formation of special education // Prospects of science. – 2019. – № 4 (115). – P. 148–150.

5. Huang Zhicheng. Inclusive education-focus on the learning and participation of all students. – M: Shanghai Foreign Education Press, 2004. – 37 P.

6. Nie Jing. Study on learning adaptation in China. – J: Journal of Beijing Institute of Education, 2006 (1): P. 38-41.

7. Luo Hao. Promote integrated education and promote – J: Special education in China, 2013(6): P. 94-96.

DOI 10.34660/INF.2022.92.50.005

形成健康生活方式的原则，作为学生物质和精神文化的组成部分
FORMATION OF THE PRINCIPLES OF A HEALTHY LIFESTYLE AS AN INTEGRAL PART OF THE MATERIAL AND SPIRITUAL CULTURE OF STUDENTS

Sirotkina Olga Vasilevna
Senior Lecturer
Kazan National Research Technological University

注解。 年轻一代健康生活方式形成过程的实施提供了学科内容的分析和调整，特别是“烹饪”部分的“技术”学科以及对青少年对生活态度的理解。 健康的生活方式，以他们的生活方式。

关键词：教育、文化、学生、目标、健康、福祉、发展、教养。

Annotation. *The implementation of the process of forming a healthy lifestyle for the younger generation provides for the analysis and adjustment of the content of academic disciplines, in particular, the discipline "Technology" of the section "Cooking" and the comprehension of adolescents' attitude to a healthy lifestyle, to their lifestyle.*

Keywords: *education, culture, students, goal, health, well-being, development, upbringing.*

The health of the younger generation and the development of effective measures aimed at strengthening it are currently the most important social task. It is in childhood, at school age, that the health of the adult population is formed [1, p. 15].

In this regard, school education in modern conditions is designed to ensure functional literacy and social adaptation of students on the basis of their acquisition of competence experience in the field of learning, cognition, professional labor choice, personal development, value orientations and meaning creation, as well as maintaining an ecologically healthy lifestyle.

The most important invariant component of the Basic Curriculum is the educational area "Technology", the purpose of which is to lay the foundations for preparing students for work in new economic conditions, to promote the upbringing and development of an initiative, creative personality, the process of its self-determination and self-realization in a future professional career.

The educational area "Technology" is one of the substantive areas of the curriculum of general education institutions. Its introduction is due to the objectively existing need in society for the formation of labor and the preservation of the health of the younger generation. It is of particular importance for the full development of the individual, designed to instill in them the foundations of a healthy lifestyle and hard work.

Leading a healthy lifestyle has now become not only fashionable, but also necessary. Children have started to run in the morning, visit fitness centers and swimming pools, but many of them forget that nutrition plays an important role in supporting a healthy lifestyle. Many of us do not think about what we eat. Therefore, it is always necessary to remember that nutrition must be correct, or rather rational.

The health problem of the younger generation is considered extremely important all over the world, since it is the main indicator of the well-being of society and the state. According to the Research Institute of Hygiene and Health Protection of Children and Adolescents of the Scientific Center for Children's Health of the Russian Academy of Medical Sciences, in recent years there has been a steady increase in the number of diseases and deviations in the health status of children and adolescents, the occurrence of which occurs during the school period. Today we understand that the school should play an important role in the formation of a healthy lifestyle. The school has an exceptional resource for promoting healthy lifestyles in schoolchildren. This resource is part of the Food Processing (Cooking) course. In this course, students are taught the following skills:

- independently prepare simple culinary dishes for your family from raw and boiled vegetables and fruits. As well as milk and dairy products, eggs, fish, meat, poultry, various types of dough, cereals, legumes and pasta that meet the requirements of a balanced diet;

- comply with the correct technological sequence of preparation, sanitary and hygienic requirements and rules for safe work;

- make up a diet based on the physiological needs of the body;

- choose food products to meet the body's needs for proteins, carbohydrates, fats, vitamins, minerals, organize your rational nutrition at home;

- apply the main types and methods of canning and preparing food products at home;

- save electrical energy when processing food; decorate cooked dishes, set the table, observe the rules of etiquette at the table;

- to determine the types of environmental contamination of food;

- to carry out measures to prevent the negative impact of the technogenic sphere on the environment and human health.

When studying the section "Cooking", you can use educational materials on traditional national (regional) types of dishes [2, p. 153].

The process of creating culinary masterpieces is unthinkable without the ability to handle special tools and equipment, without knowledge and adherence to technological regimes, without mastering the techniques of work.

It is the first steps in the knowledge of the culinary processing of various types of products that are made in technology lessons and subsequently determine the level of skill. Knowing the techniques helps you prepare hot and cold meals, drinks, baked goods and pastries, taking into account the planning of a balanced diet.

Mastering a set of techniques, acquiring professional skills is a matter of time. It is no less important, when getting acquainted with the history of the creation of a culinary dish, to understand and feel its connection with the spiritual world of the people, with its ideas about nutrition. Already in the process of teaching, schoolchildren should try to create healthy dishes and not forget that they should be beautifully decorated and properly served at the table. At the same time, you should always know that tradition is not only a set of performance techniques, verified by time, but also a special rhythm of life characteristic of a given area, nature itself, which constantly influences a person. Therefore, to understand tradition means, first of all, to plunge into this world, to be filled with it enough to become a full-fledged exponent of its wisdom. At the same time, it must be remembered that the continuation of the tradition is not a blind copying of already worked out techniques and skills, but also of the knowledge of today.

Judging by the national national cuisine, the life of a villager and a city dweller has always been clearly divided into weekdays and holidays. The most beautiful and complex dishes were prepared for the holiday, however, both in holiday and in everyday recipes, the same thing that is characteristic of the tradition of each nation as a whole was preserved.

"Technology" in the system of other school disciplines takes a certain place - it affects the formation of the intellectual and emotional spheres, the acquired knowledge is necessary for life in society and for the study of other subjects. "Technology" has deep interdisciplinary connections: physics and chemistry, life safety, mathematics, history, drawing and drawing. The purpose of technological (labor) education is associated with practical utility, with spiritual activities to master the methods of cognition and transformation of the world. Technology classes form logical thinking in students, contribute to the development of imagination. Education in technology lessons is aimed at preparing for the active participation of the child in public life, at shaping the personality of the student as a whole, the entire psyche of young people, their moral and intellectual qualities.

Practically the entire content of educational technology standards can be studied using examples of culinary art products. At the same time, great opportunities open up for the development of the creative potential of students, their aesthetic and patriotic education, as well as the formation of the foundations of an ecologi-

cal healthy lifestyle [3, p. 94].

The mastery of the relevant technologies by students is carried out more successfully when using the capabilities of modern computer support in order to illustrate the material presented, as well as to prepare for the technological process of making a culinary dish.

Thus, for many, cooking will remain a free time occupation. And some schoolchildren, having tried their hand at technology classes and identified opportunities, may want to work professionally.

What principles of a healthy lifestyle of a modern person can be defined as fundamental?

The main thing for maintaining health and increasing the duration of a healthy life of a person is:

- education from early childhood healthy habits and skills;
- environment: safe and favorable for living, knowledge about the influence of unfavorable environmental factors on health;
- quitting smoking, drug use, alcohol consumption;
- healthy food: moderate, corresponding to the physiological characteristics of a particular person, awareness of the quality of the food consumed;
- movement: physically active life, including special physical exercises, taking into account age and physiological characteristics;
- personal and public hygiene: a set of hygienic rules, the observance and implementation of which contributes to the preservation and strengthening of health, mastery of first aid skills;
- hardening of the body.

The physiological state of a person is greatly influenced by his psycho-emotional state. Therefore, some authors [6, p.10] also highlight the following additional aspects of a healthy lifestyle:

- emotional well-being: mental hygiene, the ability to cope with their own emotions, problems;
- intellectual well-being: a person's ability to recognize and use new information for optimal action in new circumstances. Positive thinking;
- spiritual well-being: the ability to set really meaningful, constructive life goals, strive for them and achieve them. Optimism.

Analysis of approaches to determining the essence of motivation and consideration of the characteristics of a healthy lifestyle allow us to determine the understanding of the motives of a healthy lifestyle.

The motives of a healthy lifestyle are understood as an integral system of conscious motives that activate and direct the manifestations of the personality (moral, spiritual, physical) in various spheres of life from the standpoint of the values of one's health.

Understanding, the essence of the need for a healthy lifestyle requires comprehension of such a basic category as a "healthy lifestyle". A healthy lifestyle is understood as a system of individual manifestations of a personality in the spheres of various activities (educational, household, social, communicative), reflecting the attitude towards oneself, the social environment, the surrounding nature from the standpoint of health values and contributing to the preservation of the body's stability corresponding to the age, maximum activity of the individual in everyday life and professional activities.

The existing school practice shows that the introduction of schoolchildren to a healthy lifestyle, the formation of conscious motives for it is not always purposeful. The indicated state is practically explained in part by the absence in the theory of a holistic concept that reveals the ways and conditions for the formation of motivation for a healthy lifestyle in a general education school [5, p.54].

It is advisable to consider the process of forming a healthy lifestyle among schoolchildren as an organic part of a holistic pedagogical process, as an interaction of external and internal factors. Internal factors are the need-motivational sphere of the student, his value orientations, attitudes, self-esteem, interests, individual properties. The external factor in this case is the educational process.

From the standpoint of a systemic-holistic approach, the process of forming motivation for a healthy lifestyle is built taking into account the logic of the development of this psychological phenomenon, which presupposes the movement of motivation from systemic manifestations to sustainable functioning, and involves several stages:

- the orientation stage, during which adolescents develop a positive attitude and interest in a healthy lifestyle, the value of health for self-realization is realized;

- the stage of formation, during which the needs for a healthy lifestyle are formed, the desire for self-education in this area from the standpoint of the values of health. At this stage, the goal is defined as the formation of sustainable motivation for a healthy lifestyle, characterized by a steady interest in the problem, the desire for self-education in the field of healthy lifestyle, self-assessment and correction of individual components of life from the standpoint of health values;

- the stage of generalization, the main content of which is the formation of an integral system of motives for a healthy lifestyle, ensuring the design of life from the standpoint of a healthy lifestyle. At this stage, the subordination of motives becomes clear, the socially valuable motives of educational activity deepen from the standpoint of a healthy lifestyle, incentives for the confident implementation of knowledge and skills in organizing educational activities, in new situations, the need for creative design of life from the standpoint of a healthy lifestyle are stimulated.

For the realization of the goal of the orientation stage, the following means are most effective:

- saturation of the content of the material of educational disciplines with modern knowledge in the field of healthy lifestyle problems ("Healthy lifestyle - the essence, modern approaches", "Health-saving technologies in education", "Safe dishes", "Choose me. How to define quality products by their appearance?") , entertaining information ("Life with taste", "What habits are bad?"), historical references ("Genesis and prospects for the development of healthy lifestyles", "It's interesting: features of the national cuisine");

- inclusion of material with a professional focus ("My future profession and health", "Career and health");

- creating situations of introspection (assessing your health by individual indicators, drawing up your own "Health Passport", "Food arithmetic. How and why to count calories?");

- the use of problematic presentation of material on certain aspects of a healthy lifestyle, discussions ("A healthy lifestyle - a hobby or a necessity?", "My lifestyle, is it healthy?", "What does food mean to us?") [4, p. 73].

The goals of the formation stage are achieved by deepening the content of academic disciplines; the creation of self-regulation situations that encourage the analysis and correction of one's lifestyle from the standpoint of a healthy lifestyle (assessment of the level of readiness for a healthy lifestyle, hygienic and moral upbringing and drawing up on the basis of the results of self-development programs), practical-imitation situations ("Point of view" , "Transfer of emotions", "Candy for happiness"), stimulating a deeper understanding of the need for knowledge and skills of healthy lifestyle in learning and other activities, encouraging schoolchildren to express value judgments, defend their beliefs on various problems of healthy lifestyle.

To achieve the goal of the generalization stage, schoolchildren are involved in situations of self-realization, stimulating the desire for self-expression, demonstrating their own approaches to building goals in the course of solving problems and in the process of implementing educational activities (creating individual healthy lifestyle programs, holding round tables "My opinion about healthy lifestyle", problem and practical and simulation situations that simulate typical features of a healthy lifestyle, future professional activity).

The formation of motives for a healthy lifestyle is considered as a purposeful process of helping a teenager in his awareness of health as the highest value, in the formation of a responsible attitude for him and in the inclusion of a student in health creation in accordance with his individual capabilities and abilities. This process is based on the principles of maintaining, strengthening and shaping health.

References

1. Agadzhanyan N.A. Human ecology: health and the concept of survival / N.A. Aghajanyan. - M.: Publishing house of RUDN, 2011. - 27 p.

2. Anfimova N.A. Cooking: a textbook for the beginning. prof. Education / N.A. Anfimova. - 6th ed. - M.: Publishing Center "Academy", 2011. - 400 p.

3. Alphabet of food. Text: method, recommendations for the organization and quality control of food in preschool educational institutions / N.A. Targonskaya. - M.: Linka-Press, 2005. - 142 p.

4. Lyakh V.I. A comprehensive program of physical education for students in grades 1-11 / V.I. Lyakh, A.A. Zdanevich - M.: - Education, 2012. - 156 p.

5. Formation of a healthy lifestyle of Russian adolescents: Study guide / L.V. Bal, S.V. Barkanova, S.A. Gorbatenko - M.: Vlados, 2013. - 190 p.

6. Charlton E. Basic principles of teaching healthy lifestyles // Questions of psychology. – 2012ю - №2. p. 3-14.

DOI 10.34660/INF.2022.10.20.006

心算作为学龄前儿童逻辑和数学发展的手段
MENTAL ARITHMETIC AS A MEANS OF LOGICAL AND MATHEMATICAL DEVELOPMENT OF PRESCHOOL CHILDREN

Abdulmanova Julia Petrovna
Senior Educator
Mazneva Marina Anatolyevna
Educator
Kalieva Olina Alexandrovna
Educator
Kindergarten No. 7 "Ulybka", Birsk, Republic of Bashkortostan

注解。 在文章中，作者分享了他们通过心算培养学龄前儿童逻辑和数学思维的经验。

关键词：大脑，逻辑和数学发展，逻辑思维，技术，心算。

Annotation. *In the article, the authors share their experience of working on the formation of logical and mathematical thinking in preschool children by means of mental arithmetic.*

Keywords: *brain, logical and mathematical development, logical thinking, technology, mental arithmetic.*

Logical and mathematical development is the foundation for the formation of the most important intellectual components of a child's personality: attention, memory, imagination, thinking, speech, creative abilities. Consequently, it is necessary to develop them already at preschool age, since it is this age that is sensitive for the formation of psychological qualities in a child that contribute to mental development and enhancement of interest in various types of activity. It has been proved that preschool children with a sufficient level of formation of logical and mathematical ideas are able to memorize educational material faster, they have a higher level of cognitive interest in comparison with their peers, they are much more successful in adapting to school conditions.

The federal state educational standard for preschool education establishes the necessary conditions for the cognitive development of preschool children: "...the use in educational activities of forms and methods of working with children that

correspond to their age and individual characteristics; building educational activities on the basis of interaction between adults and children, aimed at the interests and capabilities of each child and taking into account the social situation of his development...".

According to L. S. Vygotsky, J. Piaget, A. N. Leont'ev, the formation of thinking in a child is a qualitatively new stage in the development of cognition, which is characterized by the transition from the perception of external signs of objects, phenomena to the reflection of internal, essential connections and interrelationships between them.

It is in preschool age that the transition from visual-active thinking to visual-figurative thinking and further to logical thinking occurs. One of the important conditions for the transition to logical thinking is the acquisition of experience in solving problems by the child, because the ability to analyze, classify and generalize is one of the main prerequisites for successful schooling. Often in educational activities, we are faced with the fact that preschoolers, having the ability to solve problems based on visual material, experience difficulties in solving problems presented without reliance on visualization.

Currently, in preschool pedagogy and psychology, there is an active search for new technologies that correspond to the age and individual characteristics of children, technologies aimed at all-round intellectual development, contributing to the formation of logical and mathematical ideas in them. The study of technologies for increasing the effectiveness of work on the formation of logical thinking in older preschoolers allows us to determine the technology "mental arithmetic".

Mental arithmetic is one of the youngest innovative technologies in the formation of logical and mathematical thinking in preschool children.

Mental arithmetic originated in Ancient Greece and Mesopotamia about five thousand years ago. It was then that an incredible way appeared, stimulating the development of both hemispheres of the brain, contributing to the development of cognitive processes, the formation of the skill of verbal counting.

The technique is based on the ancient abacus abacus: a rectangular device with knitting needles on which bones move. The abacus consists of a frame, a dividing bar, upper and lower bones. In the middle is the center point. The upper bone - "queen" means five, and the lower "brothers" - ones. Each vertical strip of bones, starting from right to left, denotes one of the categories: units, tens, hundreds, thousands, tens of thousands, etc. The bones in neighboring "houses" - categories, for each other, "friends".

The abacus is designed in such a way that the ability to count on it trains the brain, develops neural connections between both hemispheres of the brain, logical thinking.

According to scientists, the human brain has enormous potential. Primarily the

right hemisphere, which provides the characteristics of visual memory, imagination and creativity. The left hemisphere of the brain is responsible for building logical chains, situation analysis and mathematical calculations.

Neural connections that develop in the first years of a child's life determine the level of brain development in the future of an adult. Therefore, it is important to develop these neural connections already in preschool age.

For teachers, mental arithmetic is a new undertaking, which requires, first of all, the creation of favorable material, technical, personnel, psychological and pedagogical conditions.

The Child Development Center began work in this direction with the purchase of abacus.

To teach children mental arithmetic, first of all, the teacher himself needs to be a specialist with the skills of teaching mental arithmetic. Therefore, our educators were trained in refresher courses under the program "Mental arithmetic in a preschool educational organization."

An additional general developmental program "Mental arithmetic" of social and pedagogical orientation has been developed for children 5-7 years old. The main goal of the program: development of mental and creative abilities, support of individuality and positive socialization of children through play, communication and other forms of activity. At the initial stages of studying mental arithmetic, an abacus is used. In the future, children make calculations in their minds, creating a mental image of the abacus.

Teaching preschool children to count on the abacus is carried out in combination with the following techniques and special developmental exercises.

Using both hands: preschoolers perform calculations on the abacus with both hands at the same time, which affects not only the development of each hemisphere, but also the optimization of the interaction between them.

Visualization: a real calculating instrument is gradually replaced in the child's imagination with its invisible counterpart.

Fingers: the child uses his fingers even in the process of oral counting. With their help, the child moves the imaginary counting bones.

Ability to control their brain: students of the program "Mental arithmetic" are able to simultaneously perform oral math exercises, perform actions with the fingers of both hands and use their creativity (drawing, sculpting, dancing, jumping).

The key benefits of mental arithmetic classes are the inclusion of video materials and mind games that develop mindfulness and creativity, as well as group and individual exercises aimed at full functioning of the right and left hemispheres of the brain.

In the process of implementing the additional general developmental program "Mental Arithmetic", teachers of the Child Development Center developed a di-

dactic manual "Mental Twister" based on the structure of the abacus, which serves as an additional tool for the development of mental counting in preschoolers in play activities. "Mental Twister" is a playing field made of eco-leather, measuring 1.5 m by 2 m. It consists of a frame, vertically spaced knitting needles. On each of the seven knitting needles there are five yellow circles (knuckles), denoting numbers from 1 to 5. The bones on top of the "heavenly" crossbar correspond to the number 5, the bones below the "earthly" crossbar correspond to numbers from 1 to 4. Inside each knuckle there is a hint in the form of a dry beans. The number of beans indicates the number. A distinctive feature of the "Mental Twister" from the abacus is that in addition to fine motor skills, gross motor skills and visual-motor coordination of the child develop. The manual also serves as prevention of flat feet.

Mental arithmetic is a unique technology for the logical and mathematical development of preschool children, which ensures the successful assimilation of school material, a clear understanding of the teacher's explanations and the correct solution of educational problems.

References

1. Wenger, L.A., Wenger, A.L. Home school of thinking [Text] / L.A. Wenger. - M.: Znaniye, 2006. - 198 p.

2. Kirilina, N.Yu. Technology "Mental arithmetic" in the organization of educational activities of preschoolers. From work experience / N. Yu. Kirilina, T. V. Fedorova. // Young scientist. - 2017. - No. 15.2 (149.2). - P. 89-91. - URL: https://moluch.ru/archive/149/41625/ (date of access: 12/26/2021).

3. Kolesnikova, E.V. Development of mathematical thinking in children 5-7 years old [Text] / E.V. Kolesnikov. - M.: Gnom-press, 1990. - 304 p.

4. Tikhomirova, L.F. Basov, A.V. Development of logical thinking in children [Text] / L.F. Tikhomirov. - Yaroslavl: LLP "Gringo", 2005. - 240 p.

5. National project "Education", implementation period: 01.01.2019-31.12.2024. Electronic resource: https://edu.gov.ru/national-project

DOI 10.34660/INF.2022.16.34.007

重新审视俄语课堂需要考虑外国学生的民族和文化特征的问题
REVISITING THE ISSUE OF THE NEED TO TAKE INTO ACCOUNT NATIONAL AND CULTURAL CHARACTERISTICS OF FOREIGN STUDENTS IN CLASSES OF RUSSIAN

Zhileykina Anna Viktorovna
Senior Lecturer
Moscow Automobile and Highway State Technical University (MADI)

注解。 文章谈到教师需要考虑外国学生的文化、宗教和社会传统。 也有“国家意义”的例子，圣经主义。 强调师生友好关系的重要性和开放性。 作者谈到了个人教学方法的原则。

关键词：俄语作为外语 (RFL)，文化对话，种族间关系，教育强化，传统和行为规范，民族意义。

Annotation. *The article speaks of the need for the teacher to take into account the cultural, religious and social traditions of foreign students. There are also examples of "national meanings", biblicalisms. The importance and openness of friendly relations between teacher and students is emphasized. The author talks about the principle of an individual approach to teaching.*

Keywords: *Russian as a foreign language (RFL), dialogue of cultures, interethnic relations, intensification of education, traditions and norms of behavior, national meanings.*

One of the tasks of the RFL teacher is to form in foreign students a sense of belonging to the common human race with its common cultural and moral values. From the first lessons, he must establish contact with students, drawing an analogy between the traditions and ways of the two countries. Implementation of the principle: “As in our country - as in your country” expands the spiritual and cultural horizons of students. It is necessary to make it clear that culture, history, religious traditions evoke genuine interest and, of course, respect from the teacher. It is also important to draw the attention of students to the fact that there are many similarities between the traditions of the peoples. This will make it possible to remove some of the difficulties that arise.

Emotional discomfort of foreigners arises from the abrupt transition from a stable state of mind “one of our own” to an alarming one - “a stranger among

strangers" in a new world for them. Therefore, undoubtedly, an important step on the way to successfully mastering the Russian language is the psychological adaptation of students. Also, to intensify learning, the teacher needs to remove this state of tension from the student. It is necessary in every possible way to demonstrate peacefulness, to express respect for problems of a religious and ethical nature. Especially now, in an era of global instability and tension.

First, you need to remove the constraint in communication, try to generate feelings of sympathy between the teacher and students. The teacher should be inclined towards positive communication, should be smiling and friendly with everyone. It is possible in the learning process that certain difficulties arise, for example, differences in worldviews, temperament, and individual life position. The teacher should try to establish a path to the dialogue of cultures and religions, to give a feeling of a single spiritual principle of all mankind. To do this, he must avoid conflict situations, try to bypass "hot" points of contact between students of different nationalities.

When teaching Russian to foreign students, it is important to acquaint them with the history of our country and its traditions. Undoubtedly, it is necessary to talk about the place of Russia in the system of world cultures. The teacher should avoid a mentoring tone in conversation with students, on the contrary, it is desirable to demonstrate in every possible way an openness to other points of view. Of course, it is necessary to respect the traditions and norms of behavior adopted in the countries of the students. All of the above will help prepare specialists with a creative search, with deep concepts of morality. Of course, the intensification of teaching all types of speech activity is facilitated by the friendliness of the relationship between the teacher and the students.

The possibility of acquiring new professions, the process of creative and professional development of the individual are associated with the level of interethnic relations in society, the interaction of cultures, and mutual respect. Social health of an individual is also determined by the level of education of a person.

Thanks to the cultural heritage of each country, there is an opportunity to assimilate the achievements of world culture, develop their own potentials, and discover the world.

One cannot but agree with the statement about the existence of "national meanings". After all, even one and the same physical thing can correspond to completely different semantic descriptions, depending on the civilization within which the thing is considered. For example, in Western cultures, white is associated with purity, innocence and elegance. That is why this is the color of the bride's outfit. However, in Korea, China and other Asian countries, white symbolizes failure, mourning and death. Therefore, it is only worn during funerals.

Of course, two words denoting the same subject in the culture of different

peoples in two different languages, but being translated equivalents, are necessarily associated with non-identical contents. This makes it possible to talk about the "national meanings" of linguistic signs in semiotics. Let's turn to the names of wild animals. For example, the wolf in Russian fairy tales appears as an evil, gloomy and lonely animal. Whereas in Turkish mythology, it is associated with the sky and is a symbol of light. Or, conversely, a bear. For Russians, he embodies strength, and in the view of the Turks, he is perceived as a large wild beast moving slowly. So, the lexical meaning and connotations of a linguistic sign are determined by the individual's belonging to a particular civilization. The assimilation of a word of a non-native language includes understanding and memorizing its meaning and rules of use, as well as the ability to use it accurately in speech [5].

It should be emphasized that the connection between the language and the history and culture of the people is most clearly manifested at the phraseological level. A large number of proverbs, sayings, stable combinations reflect specific national features, has that linguistic imagery that is rooted in the history of the people, their way of life, customs, traditions, and religion. Of course, it is difficult to determine the degree of preservation of all imagery, national flavor of phraseological units when translated into another language. Therefore, the tasks of the RFL teacher are to bring the language background closer to the students, to give the necessary knowledge, because the core of the phraseological unit is filled with national and cultural content. Following the background knowledge is important in the further development of the problems "language - culture - religion".

Every era and country gives rise to certain cultural traditions, patterns of behavior, and the ability to see them, to understand the touches of different civilizations is already a moral achievement. The task of a modern RFL teacher is to show interest and respect for foreign culture and instill it in his own, Russian.

From a religious point of view, culture is the self-realization of the spirit, the environment through which the spirit can influence a person, open to him, and the loss of spiritual gifts leads to the degradation and destruction of culture. A caring attitude to the past, as to an inseparable part of culture, strengthens the moral health of peoples in the present.

The modernity and relevance of any word or expression is always tested in practice. This also applies to phraseological phrases that go back to religious texts. Since the life of the language is regulated by many factors, including extralinguistic ones, the return to forgotten Christian values naturally influenced the use of biblicalisms in living speech, especially in journalism. The meaning of biblicalisms is by no means forgotten. Only now they are no longer archaism. As, for example, phrases: "carry your cross", "not by bread alone", "kiss of Judas" and phraseological units: "seek and find," "throw a stone", "do your bit", "return to square one", etc.

Man as a separate representative of civilization, his religion, his culture has his own psychological structure. Therefore, when teaching, the teacher should rely on the qualities of the student, which are able to enhance the positive aspects, such as: dedication, hard work, interest, openness to communication - and compensate for the negative ones.

The principle of an individual approach must be present at all times. To do this, you need to know the students, their cultural values, faith, interests, the nature of relationships.

In conclusion, it is important to emphasize that the effectiveness of the educational process is largely determined by the personality of the teacher, his ability to transform, improvise, express interest in the educational process, and the ability to create a favorable climate in the group.

References

1. Arutyunov A.R. Theory and practice of creating a textbook of the Russian language for foreigners. - M.: Russian language, 1990, 154 p.

2. Balaganskaya O.A., Balaganskaya A.V. Taking into account the cultural characteristics and socio-religious traditions in teaching the Russian language to foreign students - Collection of scientific works of MADI "International education and cooperation. Theory and Practice of Teaching the Russian Language ". - M: MADI, 2005, p. 72-76.

3. Vasilenko E.I., Dobrovolskaya V.V. Methodical tasks in the Russian language (for foreigners). - S-P.: Zlatoust, 2003, 275 p.

4. Vereshchagin E.M., Kostomarov V.G. In search of new ways of development of linguistic and regional studies: the concept of speech-behavioral tactics – M.: GIRYAP, 2000, 64 p.

5. Zhileikina A.V. Features of teaching Russian to Azerbaijani students. // Questions of Pedagogy: Journal of scientific publications, 2020 - № 07. P. 60-63

6. Kostomarov V.G., Vereshchagin E.M. Language and culture. Linguistic and regional studies in teaching Russian as a foreign language. – M.: Russian language, 1990, 251 p.

DOI 10.34660/INF.2022.59.11.006

社会进化的另类：酋长、类比和早期国家，或关于为什么马克思的理论没有解释世界上国家形成的过程

THE ALTERNATIVES OF SOCIAL EVOLUTION: CHIEFDOMS, ANALOGS AND THE EARLY STATES, OR ABOUT WHY MARX'S THEORY DOES NOT EXPLAIN PROCES OF STATE FORMATION IN THE WORLD

Pertsev Dmitry Mihailovich
Candidate of Historical Sciences, Junior Research Fellow
Institute of History, Archeology and Ethnography
of the Far Eastern Branch of the Russian Academy of Sciences
North Pacific Anthropology Laboratory

世界各地区国家的崛起是苏联和现代俄罗斯社会科学的基本问题之一。在苏联，这一过程是在单一的马克思主义计划的框架内研究的，通过管理类型的变化、私有财产的出现以及由此产生的社会分裂来解释国家的出现. 但时至今日，由于过程考古学和新进化人类学，揭示了复杂但非国家系统的多种方式和选择。因此，在现阶段，政治生成只不过是形成任何类型的复杂政治组织的过程，而不仅仅是一个国家。在苏联解体和马克思主义遭到拒绝之后，分析家，当然还有历史学家都面临着开发一种替代方法来解释早期阶级社会的政治起源的问题。摆脱僵局的方法可能是从新进化论的角度研究世界不同地区的前资本主义政治制度。

关键词：国家形成、酋长领地、早期国家、新进化论、国家类似物、宏观进化、社会进化、文明进化、全球历史、世界历史、历史分析

Abstract. *The rise of states in various regions of the world is one of the essential problems of Soviet and modern Russian social science. In the USSR, this process was studied within the framework of a single-line Marxist scheme, explaining the emergence of states by a change in the types of management, the emergence of private property and, as a result, the split of societies into classes. But by the current time, thanks to processual archeology and neo-evolutionary anthropology, revealed a plurality of ways and options to complex, but non-state systems. Thus, at the present stage, politogenesis turns out to be nothing more than a process of forming a complex political organization of any type, and not just a state. After the collapse of the USSR and the rejection of Marxism, analysts, and, of course, historians face the question of developing an alternative methodology for inter-*

preting the political genesis of early class societies. A way out of the impasse may be the study of precapitalist political systems in various regions of the world from the standpoint of neo-evolutionism.

Keywords: *state formation, chiefdoms, early state, neo-evolutionism, analogues of the state, macroevolution, social evolution, evolution of civilizations, global history, world history, historical analysis.*

In the USSR, following Karl Marx theory, the state was viewed exclusively as a machine for suppressing the majority by a minority, pointing to its negative nature. However, it is useful to remind: K. Marx, in essence, did not bring to the forefront repression, but the fulfillment of common affairs arising from the nature of society, and specific functions arising from the opposition between the government and the people.

In Marxist historiography, two ways of the formation of states are known - eastern and antique. The first is based on the usurpation of administrative functions by the leaders and turning them into masters over the people. The second type is characterized by a class society with private property, commodity relations (antique polis).

The category of formation taken by Karl Marx from geology was recognized as the leading criterion for classifying states to the corresponding historical and economic type. A formation is a large socio-economic system based on a certain mode of production and resource allocation.

The initial formation is considered to be primitive, where the mode of production was based on collective (clan) property, and power, it seems, belonged to all individuals of the tribe. Since there is no private property here, the state, as an element of suppression, is not known.

The slaveholding formation that dominates since the IV th century BC stands out next to the V th century AD. Among the largest representatives were Mesopotamia, Egypt, Hellas and especially Rome, whose history demonstrates the evolution from the *polis* in Latium to the global *mega-polis* of the oecumene. In addition to the ownership of the instruments of labor, slaves also depended on the slave owner, whose exploitation was carried out thanks to non-economic coercion. The emerging state thus protected the ownership of the slaves and, importantly, suppressed their riots. A slave who is not interested in the results of his own activities, in the end, reduced productivity and, as a result, lost his own significance, giving rise to a crisis of the formation and the state in particular. Thus, the decline of slave-owning exploitation led to the maturation, and soon the dominance of the feudal system in the Middle Ages.

States of this type appeared in Europe from about the VI th to the IX th centuries. Unlike slavery, where the slave was the «talking tool», in the new conditions

the leading form of ownership was land, signaling wealth and the material basis of political power. The residence of the lords on the land, the *feud*, as well as the use of it as a means of production, automatically gave rise to an exploitative relationship. The difference between the feudal structure, most likely, was that the peasants turned into the owners of tools[1] and the entire private economy cultivated by personal labor. The relationship between feudal lords and peasants was defined as the tenant and landlord of land, and the method of appropriating products was characterized by the collection of labor, food and cash rent.

The next type of state, bourgeois or capitalist, developed as a result of the revolutions in Europe and America in the XVI th–XVIII th centuries. The long XVI th century, including the period between the 1450s (the decline of Constantinople) and the 1640s (the end of the Thirty Years' War), shaped the order in which European elites emerged from the crisis of feudalism caused by a lack of land by exploring «alien» horizons. This is how Geographical discoveries and the stage of initial capital accumulation started. It manifested itself most vividly in England during the «fencing» period. The capitalist formation, unlike the previous ones, demanded independent producers who sold their labor and were deprived of their property. Exploitation here is based on making a profit - money, which is the main social value.

The key contradiction of capitalism is determined by the discrepancy between the owner of capital and the employee, as a rule, deprived of property and forced to be hired. Such a contradiction is constantly deepening and is being resolved by the revolution. The success of the proletariat determines the transformation of societies to a different formation - the communist one. However, since an instant replacement of capitalism with communism is impossible, a transitional socialist formation is necessary.

Classes do not die out under socialism. On the contrary, the workers and peasants, together with the *intelligentsia*, are drawing closer together and forming the Soviet community. Private property is replaced by public property and, thus, loses its significance as a source of class contradictions.

Thus, state formation process was considered and, by the way, is still considered in Russia in line with the formation theory. However, thanks to new data from processual archeology and evolutionary anthropology, the situation has changed significantly. Speaking frankly, it should be emphasized that the discrepancy between the available data and the formation theory, which claims to be universal, is

[1] Compared to slavery technologies, the Middle Ages were lucky. We can talk about the «industrial revolution» of the West in the XI th century and, apparently, was the forerunner of the industrial revolution of the first quarter of the XVIII th century in England. For research, see: White L.J.R. Medieval Technology and Social Change. Oxford University Press. 1974; Gimpel J. The Medieval Machine: Industrial Revolution of the Middle Ages. Penguine Press. 1976.

revealed upon closer examination.

For example, the formation theory, developed on the basis of Western Europe, has been transferred to world history, but the forms of development of other, non-Western systems do not fit well into such a scheme. The theory of Karl Marx, as a rule, highlights the only aspect - the socioeconomic one. But it is not possible to convincingly demonstrate the universal, in other words, worldwide dependence of spiritual life and culture on the material base. The theory of formations is based on the recognition of the cultural monotonousness of peoples, which does not correspond to the multifaceted historical reality. Formation theory explores the *macrosociological* level, ignoring the *microsociological* level - values, collective behavior, and religious attitudes. The theory is one-lined.

The most striking example of underdevelopment is the Middle Ages. More precisely, the period called the Dark Ages, lasting in Europe from the decline of the Roman Empire and its infrastructure, in the V th century and, ending by the IX century the collapse of the Carolingian core that held the sprawling lands of Rome together.

Polities that emerged on the site of an empire are considered states. Back in the 1940s, when the term *barbarian state*[2] arose, which, however, in its socio-political essence, was neither slaveholding, let alone feudal. We are talking about the polities of the Germans, the polities of the Caucasus, Central Asia and Kievan Rus IX-X centuries. They were born as a result of the decomposition of the primitive communal system and were pre-feudal.

Attempts to establish the patterns of their development are very rare even today[3]. The prevailing attitude is due to the reluctance of specialists to raise the question of the existence of polities that are not related to either slavery or feudalism. A kind of intermediate stage of evolution not fixed by K. Marx is fixed before the researcher. Therefore, it is important to analyze more deeply the gap in the history of the political genesis of the barbarians of the medieval West.

Within the framework of this problem, two groups of pre-feudal states are known: where feudal relations were established as a result of the union of slave-owning and patriarchal elements, and pre-feudal states that arose as a result of the decomposition of the primitive communal system.

Where is the difference between the two types of states? In a feudal state,

[2] See.: Yushkov S.V. On the question of the pre-feudal (barbarian) state // Questions of history. 1946. No. 7. P. 45–46. Among the new studies initially see: Etherington N. Barbarians Ancient and Modern // American Journal of Ophthalmology. 2011. Vol. 116. P. 31–57; Romans, Barbarians and the transformation of the Roman World / Eds.by R. Mathiassen, D. Shanzer. Ashgate Publishing Limited. UK. 2011; Jones D. Barbariginesis and the Collapse of Complex Societies: Rome and After // PLoS ONE. 2021. Vol. R. 1–33.

[3] Pertsev D.M. Reimaging our World: From Fernan Brodel to World-System Analysis and from Historical Globalization to the G.D.E.L.T. Project. Science and Innovations 2021: Development Directions and Priorities. Inernational Conference. Australia, Melbourne, 2011. P. 112-127.

most likely, the economic basis is based on the labor of dependent peasants. In the pre-feudal polity, there was a feudal system, whose importance gradually increased, since the community members became dependent, but the feudal lords had not yet come to dominance despite, however, the increase in their influence. As a result, the organization of power did not receive the structure of a feudal state, namely:

1) the pre-feudal state is not a hierarchy of seigneurs based on vassalage, but a complex of parts that are at different stages of socio-economic development. Moreover, the connection with the king is based here on vassalage without a *fief*.

2) the features of military democracy have not been eliminated in the political structure.

3) a ruler is not a supreme leader who has turned the country's territory into a personal domain, but a military leader, whose functions outside the military sphere are usually limited. The leader received power not by inheritance, but by election.

4) the policy of the head of the pre-feudal state was supported not at all by the feudal elite, who served for the land, but by the council of the tribal nobility and squads.

5) in the pre-feudal state there are remnants of popular assemblies, which are almost completely eliminated in the feudal state, where power is dispersed between the king and the large barons.

6) in the local government of the *prefeudal state*, a decimal system operates, whose tens, hundreds and thousands are transformed by territorial districts. In a feudal state, on the contrary, it is outdated. Instead of it, there are two: the palace-fiefdom and the feeding system.

7) the military force in the pre-feudal state is constituted by the squad and the militia.

8) the source of income for the leader of the pre-feudal state, it seems, is not income from the domain, but tribute from the subordinate peoples collected by passing them.

Finally, as for the term prefeudal itself. It appeared in the 1950s. under Stalin, when was decided not to combine the feudal and pre-feudal periods into a single scheme, since It is not logical to consider a system without rent from land ownership and the presence of a class of exploiters as feudalism.

The concept of the *prefeudal period* was developed by A.I. Neusykhin. He showed: the barbarians of Europe of the Dark Ages, according to the degree of political hierarchy, do not belong either to slavery or to feudalism. «In the process of historical development, the change of social formations occurs through a revolutionary leap, which finds its expression in the social and political revolution. However, such leaps are always preceded by periods of transition; during these periods, those changes accumulate and those contradictions of formations arise, which lead

to a revolutionary leap. During transition periods, the features of the social system of the previous formation are already reborn, they begin to become obsolete or completely die off, and at the same time, elements of the subsequent formation are born. However, since the former are still quite tenacious, and the latter have not yet had time to triumph and exist in the form of development trends, then in each of the transition periods a peculiar and complex interweaving of the structural elements of the previous formation appears. This interweaving leads to the fact that during the transitional periods, the elements of the old and the new are synthesized in the form of a social structure with its inherent laws of development»[4].

The identification of the pre-feudal period, which was not taken into account by the formation theory, is necessary, since the development of feudalism in Europe was preceded by a structure that turned out to be no longer slave-owning, but not yet feudal The term prefeudal, however, was rejected due to the impossibility of embedding into the scheme: primitiveness, slavery, feudalism, capitalism, communism.

Despite the exclusion of the concept of pre-feudal period, the Marxist theory, however, does not reflect the entire variety of stages of political genesis. This is also relevant with regard to military democracy, allegedly preceding the genesis of states. In the USSR, since the mid-1970s. the idea spread that military democracy was being replaced by some other system, where the masses were removed from power, but classes, exploitation and political organization were not formed yet.

Moreover, military democracy, in all likelihood, was not universal, as the formation theory asserted. For example, the Scythians of the VI th–IV th centuries, the societies of Polynesia, New Zealand, Africa, the Mariana and Marshall Islands were not military democracies due to the presence of central power and social differentiation there. But, despite this, the states did not take shape.

In the West, the stage of evolution between primitive and state has been known since the 1960s-1970s called chiefdom[5]. The chiefdom construct in the USSR was

[4] See.: A.I. Neusykhin The pre-feudal period as a transitional stage of development from the tribal system to the feudal one // Voprosy istorii. 1967. No. 1. S. 75 - 87.

[5] Здесь приводятся наиболее актуальные и современные работы, охватывающие особенности эволюции сложных систем. Первоначально см.: Earle T. Chiefdoms in Archaeological and Ethnohistorical Perspective // Annual Review Anthropology. 1987. P. 281–288. Idem. Chiefs, Chieftaincies, Chiefdoms, and Chiefly Confederacies: Power in the Evolution of Political System // Social Evolution and History. 2011. Vol. 10. № 1. P. 27–54. Abrutyn S., Lawrence K. From Chiefdom to State: Toward an Integrative Theory of the Evolution of Polity // Sociological Perspectives. 2010. Vol. 53, № 3. P. 424. Я также благодарен Петеру Скальнику за предоставление материалов, Итак, введением в проблематику *chiefdom* по праву является исследование о вождестве как универсальном, глобальном явлении, см.: Skalnik P. Chiefdom: A Universal Political Formation? // Focaal. 2004. Vol. 43. P. 76–98; Idem. Chiefs and Chieftains // The International Encyclopedia of Anthropology. John Wiley and Sons. Ltd. 2018. P. 56–86; Grinin L.E., Korotaev A. Chiefdoms: Yesterday and Today // Globalistic and Globalization Studies. 2019. P. 229–236; Emanuelson P., Willer D. Social Structures in Transition: Applications of Two Theories to Chiefdoms // Socius: Sociological Research for a Dynamic World. 2018. Vol. 4. P.1–14.

used in relation to the analysis of Asian political systems only since the 1980s, when there was an ideological thaw.

The chiefdom has the following characteristics: redistributive exchange; deepening social stratification, i.e. inequality of access to resources; the presence of the power of a leader who concentrates the surplus product; ideology. It is important, of course, to remember that the chiefdom belongs to primitiveness, but that stage when the majority of the tribe is removed from power in favor of the leader who redistributes resources. Ultimately, one of the main features that distinguish chiefdom from the state is the *absence of the legalized use of violence here, as well as the absence of laws*.

Chiefdom construction as an intermediate form of social evolution was applied mainly to non-european systems. In the East, for example, the power of senior persons in collectives was formed - a patriarchal family-clan community, which, most likely, with a combination of monopolization on the organization of hydraulic work in an arid climate, led to the rise of states. Chiefdoms exist without private property. Unlike the West, they hold on to the sole dominance of the ruler through *power-property*[6]. This phenomenon is most fully traced in the despotisms of Mesopotamia, Egypt and, especially, China, where the territories, as well as the rent from them, completely belonged to the rulers. The concept of chiefdom was developed as part of the discussion about the *Asian mode of production*.

In addition to this theoretical module, the theory of the early state was applied to the East, mostly to China. It was, in a way, an alternative to the Marxist interpretation of pre-capitalist formations and in many respects echoed the concept of the pre-feudal period, when political structures that did not reflect the signs of classical feudalism were formed in medieval Europe.

The term *early state* was first used by P. Skalnik, who studied at the University of Leningrad. In his 1973 Ph.D. work, he concluded that many of the polities of pre-colonial Africa did not have features characteristic of the feudal formation. Accordingly, it is reasonable to define such systems by early states. The defense of the dissertation, however, was not destined to take place due to the impossibility of embedding the concept in the Marxist interpretation of the historical process. P. Skalnik was forced to immigrate to Czechoslovakia. It was during the years of emigration that a tandem with H.J.M. Klassen, the result of which was the publication in the West of a volume on the early states[7]

[6] См.: Васильев Л.С. Феномен власти-собственности. К проблеме типологии докапиталистических структур. Типы общественных отношений на Востоке в Средние века М., Наука. 1982; Он же. Проблемы генезиса китайского государства. М.: Наука, 1983; Он же. Восток и Запад в истории. Основные параметры проблематики // Альтернативные пути к цивилизации / под ред. Н.Н. Крадина, А.В. Коротаева, Д.М. Бондаренко, В.А. Лынши. М., Логос, 2000. С. 96–114.

[7] Первоначально см.: Claessen J.M., Skalnik P. The Early State. Mouton Publishers. 1978. P. 22, 641; Claessen H. J. M. Before the Early State and After // Social Evolution and History. 2008. Vol. 7. №

In the most general sense, an early state is understood as a large territorial structure where clan ties remain, but with some development of extra-clan relations in the governing subsystem. The source of the existence of officials here is feeding at the expense of entrusted subjects and salaries from the center. Along with unwritten customs, there is a written code of laws. There is an apparatus of judges. Officials appear. The collection of the surplus product by the rulers is precisely established and carried out systematically, leading to the withering away of such institutions for the collection of tribute as, for example, the ancient Russian polyudye, or the ancient Norwegian analogue - Weizl.

In other words, the early state differs from pre-state forms, such as chiefdoms, by the appearance of: special officials, an apparatus of judges, a written code of laws. It is a political structure based on clan and non-clan connections and familiar with craft specialization.

Undoubtedly, the key function of the early states was the management of territory and the provision of prestigious consumption to the elite through taxes and taxes from the population. The reasons for the genesis of early states are likely to be rooted in population growth leading to pressure on limited resources, wars, a rise in the level of productive forces, as well as the influence of neighboring states.

The early states are a transitional leap in political genesis. Most pre-capitalist systems, with a howl of development, are unlikely to have advanced beyond this stage. In all likelihood, the fact is that history often does not record a single-line social evolution from simple to complex, but, on the contrary, with a scrupulous analysis, indicates certain cyclicality, i.e. the ability to rollback complex systems to primitive modifications.

The application of the modules of the early state and chiefdom to the political structures of the East, as noted, gained some popularity in the USSR in the 1980s, while these alternatives to Marxism in relation to the analysis of the European Middle Ages became known, albeit very timidly, only after the decline of the Soviet state[8]. It was noted that the transition from a clan system to a class system

1. P. 8–12. Помимо указанных материалов см.: Claessen H. J. Early States-Structure, Development and Fall // Social Evolution and History. 2010. Vol. 9. № 1.P. 12–18; Bondarenko D.M., Korotaev A. V. «Early State» in Cross-Cultural Perspective: A Statistical Re-Analysis of Henri J.M. Claessen Database // Cross-Cultural Research. 2003. Vol. 37. № 1. P. 105–132. Более новые данные см.: Stocker T., Xiao J. Early State Formation: A Complete Rejection of the Circumscription Theory // Social Evolution and History. 2019. Vol. 18. P. 166–190. Особенно полезна глава Фреда Спира в сборнике: Spier F. Early State Formation from Big History Point of View // Eurasia at the Dawn of History. Urbanization and Social Change / Eds. by M. Fernandez-Gotz, D. Krause. Cambridge University Press. 2017. P. 127–132.

[8] См.: Мельникова Е.А. К типологии предгосударственных и раннегосударственных образований в Северной и Северо-Восточной Европе (постановка проблемы) // Древнейшие государства Восточной Европы. М., 1995. С. 16–33; Она же. Возникновение Древнерусского государства в европейском контексте // 1150 лет российской государственности и культуры / под. ред. акад. А.П. Деревянко. М.: Наука, 2012. С. 5–20.

in Europe was carried out not due to a change in formation, but with the help of chiefdom, a squad state, or an early feudal state. The essential role of the military, as well as of the trade, factor in the formation of the barbarian kingdoms of the medieval West was also noted.

As a rule, all this led to the emergence of barbarian states, which were pre-states, i.e. political structures, where already there are elements of future statehood. However, it must be remembered that in a barbarian society, the process of class formation has not yet been completed, but there were no antagonistic contradictions.

In addition, the inferiority of the formation theory, however, was most clearly manifested in the East and Africa. The criticism, very delicate, came from orientalists (L. S. Vasiliev, V. P. Ilyushechkin, L. A. Sedov, A. I. Fursov, A. V. Korotaev), Africanists (L. E. Kubbel, Yu. M. Kobishchanov, O.S. Tomanovskaya, N.B. Kochakova, V.A.Popov, D.M.Bondarenko), experts on the nomadic empires of Eurasia (A.M. Khazanov, G.E. Markov, E.P. Bunyatyan, E. I. Kychanov, E. G. Klyashtorny, N. N. Kradin) and medievalists (E. M. Melnikova).

These regions are zones whose politogenesis did not fit into the framework of materialism, demonstrating alternative ways of evolution of complex systems. The concept of «*politogenesis*» needs to be clarified. For the first time, it appears to have been used in the research of L.E. Kubbel "*Essays on potestarno-political ethnography*" (1988), where it was considered as the genesis and further development of statehood[9].

It was assumed that the direction of the genesis of the state depends on its leaders. So, in general, three options are known: military, aristocratic, plutocratic: the first indicated the seizure of power by military leaders thanks to the squads; under the second, the leaders concentrated leadership over the majority and, in the end, limited the access of fellow tribesmen to resources; the third way put individual wealthy individuals at the head of social systems, who transformed economic into political authority.

Most of the non-state forms were considered here as state ones. The development of political structures led to the formation of statehood, and undeveloped political systems were thought more difficult than a non-state society. In addition, it was assumed that political relations arise only with the rise of the state. As a result, this approach demonstrates the outdated one-line scheme of social evolution adopted in the USSR.

Indeed, political genesis is not limited to the formation of a state. In parallel with it, other polities took shape, which were not inferior to states in terms of complexity, but had a stateless nature, which signals the abundance of ways of social evolution[10]. These include:

[9] См.: Куббель Л.Е. Очерки потестарно-политической этнографии. М. : Наука, 1988.

[10] В качестве введения в проблематику см.: Перцев Д.М. К вопросу о теориях политогенеза

1. *Self-governing urban, temple communities and territories with a population of several thousand to tens of thousands of people*. Examples: Etruscan cities in Latium, some ancient city-states, civil-temple communities in southern Arabia.

2. *Some tribal unions of barbarians of the medieval West*. We are talking about Burgundians, Salic Franks, Ostrogoths, Visigoths, and Vandals.

3. *Large unions and confederations without royalty, but socially stratified*. For example, the Anglo-Saxons up to the V th–VII th centuries, or the Gauls of the Roman province of Belgica[11].

4. *Nomadic empires*. Scythians, Xiongnu empire at the end of the III century BC, union of the Huns of the 5th century AD, Avar Kaganate of the first half of the 6th century AD

5. *Chiefdoms of Haiti XV – XVI.*

6. *Polities whose structure is difficult to interpret due to lack of data*. These include the Indian and Harappan civilizations.

Some of these analogs have never become states. Others, on the contrary, turned into them, but already at a fairly high level development, immediately going to the state.

// Вестник Томского государственного университета. 2016. № 407. С. 115–120; Бондаренко Д.М., Коротаев А.В. Политогенез, «гомологичные ряды» и не линейные модели социальной эволюции // Общественные науки и современность. 1995. № 5. С. 128–139; Коротаев А.В., Крадин Н.Н. Лынша А.В. Альтернативы социальной эволюции (вводные замечания) // Альтернативные пути к цивилизации / Под ред. Н.Н. Крадина., А.В. Коротаева, В.А. Лынши, Д.М. Бондаренко. М.: Логос, 2000. С. 24–83; Коротаев А.В., Бондаренко Д.М., Гринин Л.Е. Социальная эволюция: альтернативы и варианты (к постановке проблемы) // Универсальная и глобальная история: эволюция вселенной, земли, жизни и общества / под ред. Л.Е. Гринина, И.В. Ильина, А.В. Коротаева. Волгоград. Учитель. 2012. С. 347–362. Примерами эволюции в виде сложноиерархиезированных систем, однако, не государств, служат политии казаков Украины и южной России до XVII в., кельтов V–VI вв. до н.э., исландская полития эпохи народовластия XIII в., античные полисы Эллады и доимперского Рима, политии Месопотамии III тыс. до н.э., общества Бенина XIII–XIX вв.,королевство Баум XVI–XIX вв., индийская система конца I тыс. до н.э., кочевники Евразии, Индская и Хараппская цивилизации. Подробнее о нелинейной эволюции указанных политий см.: Bondarenko D.M. Pre-Imperial Benin: Formation and Evolution of Sociopolitical Institutions System. Moscow: Institute for African Studies. 2001. P. 199–231; Idem. Homoarchy:A Principal of Culture Organization The 13-th 19-th Benin Kingdom as a Non State Super Complex Society. Moscow. USSR. 2006. P. 65–73; Idem. The Benin Kingdom (13th–19thCenturies) as Megacommunity // Social Evolution and History. 2015. Vol. 14, № 2 . P. 46–76; Korotaev A., Grinin L. Chiefdoms and their Analogues: Alternatives of Social Evolution at the Social Level of Medium Cultural Complexity // Social Evolution and History. 2011. Vol. 10. P. 276–335; Kradin N.N., Skrynnikova T. Why Do We Call Chingis Chan Polity an Empire // Ab Imperio 2008. Vol.1. P. 89–120; Idem. Mongols Empire and the Debate of the Nomadic State Origins // Papers in Honour Maurizio Tossi for his 70th Birthday / Ed. by B. Cerasetti. International Series. 2016 P. 369–377. Bondarenko D. M., Korotaev A.V., Kradin N.N. Social Evolution, Alternatives and Nomadism Nomadic Pathways in Social Evolution. Moscow. 2003. P. 1–25.

[11] См.: Перцев Д.М. Политии англосаксонской Британии V–IX вв. // Ранние формы политической организации. - Спб.: СпбНЦ Российской Академии наук. АНО "КИО", 2016. С. 130-152.

The appearance of *analogs*[12] in world history is not an exceptional phenomenon. On the contrary, the emergence of the state in this respect is just a rare event and only in the long term proved its superiority over other complex polities, such as the chiefdom.

Analogs, i.e. polities that develop in parallel with states and are not inferior to it in terms of degree of complexity, represent a very specific category, denoting various forms of complex non-state systems comparable to the early state in terms of sociocultural or political complexity, the level of functional differentiation and the scale of the tasks facing society.

Nevertheless, analogs of states do not seem to have clear signs, but lack: hierarchy, centralization, control over resources, a formal leader. This oddness is probably the merit of the scheme, whose features can be increased or decreased relative to a particular polity.

The analogs differed from the societies of pre-state forms by their superiority in the following categories:

1. *Population size*. Complex systems are superior to simple ones.

2. *An increase in the volume of surplus for deepening stratification*, redistribution and organization of supra-community activities.

3. *Difficulty level.* There is an increase in the levels of complexity of the organization and management of society.

4. *Complication and growth of the importance of institutions regulating socio-political life*: the division of society into two or more layers, distinguishable by rights; a change in the relationship between the elite and the population in terms of the growth of inequality in the exchange of services; changing traditions and institutions associated with the regulation of socio-political life; ideology that justifies social inequality[13].

In general, analogs differ from pre-state forms, as well as state peculiarities of political structure and management. In this regard, the essence of the so-called

[12] Подробнее об аналогах см.: Гринин Л.Е. Ранние государства и их аналоги в политогенезе: типологии и сопоставительный анализ // Ранние формы политических систем / Российская академия наук. Музей антропологии и этнографии им. Петра Великого. Сост. и отв. ред. В.А. Попов. Спб.: МАЭ РАН, 2012. С. 9–86; Korotaev A., Grinin L. Chiefdoms and their Analogues: Alternatives of Social Evolution at the Social Level of Medium Cultural Complexity // Social Evolution and History. 2011. Vol10. P. 276–335. Некоторые идеи по вопросу указаны в.: Ткаченко С.В. Рецепция и имплементация в теории права: к проблеме содержательного понятия // История государства и права. 2017. № 24. С. 9–13. Он же. Рецепция либеральной идеи важности института частной собственности в постсоветской России // История государства и права. 2020. № 7. С. 64–70; Он же. Содержание института лоббизма в российском механизме рецепции права // актуальные проблемы правоведения. 2021. № 1. С. 10–14.

[13] См.: Korotaev A., Grinin L. Chiefdoms and their Analogues: Alternatives of Social Evolution at the Social Level of Medium Cultural Complexity // Social Evolution and History. 2011. Vol10. P. 276.

Greek miracle - *polis* is relevant. In the most general sense, the polis is a civil community with an ancient form of property, whose nature combines the power of the slave owner over the slave deprived of the means of production, but restricts the ownership of land.

The decentralized political system of the polis is similar to the socio-political structures of the mountain peoples[14]. The democratic character of both structures seems to be logical for a number of reasons: the tiny size of their societies presupposed the participation of the majority of members of society in politics; the rugged relief of the landscape of Hellas and, for example, the Circassian peoples of the XV th–XVIII th centuries, did not contribute to the unification of geographically scattered communities into large hierarchical structures, which prevented the subordination of the highlanders by the peoples of the lowland polities.

Of course, these features do not fully explain the phenomenon of the polis, as well as the fact that not all of the highlanders' polities turned out to be democratic. In Hellas, for example, there are periods when the democracies of the policies were replaced by tyrannies or oligarchs. However, such civic communities, scattered among mountainous landscapes, could create non-hierarchical, stateless forms of political organization. Thus, as it is seen, in parallel with the birth of hierarchical societies, a fundamentally different line of social evolution is recorded - non-hierarchical systems that confirm the existence of evolutionary multilinearity.

Such, quite possibly, are the nomadic empires of Eurasia[15]. They, as a rule, were created by nomads to withdraw resources from outside the steppe by plundering and conquering the surrounding civilizations. Within such systems, it seems, there was no, at least initially, taxation of tribesmen, but there was an opportunity to

[14] См. напр.: Korotaev A.V. Mountains and Democracy // Alternative Pathways to Early State / Eds. By Kradin N.N., Lynsha. Vladivostok: Far East Branch of the Russian Academy of Sciences. Dalnauka. 1996. Vol. 1. P. 64–68; Цеева З.А. Влияние ландшафта на становление демократических институтов в горных адыгских обществах: к постановке проблемы // Вестник АГУ. 2017. Выпуск 2. С. 68–76.

[15] I am especially grateful to N.N. Kradin for extensive explanations regarding the general organization of power of the nomadic empires of the Xiongnu, the empire of Chingis Khan, the Khitan, and the Avar Kaganate. In addition, my commentary on nomads is based on the ones provided by N.N. Kradin research. Among them, see: N.N. Kradin. Nomads, the world - empires and social evolution // Early state: its alternatives and analogues. / ed. L.E. Grinina, D.M. Bondarenko, N. N. Kradina, A. V. Korotaeva. Volgograd. Teacher, 2006. S. 490-511; Kradin N.N., Skrynnikova T. Why Do We Call Chingis Chan Polity an Empire // Ab Imperio. 2006. Vol. 1. R. 89–120; Kradin N.N. Mongols Empire and the Debate of the Nomadic State Origins // Papers in Honor Maurizio Tossi for his 70th Birthday / Ed. by B Cerasetti. International Series. 2016. P. 369–377; Idem. Social Complexity, Inner Asia, and Pastoral Nomadism // Social Evolution and History. 2019. Vol. 18.No. 2. P. 3–34. About the emergence and spread of the stirrup in Eurasia, which played a revolutionary role in the military affairs of nomadic empires, see: Turchin P., Hoyer D., Korotaev A., Kradin N .. Nefedov S., Feinman G. Et al. Rise of the War Machines: Charting the Evolution of Military Technologies from Neolithic to Industrial Revolution // PLoS ONE. 2021. Vol. 16. P. 1–23. See also: Jeong H. et al., A Dynamic 6,000-Year Genetic History of Eurasia's Eastern Steppe // Cell. 2020. Vol. 183. P. 1-15.

stand out by equipping campaigns. The duration of the leader's reign, therefore, in addition to organizing wars, also depended on the skill of redistributing what was won.

This brief analysis of the complex, however, stateless systems of Hellas and nomads makes a significant addition to the scheme of political genesis widespread in the USSR, where evolution was considered exclusively within the framework of a single-line Marxist concept. According to it, the overwhelming number of peoples in world history, sooner or later, come to the creation of states. If this does not happen, societies are considered «undeveloped».

Moreover, by the present time, thanks to processual archeology and non-evolutionary anthropology, a fundamental addition to the term of L.E. Kubbel, taking into account the multiplicity of paths and options to complex, but non-state systems. From now on, *politogenesis is a process of forming a complex political organization of any type, and not just a state*.

Thus, the folding of states, in other words, state genesis, in the modern sense is only a part of political genesis, for no less complex pre-state organizations are known, whose evolution did not develop linearly. The state here, in the end, turns out to be only one and, perhaps, far from an obligatory result of political genesis.

Finally, in conclusion, it seems worth noting that the genesis of a particular polity depends on a number of factors: limited territory and resources; war; organization of hydraulic works; long distance trade. By the way, none of the features was decisive, since they were all intertwined.

After the collapse of the USSR and the rejection of Marxism historians face the question of developing an alternative methodology for interpreting the political genesis of early class societies. A way out of the impasse may be the study of precapitalist political systems in different regions of the world from the standpoint of *neo-evolutionism*.

References

1. Бондаренко Д.М., Коротаев А.В. Политогенез, «гомологичные ряды» и не линейные модели социальной эволюции // Общественные науки и современность. 1995. № 5. С. 128–139.

2. Васильев Л.С. Феномен власти-собственности. К проблеме типологии докапиталистических структур. Типы общественных отношений на Востоке в Средние века М., Наука. 1982.

3. Васильев Л.С. Проблемы генезиса китайского государства. М.: Наука, 1983.

4. Васильев Л.С. Восток и Запад в истории. Основные параметры проблематики // Альтернативные пути к цивилизации / под ред. Н.Н. Крадина, А.В. Коротаева, Д.М. Бондаренко, В.А. Лынши. М., Логос, 2000. С. 96–114

5. Коротаев А.В., Крадин Н.Н. Лынша А.В. Альтернативы социальной эволюции (вводные замечания) // Альтернативные пути к цивилизации / Под ред. Н.Н. Крадина., А.В. Коротаева, В.А. Лынши, Д.М. Бондаренко. М.: Логос, 2000. С. 24–83.

6. Коротаев А.В., Бондаренко Д.М., Гринин Л.Е. Социальная эволюция: альтернативы и варианты (к постановке проблемы) // Универсальная и глобальная история: эволюция вселенной, земли, жизни и общества / под ред. Л.Е. Гринина, И.В. Ильина, А.В. Коротаева. Волгоград. Учитель. 2012. С. 347–362

7. Крадин Н.Н. Кочевники, мир–империи и социальная эволюция // Раннее государство: его альтернативы и аналоги. / под ред. Л.Е. Гринина, Д.М. Бондаренко, Н. Н. Крадина, А. В. Коротаева. Волгоград. Учитель, 2006. С. 490–511

8. Куббель Л.Е. Очерки потестарно-политической этнографии. М. : Наука, 1988. 129 с.

9. Мельникова Е.А. К типологии предгосударственных и раннегосударственных образований в Северной и Северо-Восточной Европе (постановка проблемы) // Древнейшие государства Восточной Европы. М., 1995. С. 16–33.

10. Мельникова Е.А. Возникновение Древнерусского государства в европейском контексте // 1150 лет российской государственности и культуры / под. ред. акад. А.П. Деревянко. М.: Наука, 2012. С. 5–20.

11. Неусыхин А.И. Дофеодальный период как переходная стадия развития от родоплеменного строя к феодальному // Вопросы истории. 1967. № 1. С. 75 – 87.

12. Перцев Д.М. К вопросу о теориях политогенеза // Вестник Томского государственного университета. 2016. № 407. С. 115–120.

13. Перцев Д.М. Политии англосаксонской Британии V–IX вв. // Ранние формы политической организации. Спб.: СпбНЦ Российской Академии наук. АНО "КИО", 2016. С. 130–152

14. Ткаченко С.В. Рецепция и имплементация в теории права: к проблеме содержательного понятия // История государства и права. 2017. № 24. С. 9–13.

15. Ткаченко С.В. Рецепция либеральной идеи важности института частной собственности в постсоветской России // История государства и права. 2020. № 7. С. 64–70.

16. Ткаченко С.В. Содержание института лоббизма в российском механизме рецепции права // актуальные проблемы правоведения. 2021. № 1. С. 10–14.

17. Юшков С.В. К вопросу о дофеодальном (варварском) государстве // Вопросы истории. 1946. № 7. С. 45–46.

18. Abrutyn S., Lawrence K. From Chiefdom to State: Toward an Integrative Theory of the Evolution of Polity // Sociological Perspectives. 2010. Vol. 53, № 3. P. 424–430.

19. Bondarenko D. M., Korotaev A.V., Kradin N.N. Social Evolution, Alternatives and Nomadism Nomadic Pathways in Social Evolution. Moscow. 2003. P. 1–25

20. Bondarenko D.M. Pre-Imperial Benin: Formation and Evolution of Sociopolitical Institutions System. Moscow: Institute for African Studies. 2001. P. 199–231; Idem. Homoarchy:A Principal of Culture Organization The 13-th 19-th Benin Kingdom as a Non State Super Complex Society. Moscow. USSR. 2006.

21. Bondarenko D.M. The Benin Kingdom (13th–19thCenturies) as Megacommunity // Social Evolution and History. 2015. Vol. 14, № 2 . P. 46–76.

22. Bondarenko D.M., Korotaev A. V. «Early State» in Cross-Cultural Perspective: A Statistical Re-Analysis of Henri J.M. Claessen Database // Cross-Cultural Research. 2003. Vol. 37. № 1. P. 105–132.

23. Claessen J.M., Skalnik P. The Early State. Mouton Publishers. 1978.

24. Claessen J.M. Before the Early State and After // Social Evolution and History. 2008. Vol. 7, № 1. P. 4–18.

25. Claessen H. J. Early States-Structure, Development and Fall // Social Evolution and History. 2010. Vol. 9. № 1.P. 12–18

26. Earle T. Chiefdoms in Archaeological and Ethnohistorical Perspective // Annual Review Anthropology. 1987. P. 281–288.

27. Earle T. Chieftaincies, Chiefdoms, and Chiefly Confederacies: Power in the Evolution of Political System // Social Evolution and History. 2011. Vol. 10. № 1. P. 27–54

28. Emanuelson P., Willer D. Social Structures in Transition: Applications of Two Theories to Chiefdoms // Socius: Sociological Research for a Dynamic World. 2018. Vol. 4. P.1–14.

29. Etherington N. Barbarians Ancient and Modern // American Journal of Ophthalmology. 2011. Vol. 116. P. 31–57.

30. Gimpel J. The Medieval Machine: Industrial Revolution of the Middle Ages. Penguin Books. 1976.

31. Grinin L.E., Korotaev A. Chiefdoms: Yesterday and Today // Globalistic and Globalization Studies. 2019. P. 229–236

32. Jeong H. et al., A Dynamic 6,000-Year Genetic History of Eurasia's Eastern Steppe // Cell. 2020. Vol. 183. P. 1–15.

33. Jones D. Barbariginesis and the Collapse of Complex Societies: Rome and After // PLoS ONE. 2021. Vol. P. 1–33

34. Korotaev A.V. Mountains and Democracy // Alternative Pathways to Early State / Eds. By Kradin N.N., Lynsha. Vladivostok: Far East Branch of the Russian Academy of Sciences. Dalnauka. 1996. Vol. 1. P. 64–68.

35. Korotaev A., Grinin L. Chiefdoms and their Analogues: Alternatives of Social Evolution at the Social Level of Medium Cultural Complexity // Social Evolution and History. 2011. Vol. 10. P. 276–335.

36. Kradin N.N., Skrynnikova T. Why Do We Call Chingis Chan Polity an Empire // Ab Imperio. 2006. Vol. 1. P. 89–120.

37. N.N., Skrynnikova T. Why Do We Call Chingis Chan Polity an Empire // Ab Imperio 2008. Vol.1. P. 89–120.

38. Kradin N.N. Mongols Empire and the Debate of the Nomadic State Origins // Papers in Honour Maurizio Tossi for his 70th Birthday / Ed. by B Cerasetti. International Series. 2016. P. 369–377.

39. Kradin N.N. Social Complexity, Inner Asia, and Pastoral Nomadism // Social Evolution and History. 2019. Vol. 18. № 2. P. 3–34.

40. Pertsev D.M. Reimaging our World: From Fernan Brodel to World-System Analysis and from Historical Globalization to the G.D.E.L.T. Project. Science and Innovations 2021: Development Directions and Priorities. Inernational Conference. Australia, Melbourne, 2021. P. 112-127.

41. Romans, Barbarians and the transformation of the Roman World / Eds.by R. Mathiassen, D.Shanzer. Ashgate Publishing Limited. UK. 2011

42. Skalnik P. Chiefdom: A Universal Political Formation? // Focaal. 2004. Vol. 43. P. 76–98.

43. Skalnik P. Chiefs and Chieftains // The International Encyclopedia of Anthropology. John Wiley and Sons. Ltd. 2018. P. 56–86

44. Stocker T., Xiao J. Early State Formation: A Complete Rejection of the Circumscription Theory // Social Evolution and History. 2019. Vol. 18. P. 166–190.

45. Spier F. Early State Formation from Big History Point of View // Eurasia at the Dawn of History. Urbanization and Social Change / Eds. by M. Fernandez-Gotz, D. Krause. Cambridge University Press. 2017. P. 127–132.

46. Turchin P., Hoyer D., Korotaev A., Kradin N., Nefedov S., Feinman G. Et al. Rise of the War Machines: Charting the Evolution of Military Technologies from Neolithic to Industrial Revolution // PLoS ONE. 2021. Vol. 16. P. 1–23.

47. White L.J.R. Medieval Technology and Social Change. Oxford University Press. 1974.

DOI 10.34660/INF.2022.51.96.008

关于极端主义活动：问题的政治和哲学方面
ABOUT EXTREMIST ACTIVITY: POLITICAL AND PHILOSOPHICAL ASPECTS OF THE PROBLEM

Archakov Mikhail Konstantinovich
Doctor of Political Sciences, Candidate of Historical Sciences, Full Professor
Blagoveshchensk State Pedagogical University

抽象的。 本文考察了研究政治极端主义本质的理论方面。 通过分析，我们可以从理论上假设并确立一个观点，即政治极端主义从原始极端主义阶段到目前的状态都有出现和发展的历史。 研究过程中确定的政治极端主义形成阶段将使政治学领域的专家能够以最佳方式从理论上证实和研究这种政治现象。

关键词：政治意识形态； 政治极端主义； 原始极端主义； 政治暴力； 社会；状态

Abstract. *The article examines the theoretical aspects of studying the nature of political extremism. The analysis allows us to assume and establish a point theoretically that political extremism has a history of emergence and development from the stage of proto-extremism to the current state. The stages of the formation of political extremism identified in the course of the study will allow specialists in the field of political science to substantiate theoretically and study this political phenomenon in the best way.*

Keywords: *political ideology; political extremism; proto-extremism; political violence; society; state*

The problem of extremism has recently become one of the most urgent for both Russia and the world community as a whole. And this is connected, first of all, with the growth of political activity of radical organizations, associations and groups. Moreover, the spectrum of this activity is quite wide and manifests itself both in political hooliganism (insulting government officials, holding an unsanctioned meetings, pickets, political inscriptions, etc.), and in political killings, hostage-taking, and the activities of various terrorist organizations.

Some researchers define “extremism” based on the etymology of this concept, emphasizing that the word “extremism” is derived from the Latin “extremus” - extreme, which, in a general and rather abstract sense, means adherence to extreme

measures, actions, views and decisions [7; P. 67]. And this is a broader interpretation of the concept of "extremism". But, as a rule, they often pay attention to the fact that extremism is a political practice, illegal activities of political parties and movements, a political ideology that provides for the compulsory dissemination of its principles, intolerance towards opponents and their violent suppression. And, according to S. A. Bogolyubova is a political science and journalistic term that denotes all actions that are undesirable and dangerous for the state [1; P. 53].

In modern scientific research, the term "extremism" is mainly viewed as a phenomenon of political life, "consisting in pursuing a specific line in politics, rejecting compromises with the opposing side and reflecting the most aggressive attitudes of the subject, and as a kind of existing political currents located on the extreme left or extreme right political positions. It is also considered as a method of political struggle that rejects coordination and cooperation with political opponents or adversaries, and as a negative social protest developing at the levels - society, classes, individual social strata, ethno-national and professional groups - in different territorial boundaries and on different ideological, psychological and political foundations" [6; P. 21].

Without denying the sphere of politics, as the main one for manifestations of extremist activity, it should be noted that extremism is present in various areas of human life: in the economy, social and interethnic relations, religious life, the ecological sphere, in art, music, activities of youth groups, etc. It is no coincidence that in recent years, a significant place has been devoted to researching youth extremism and the search for effective measures to counter it.

Therefore, political extremism can be considered as a variety of a broader concept - the category of "extremism" along with economic, social, religious, youth, everyday life and others. That is, extremism can be understood as any form of extreme social behavior. These may be the actions of the desperate (for example, a social protest with the closure of the road) or unbalanced (mentally ill) people, or there may be mass street fights of representatives of youth informal groups.

Thus, the spectrum of manifestations of extremist actions in modern society is quite wide and therefore requires a rethinking and a more specific definition of the basic concept of "extremism" in order to define clearly with what and against whom society must fight.

Extremism is a complex, historically changing phenomenon (for example, the era of the Middle Ages did not know such a thing as "left-wing radical or extreme right extremism") that accompanies humanity throughout its history.

Based on modern ideas, the origins of extremism lie in deep primitive antiquity. Since the tribal enmity for the best places (territory) of habitation, the best conditions for survival, accompanied by mutual violence, raids, murders of prisoners (extra eaters), seizure of other people's property (prey) from the stand-

point of today can be qualified as manifestations of extremism, i.e. using extreme measures to solve the problem of capturing a better habitat. Moreover, often such "extremism" was justified by the need for survival of primitive tribes in a hostile external environment, i.e. was dictated by the completely objective realities of that time. Of course, we cannot classify this type of primitive "extremism" as political, religious, social or national, but we can quite consider it as a historically established basis (form) of the development of extremist activity in general. Moreover, the massacres committed in that era, the conversion of captured prisoners into slaves, the seizure of someone else's property and other acts cannot be qualified on the basis of modern political and criminal procedural norms. But the same deeds may well be attributed to proto-extremist activities, i.e. that on the basis of which, such a phenomenon as political extremism will arise in the future.

So at the stage of development of the late primitive community, according to A. I. Pershitsa, Yu. I. Semenova, V. A. Shnirelman: “The conflicts were not so much intragroup as intergroup in nature. Between members of different lineages, clans and communities gravitating towards them, quarrels arose due to non-observance of the rules of gift exchange, sexual and marital rivalry, and for various other reasons. Members of the linekage, clan, community stood up for their own people, and in the event of someone's death, they took revenge. So blood, or family, revenge was developed, in which any of the relatives of the murdered was obliged to pay for the blood to any of the relatives of the murderer” [9; P. 53]. The period of disintegration of the tribal system, the formation of private property, classes and the state coincided with the rapid development of military activity. Of course, wars existed before because of the violation of tribal boundaries, the murder of a fellow tribesman, the kidnapping of a woman, alleged magical "corruption" and for other reasons. Now, with the advent of wealth and greed, robbery made it possible to get rich quick. Therefore, the episodic clashes in the past turned into regular, massive and organized i.e. wars in the strict sense of the word. Wars have now become, as it were, a permanent trade. The winners took with them everything that was of value - treasures, cattle, slaves. Then, with the growth of the population, they began to seize neighboring lands. The very psychology of people in the era of class formation began to change. Robbery began to be considered as an honorable occupation, but peaceful work was a non-prestigious and even shameful activity for a real man.

If we turn to Russian history, relying on the "The Tale of Bygone Years", it can be noted that before the unification of most of the East Slavic tribes under the rule of Kiev, there were at least fifteen large tribal unions that were at enmity with each other, participated in clashes with neighboring tribes - the Khazars, the Avars, the Pechenegs. In other words, "The Tale of Bygone Years" describes military campaigns, the killing of prisoners, the seizure of other people's property,

forcing to pay tribute to the vanquished [10; P. 112]. That is, everything that, after the formation of the state and the development of legal norms, can be qualified as extremist activity.

Thus, extremism as a social phenomenon arises at the stage of development of tribal relations (proto-extremism) and subsequently, from the moment of the emergence of state structures, begins to acquire a political character.

If we consider extremism as a philosophical category, then it is quite possible to speak of it as a phenomenon of social life. In other words, any manifestation of extremism is a manifestation of its existence in various ways. From the point of view of Hegel's "Science of Logic", "extremism" is "a category of "pure being", extremely abstract, indefinite and meaningfully poor" [3; P. 42]. In addition, many researchers of this problem draw attention to the absence in the philosophical and political science literature of a generally accepted strict definition of the concept of "extremism".

Indeed, in the ordinary way, "extremism" is adherence to extreme views and actions. That is, we can say that extremism exists and manifests itself in various extreme views and actions, mainly in politics. But before becoming truly "present being", i.e. being with a certain degree of certainty, extremism as "pure being" goes through the stage of "becoming". "Becoming" is precisely the stage of the emergence of extremism as a social phenomenon (proto-extremism) at the stage of development of tribal relations, when the conditions necessary for survival in an external hostile environment demanded and led to the manifestation of human aggressiveness not only in hunting and in defense from predatory animals, but and in the use of violence against potential competitors of their own kind.

The problem of the emergence of extremism as a social phenomenon during the development of tribal relations allows us to speak of its initial stage - proto-extremism, i.e. pre-state stage in the development of human destructiveness. State, political, economic, legal and other relations have not yet developed here. Therefore, political extremism is a kind of "thing in itself" that will "open up", become "a thing for itself", acquire visible forms, signs, properties only at the stage of statehood , with the formation of the first political systems.

Manifestations of proto-extremism at the pre-state stage - tribal conflicts, murders, including blood feud, the capture of prisoners and their turning into slavery, the robbery of other people's property, the imposition of tribute on the defeated, cannot be qualified on the basis of modern regulatory legal acts. However, it can well be designated as extremist actions based on the process of formation of a given social phenomenon.

The second stage in the development of extremism is state. It is associated with not only the formation of the state, institutional authorities, the possibility of using violence from state structures, but also with the emergence of various types of

extremism - political, economic, social, religious, etc. According to A. A. Kozlova: “In this sense, the concept of “extremism” should be understood broadly and should not be limited to political extremism, because manifestations of extremism reveal themselves in all spheres of human activity: in interpersonal communication (everyday extremism), in the interaction of the sexes (sexual extremism), in relation to nature (environmental extremism), etc." [5; P. 6].

At this stage, not only types of extremism appear, but also its main types: state and opposition. Subjects who have real economic, political and spiritual domination in a given society carry out state extremism. And oppositional - extremism on the part of subordinate social groups, classes and strata. As noted by A. M. Kadiyeva: “If the first one is intended to preserve power and the privileges associated with it by the upper strata of society, the latter acts as a defensive reaction to a sharp qualitative deterioration in the living conditions of the lower, subordinate social groups or to a real threat of such a deterioration” [4; P. 136].

Naturally, from the point of view of universal human norms and values, extremist violence, either state or opposition, cannot be justified. Since extremism only aggravates the situation, brings it to the extreme, mutual violence of opposing social groups, due to which a calm constructive resolution of the conflict, as a rule, becomes impossible. But if the issue of manifestations of oppositional extremism has been studied quite well, then the problem of state extremism requires some explanation.

At first glance, any state uses a legitimate political one, if necessary, and extremism manifests itself in illegitimate violent actions. However, according to V. S. Martyanova: "Any state can also act as a subject of illegitimate violence if such a state or its individual institutions use the apparatus of violence, coercion and laws to serve certain private or corporate interests identified with national-state interests" [8; P. 86].

A textbook historical example of such use of the apparatus of violence and coercion to serve private, corporate interests is the notorious fact of collecting tribute by the Prince Igor of Kiev from the Drevlyans in 945. Prince Igor and his armed force (druzhina) acted as the authorities of Kievan Rus and collected tribute as a kind of "tax" from the subjects of the state. However, the tribute was not fixed, and therefore they took everything that could be taken, adapting themselves to a particular locality and type of economy. Therefore, during the collection of tribute, there were frequent manifestations of violence against the inhabitants and their actions against the princely people. It is well known how the next collection of tribute by Prince Igor from the Drevlyans ended. The armed force was killed, and the prince himself was executed by a cruel death. So having once taken a tribute from the Drevlyans, and deciding to take another one, Prince Igor paid for the "service" not to the state, but to the private, corporate interest of people closest to him - the "small" druzhina.

In general, history knows many examples (massive unjustified repressions in Stalin's Russia, the Holocaust, the "cultural revolution" in China, etc.) when not only the activities of marginalized groups can become extremist, but also the politics, official practice and laws of large "civilized" states.

In addition, the state can act as a subject of the legal struggle against extremism, without refusing, at the same time, from pursuing its own extremist policy, using methods of illegitimate violence against opposition organizations and groups. Examples of the application of such "double" standards were the regimes of Mussolini in Italy, Hitler in Germany, Franco in Spain, Stroessner in Paraguay, Pinochet in Chile, as well as in Haiti, Argentina, Guatemala, Salvador, South Africa, Uruguay and Southern Rhodesia.

According to V. S. Martyanov, the fight of the state against extremism performs two important functions. Firstly, it personifies the morality of the existing state structure, the social and economic system and those who act on their behalf. Secondly, it clearly divides the normal and pathological, legal and illegal, law and violence, etc. [8; P. 86]. An equally important function, in our opinion, is the one that allows you to form the image of the "enemy" (enemies, pests, freemasons, spies, etc.) in the mass consciousness in order to explain crises, failures, failures in the policy pursued by the existing ruling regime. It is no coincidence that the state monopoly on the classification of the political field makes it possible to "push" out of it all (radical oppositionists, parties, movements) who at least potentially threaten the existence of a particular political regime.

Therefore, for any state, extremism is a kind of official policy, in the language of J. Baudrillard, “the damned side of things”, the opposite of law and order” [2; P. 32].

Consequently, from the moment the first states appeared and up to the present time, manifestations of extremism in various spheres of life have become an objective reality, which characterizes the state stage in the development of this social phenomenon. Of course, the periodization of the stages in the development of extremism is not limited to this. There is also the third stage - post-state stage is possible in the future, but at this stage of development, extremism experiences and will experience the impact (struggle or use) of state authorities, in whatever forms it manifests itself.

Thus, the conducted research suggests that extremism is not a kind of label for hanging on opponents, but rather a dynamically developing phenomenon of modern political life.

References

1. Bogolyubov S. A. 2019. Is there a need for a law on countering political extremism? // Advocate. - №11. P.48-67.

2. Baudrillard J. 2021. Transparency of evil. - M.: Dobrosvet. 260 p.

3. Hegel G.V.F. 2018. Science of Logic. - M.: AST. 912 p.

4. Kadiyeva A.M. 2017. To the question of the essence of religious extremism // Religious studies. -№4. P. 131-143.

5. Kozlov A. A. 1996. Youth Extremism. - SPb.: Neva. 216 p.

6. Kofman B. I., Mironov S. N., Safarov A. A., Safiullin N. Kh. 2017. Terrorism: History and Modern Times. - Kazan.: RIF, 236 p.

7. Luneyev V. V. 2009. Problems of criminalization and countering extremism // State and law. - №9. P. 61-72.

8. Martyanov V. S. 2008. The multiplication of evil by good - Free thought. No. 5. P. 82-96.

9. Pershits A. I., Semenov Yu. I., Shnirelman V. A. 1994. War and Peace in the Early History of Humanity. - Moscow: Progress, 474 p.

10. The Tale of Bygone Years. 2021. - M.: Azbuka. 384 p.

DOI 10.34660/INF.2022.17.26.009

3.1-7岁烧伤毒血症强化治疗效果评价

EVALUATION OF THE EFFECTIVENESS OF INTENSIVE THERAPY FOR BURN TOXEMIA AT THE AGE OF 3.1-7 YEARS

Muhitdinova Hura Nuritdinovna
Doctor of Medical Sciences, Full Professor
Alauatdinova Gulhan Inyatdinovna
Assistant
Shomurodov Akmal Yangibayevich
Clinical Resident
Center for professional development of medical personnel

抽象的。烧伤 2-3A 度 59.2±12.2%，3B 度 36.7±13.3%，IF 127.5±33.3 在 3.1-7 岁时，休克恢复后强化治疗包括强制纠正输注治疗 1678-1500 毫升/天，肠内营养 至少 100% 的与年龄相关的生理需要，通过额外的肠胃外给药（氨基酸、碳水化合物、脂肪乳剂）的营养支持。注射氨基酸量的波动在 9、8、6、6 天的波浪周期内，这使我们能够假设学龄前儿童急性严重烧伤毒血症的能量机制变化大约为每周节律。通过在血管扩张剂的背景下以每分钟 4-5 μg/kg 的强心剂量引入多巴胺来维持血液动力学，抗凝治疗使得通过增加水负荷强制利尿而提供解毒治疗成为可能，而不会导致肺循环、心脏负荷过重失败。

关键词：烧伤毒血症重症监护，年龄3.1-7岁。

Abstract. *With burns 2-3A degree 59.2±12.2%, 3B degree 36.7±13.3%, IF 127.5±33.3 at the age of 3.1-7 years, intensive therapy after recovery from shock included compulsory corrective infusion therapy 1678 - 1500 ml per day, enteral nutrition at least 100% of the age-related physiological need, nutritional support with additional parenteral administration (amino acids, carbohydrates, fat emulsions). Fluctuations in the volume of injected amino acids were within 9, 8, 6, 6 day periods of waves, which allows us to assume about weekly rhythms of changes in energy mechanisms in acute severe burn toxemia in preschool children. Maintaining hemodynamics by introducing dopamine at a cardiotonic dose of 4-5 μg/kg per minute against the background of vasodilators, anticoagulant therapy made it possible to provide detoxification therapy by forcing diuresis by increasing water load without developing an overload of the pulmonary circulation, heart failure.*

Keywords: *intensive care of burn toxemia, age 3.1-7 years.*

Relevance

The period of toxemia in severe burns occurs within a few hours or during the first days after receiving a burn. Along with the pain factor during this period, the phenomena of intoxication of the body come to the fore. Despite the large number of studies in combustiology, recommendations for intensive care during the period of burn toxemia are predominantly general in nature, do not take into account age characteristics, the severity of the patient's condition [1-4].

Purpose

To assess the effectiveness of intensive therapy for burn toxemia at the age of 3.1-7 years.

Material and research methods

In total, data from studies of 25 children aged from 3.1 to 7 years were studied. Patients were considered depending on the severity and area of damage, age, duration of treatment in the ICU. Thus, the number of children in the ICU for up to 10 days was 10 (1 subgroup), 11-20 days - 8 children (2 subgroup), more than 21 days (21-54 days - 7 children). Patients were considered depending on age, severity of burn injury, duration of treatment in ICU. The severity of the burn was assessed by calculating the surface area of the damaged skin and using the Frank index. A detailed analysis of reliably significant deviations, intergroup differences of the studied indicators was carried out. The results were obtained by monitoring the hourly parameters of respiration rate (RR), hemodynamics, body temperature, assessment of fluid balance, analysis of drug correction. The research data were processed by the method of variation statistics using the Excel program by calculating the arithmetic mean values (M) and the errors of the means (m). To assess the significance of the differences between the two values, the parametric Student's test (t) was used. In this case, the critical level of significance was taken equal to 0.05. The interrelation of the dynamics of the studied indicators was determined by the method of paired correlations. Intensive therapy from the moment of admission was aimed at removing burn shock, adequate anesthesia and intravenous administration of crystalloids, volemic and other solutions under the control of hemodynamics, volume of urine output.

Results and its discussion

Table 1.

Characteristics of patients aged 3.1-7 years

Groups	Body weight, kg	Age in years	Height in cm	Burn area 2-3A step in%	Burn area 3B degree in%	IF in units	Duration of inpatient treatment	Number of days in the ICU
1	15.8± 1.8	4.7± 0.8	99.7± 5.9	37.3± 14.7	3.1± 4.4	42.5± 15.7	25.5± 10.3	8.1± 1.3
2	16.6± 2.4	4.0± 0.1	103.5± 8.3	47.9± 17.1	18.1± 12.2	85.1± 28.7	49.9± 16.9	13.1± 1.9*
3	16.4± 2.4	4.4± 0.6	107.3± 9.8	59.2± 12.2	36.7± 13.3*	127.5± 33.3*	61.8± 13.5*	27.3± 3.2*

reliably relative to data in group 1 reliably relative to data in group 1

The average age of children with severe burns in the age group from 3.1 to 7 years ranged from 4 to 4.7 years, height from 99.7 to 107.3 cm, body weight 15.8 - 16.4 kg (tab. 1). There were no significant differences between the groups and in the index of the area of the 2-3A burn, which was 37.3±14.7% in group 1, 47.9±17.1% in group 2, and 59.2±12.2% in group 3. However, a statistically significant difference was found in the area of grade 3B burns in groups 1 and 3, which in the most severe group of children exceeded the grade 3B burn in group 1 by 11 times ($p < 0.05$) and was 6 times greater than in group 2. At the same time, the Frank index in group 2 turned out to be two times higher than in the first (unreliable due to the large spread of the indicator in the group), and in group 3 it was significantly higher than in the first more than three times ($p < 0.05$). In accordance with the severity of the condition, the duration of intensive therapy in ICU conditions in group 2 was more than in the first by 62% ($p<0.05$), in group 3 more than three times longer ($p<0.05$) than in the first. According to the severity of the condition, the duration of inpatient therapy in group 1 was 25.5±10.3 days, in group 2 - 49.9±16.9, in group 3 - 61.8±13.5 days.

The volume of parenteral infusion therapy per day (fig. 1) in the first two days averaged 1677.9 ml and 1735.0 ml, respectively, in subsequent lives gradually, decreasing on the 30th day to 1500 ml per day. Despite enteral feeding of at least 100% of the age-related physiological need, nutritional support included mandatory additional parenteral nutrition (amino acids, carbohydrates, fat emulsions). However, the study revealed a noticeable instability in the amount of nutritional support during severe burn toxemia. So, according to the data presented in fig. 2, it

follows that the parenterally administered volume of amino acids ranged from 50 ml on day 1 to 310 ml on days 7, 10 with a decrease to 165 ml on day 9. Fluctuations in the volume of injected amino acids fit into 9, 8, 6, 6 day periods of fluctuations, which allows us to assume about weekly rhythms of changes in energy mechanisms in acute severe burn toxemia in preschool children. A decrease in the introduction of parenteral amino acid solutions was most often due to the need for a qualitative restructuring of infusion therapy in favor of correcting progressive hypoproteinemia, anemia, the need to improve the rheological properties of blood, impaired perfusion, heart failure, and detoxification therapy. Confirmation is the oppositely directed changes in the injected volume of amino acids and protein preparations on days 9, 14-16, 22-28 days (fig. 2). The provision of basic calorie intake was carried out enterally, in this regard, the introduction of glucose as the most easily assimilated energy-producing product was limited to the introduction of 200.8±14.5 kcal per day. The introduction of fat emulsions was limited to 40.5±16 ml of 10% lipofundin on days 14-24. The limitation of the introduction of fat emulsions is probably associated with an increased risk of a negative effect on the perfusion characteristics, which are already difficult to correct due to the severity of the general condition, intoxication, heart and respiratory failure, constantly participating as aggravating factors against the background of age-related instability of adaptive capabilities and rapidly depleted compensatory reactions at the age of 3.1-7 years.

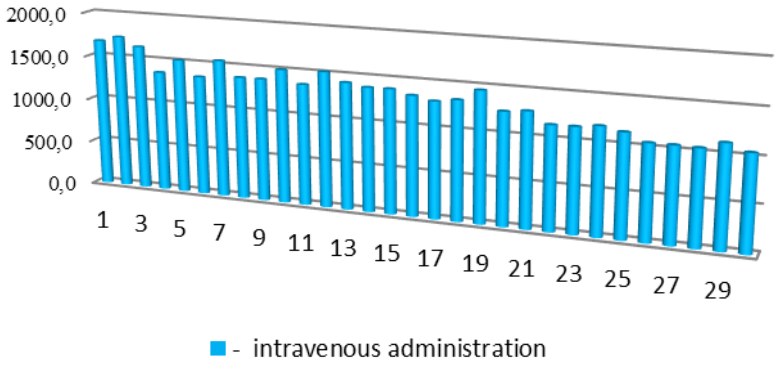


Figure 1. *Intravenous infusion therapy in ml/day*

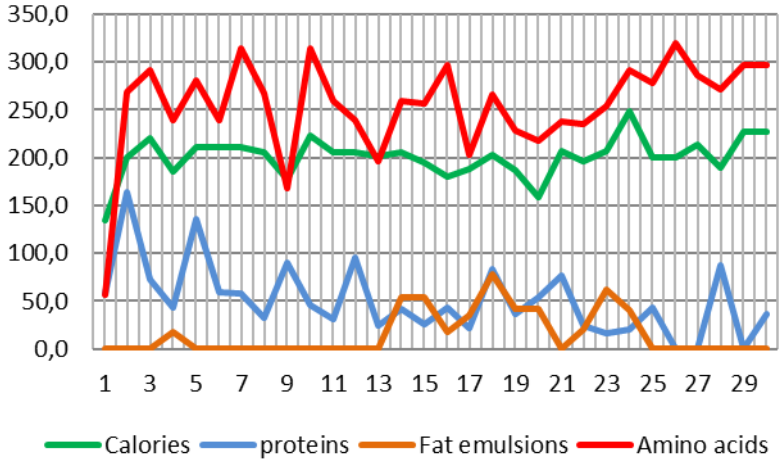


Figure 2. *Dynamics of parenteral nutritional support in ml*

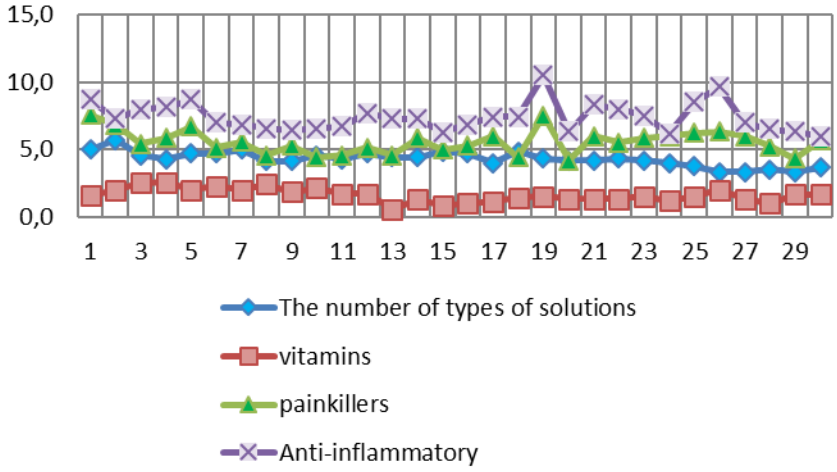


Figure 3. *Frequency rate of administration of medicines per day*

All drugs were administered at a standard therapeutic dose for age. The study of changes in the frequency of introduction in connection with the appropriateness in a particular situation, we were able to identify some features. Thus, the number of different infusion media according to the dynamics of the state, specific individual indications turned out to be the highest in the first three days, amounting to

4.3±0.4 (fig. 3), gradually decreasing to 3.3 on the 26th day. Draws attention with the maximum introduction on the first day 7.6 times the introduction, a repeated increase in the administration of painkillers on days 14, 19 (up to 5.9 and 7.5 injections) and on the 26th day 6.3, which was associated not only with dressings, but also the need to change antibiotic therapy in connection with an exacerbation of the inflammatory reaction. This is confirmed by the almost synchronous change in the volume of anti-inflammatory therapy (fig. 3). The metabolic (vitamin) load decreased slightly from 1.9±0.3 on days 2-13 to 1.3±0.17 per day on days 15-24.

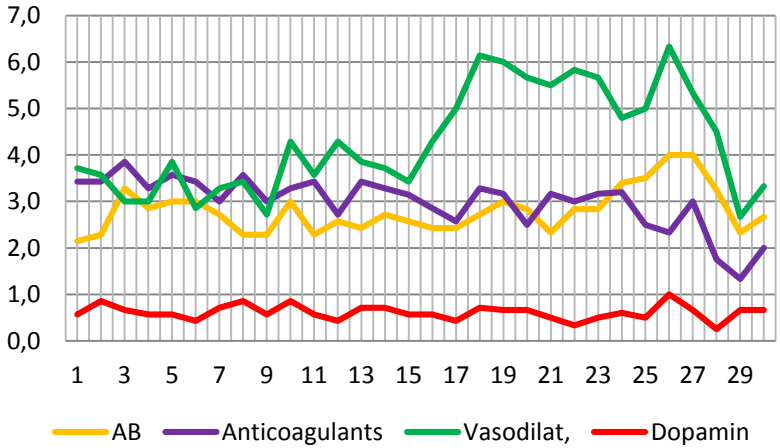


Figure 4. *Frequency rate of administration of medicines per day*

As shown in fig. 4, draws attention to the need to increase vasodilator therapy on days 17 - 26, which was primarily due to the need to treat pulmonary complications, clinically diagnosed pneumonia during prolonged recovery of the skin surface deeply damaged by thermal burns. The multifactorial nature of the pathogenetic mechanisms of the development of severe pneumonia in burn injury is known, the treatment of which should also be carried out taking into account the complexity of the pathogenesis of this manifestation of burn toxemia. Antibiotic therapy was carried out with broad-spectrum drugs of the latest generations under the control of bacteriological studies. Positive results of bacteriological analysis with the detection of a particular infection were obtained mainly in washings of the pharynx, sputum, wound surface, significantly less urine, intestinal secretions. According to the existing recommendations, empirical, etiotropic, de-escalation therapy was performed. The anticoagulant heparin was administered to all patients throughout the entire period of toxemia (fig. 4). Maintaining hemodynamics by

administering dopamine at a cardiotonic dose of 4-5 μg/kg per minute against the background of vasodilators made it possible to provide detoxification therapy by forcing diuresis by increasing water load without developing pulmonary overload and heart failure.

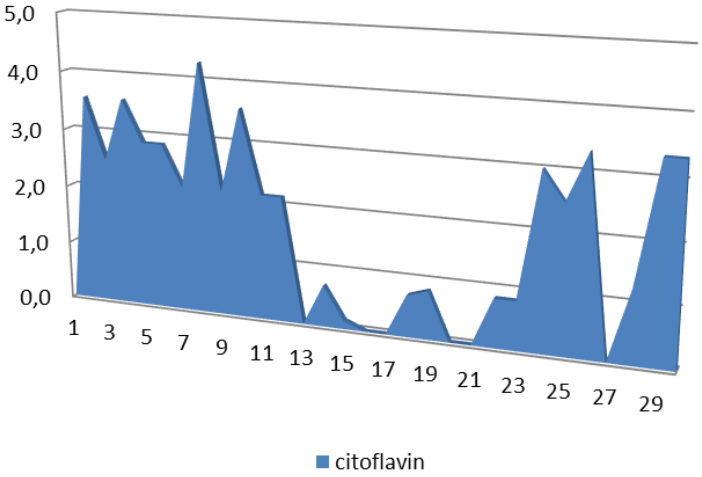


Figure 5. *Administration of Cytoflovin for burn toxemia (ml/day)*

Based on clinical observations (fig. 5), we believe that an increase in the use of Cytoflavin can significantly increase the effectiveness of not only correcting the energy deficiency state, but also improve the results of detoxification therapy, increase the adaptive, wound healing capabilities of the body in severe burn toxemia in children.

Conclusion

With burns 2-3A degree 59.2±12.2%, 3B degree 36.7±13.3%, IF 127.5±33.3 at the age of 3.1-7 years after recovery from shock, the effectiveness of intensive therapy was revealed, which included mandatory corrective infusion therapy in the range of 1678 - 1500 ml per day, enteral nutrition at least 100% of the age-related physiological need, nutritional support with additional parenteral nutrition (amino acids, carbohydrates, fat emulsions). Fluctuations in the volume of injected amino acids fit into 9, 8, 6, 6 day periods of fluctuations, which allows us to assume about weekly rhythms of changes in energy mechanisms in acute severe burn toxemia in preschool children. Maintaining hemodynamics by introducing dopamine at a cardiotonic dose of 4-5 μg/kg per minute against the background

of vasodilators, anticoagulant therapy made it possible to provide detoxification therapy by forcing diuresis by increasing water load without developing an overload of the pulmonary circulation, heart failure.

References

1. *https://hpt-kld.ru/tsirkadnyy-ritm-pod-vliyanie-stressa*
2. *https://pediatricsrus.site/prevention/detskij-son-i-cirkadnye-ritmy/https://studfile.net/preview/6159959/page:15/*
3. *https://scienceforum.ru/2016/article/2016021616*
4. *https://vsovetmedik.ru/chastota-dyhanija-u-detej-chdd-norma-po-vozrastam-normalnaja-chastota-dyhanija-u-rebenka.html*

DOI 10.34660/INF.2022.22.74.010

三岁以下儿童重度烧伤毒血症重症监护评价
EVALUATION OF INTENSIVE CARE FOR SEVERE BURN TOXEMIA IN CHILDREN UNDER THREE YEARS OF AGE

Muhitdinova Hura Nuritdinovna
Doctor of Medical Sciences, Full Professor
Center for the Development of Professional Qualifications of Medical Workers

抽象的。 7个月至3岁组烧伤2-3A度46.7±8.3%、3B度-17.2±7.2%、IF 73.4±9.6单位的注射液量在毒血症第一周最高 ，达到 950.2±88.6 ml/天，即比第 8-26天（758.2±42.0 ml/天）多 20%。 在最初的 2-8 天内纠正低蛋白血症平均每天79.7±20 毫升。 肠外+肠外营养支持使白蛋白输注量减少了 68 ml/天，即 9 天后减少了 81.5%。 最活跃的抗凝治疗在第 2-9 天进行。 已经揭示了在血浆白蛋白输注治疗期间增加抗凝剂的权宜之计。

关键词：重症监护，重度烧伤毒血症，3岁以下儿童。

Abstract. *The volume of parenteral fluid administration for burns 2-3A degree 46.7±8.3%, 3B degree - 17.2±7.2%, IF 73.4±9.6 units in the group of children aged 7 months to 3 years was the highest in the first week of toxemia, amounting to 950.2±88.6 ml/day, that is, 20% more than in 8-26th day (758.2±42.0 ml/day). Correction of hypoproteinemia in the first 2-8 days averaged 79.7±20 ml per day. The eneteral+parenteral nutritional support allowed to reduce the volume of albumin transfusion by 68 ml/day, that is, by 81.5% after 9 days. The most active anticoagulant therapy was performed on days 2-9. The expediency of increasing anticoagulants during plasma albumin transfusion therapy has been revealed.*

Keywords: *intensive care, severe burn toxemia, children under 3 years of age.*

Relevance

With extensive burns, the prognosis is always serious and especially unfavorable when 50% of the body surface is affected or more. Burns that cover more than 1/3 of the body surface are life-threatening for the child. Mortality among children with body burns has recently decreased to 1.86%; it remained relatively high in children under 3 years of age - 6.8% [1-4]. Due to the ambiguous approach to the expediency of the complex introduction of a multidirectional mechanism of action of drugs, there are no clear indications and contraindications in terms of

individual characteristics of the reaction not only to trauma, but also to ongoing intensive therapy, including many drugs, the place of which in intensive care has not yet been clearly defined, often the decision is made by the doctor without a clear understanding of the dynamics and features of the pathogenetic mechanisms of the development of organ failure in burn disease in children.

Purpose of the work

To assess the features of intensive care of severe burn toxemia in infants.

Material and research methods

The clinical material is presented by the data of hourly monitoring of body temperature, hemodynamic parameters: systolic (SBP), diastolic (DBP) pressure, cardiac output (CO), total peripheral vascular resistance (TPVR) in 8 children, admitted to the Republican Scientific Center for Emergency Medical Aid (RSCEMA) in connection with thermal burns at the age from 9 months to 3 years. The main feature that determined the division into groups was the duration of intensive care in the conditions of the intensive care unit (ICU), due to the severity of the burn disease. In the study group, the monitoring data of the studied parameters and the volume of intensive therapy in 8 children (more than 21 days 24.6±2.4) were considered. This paper presents an estimate of the volume of intensive care in children aged 17.9±8.6 months. Thermal burns of 2-3A degrees with an area of 46.7±8.3%, 3B degrees of 17.2±7.2%, the severity of the condition was assessed by IF as 73.4±9.6 units. The duration of intensive care in the ICU was 24.6±2.4 days (tab. 1). The studies were carried out while providing 100% of the physiological requirement by enteral administration throughout the study period of burn toxemia.

Table 1.

Characteristics of patients of group 3, aged from 7 months to 3 years

Age, months	2-3A degree,%	3B degree,%	IF, units	Days at the ICU	weight, kg	Height, cm
17.9±8.6	46.7±8.3	17.2±7.2	73.4±9.6	24.6±2.4	9.1±0.9	68.5±3.3

Results and its discussion

The volume of parenteral fluid administration in the studied group of children aged 17.9±8.6 months turned out to be the highest in the first week of toxemia, amounting to 950.2±88.6 ml/day, more than in 8-26 days, which averaged 758.2±42.0 ml/day. That is, the volume of intravenous infusion during the first seven days turned out to be 20% higher than on the following days of toxicosis ($p < 0.05$) (fig. 1).

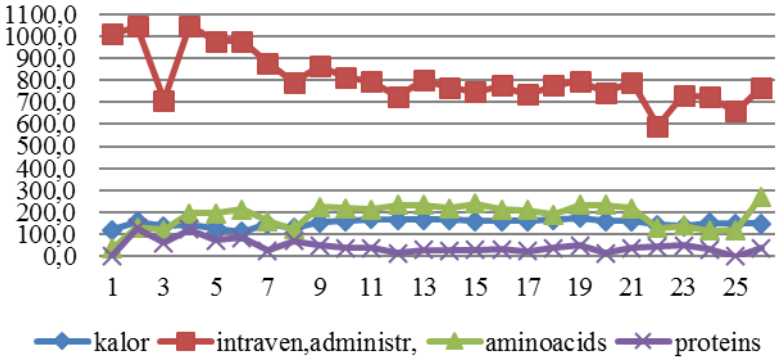


Figure 1. *Infusion therapy (daily fluid in ml, amino acids in ml, calories in glucose solution)*

Supplementary parenteral nutrition included the administration of amino acids and glucose solutions (fig. 1), on average, 185.1±46.1 ml/day, 150.6±13.1 kcal, respectively. Attention is drawn to the need for a more active correction of hypoproteinemia in the first 2-8 days, so the average daily volume of albumin transfusion averaged 79.7±20 ml per day, on the following days 31.2±10.1 ml/day. The eneteral+parenteral nutritional support allowed to reduce the volume of albumin transfusion by 68 ml/day, that is, by 81.5% ($p < 0.05$) in children under 3 years of age after 9 days.

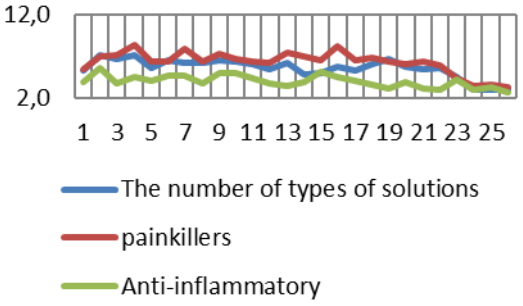


Figure 2. *Dynamics of the frequency of administration of painkillers, anti-inflammatory, types of solutions*

The need for the most active pain relief was observed on days 2-22, when the frequency of administration of the corresponding drugs averaged 6.9±0.5. On the next 23-26 days, the volume of anesthetic therapy decreased to 3.7±0.4 times a day, that is, by 46% (fig. 2). The increase in the frequency of administration of painkillers, including sedatives, was primarily due to the severity of the systemic inflammatory response of the body to severe extensive trauma, infection (almost all children had pneumonia), repeated operations (delayed nercectomy), plastics of damaged skin tissue, and repeated dressings.

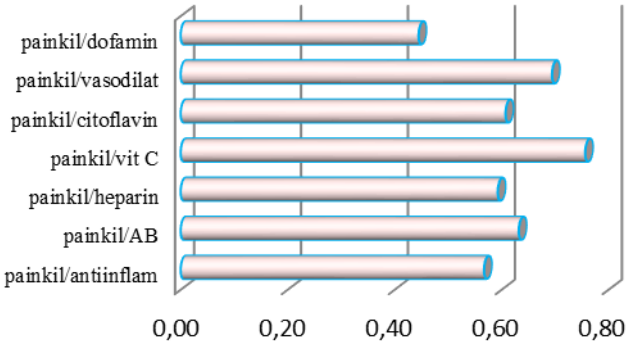


Figure 3. *Correlation between the frequency of anesthesia and correction methods*

At the same time, positive correlations were found between the volume of analgesic therapy with the introduction of dopamine (0.44), the need for vasodilating therapy (0.69), the introduction of vitamin C (0.75), cytoflavin (0.61), heparin (0.59), antibiotics (0.63), anti-inflammatory drugs (0.57) (fig. 3).

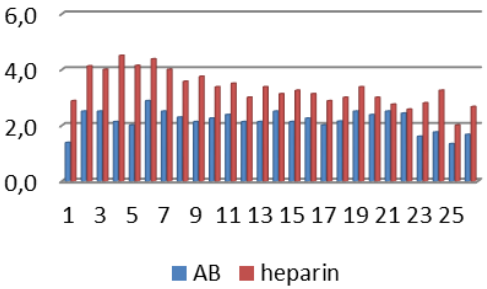


Figure 4. *Dynamics of the frequency of administration of antibiotics and heparin*

In accordance with the severity of the inflammatory response of the body of young children to severe burn injury, significant deviations in the parameters of homeostasis systems, including hemocoagulation, required the most active anticoagulant therapy on days 2-9 with a frequency of administration on average (4.1±0.2) s a slight decrease (3±0.2) on days 10-26 ($p < 0.05$) (fig. 4). Antibiotic therapy was inconsistent, in dynamics it increased by 2-3 days to 2.5, decreased by 5 days to 1.9, then, according to clinical indications, it was increased by 6 days to 2.7 times a day. We consider it incorrect to reduce antibacterial protection, especially during the first week after a severe burn injury, in conditions of severe toxemia. It is absolutely clear that adequate etiotropic antibiotic therapy should be carried out without prejudice to the child under conditions of maximum tension of all protective systems, post-traumatic stress immunodeficiency state, which allows empirical and earlier deescalation therapy to be performed, given that already for 3 and subsequent days, microflora resistant to most antibacterial drugs.

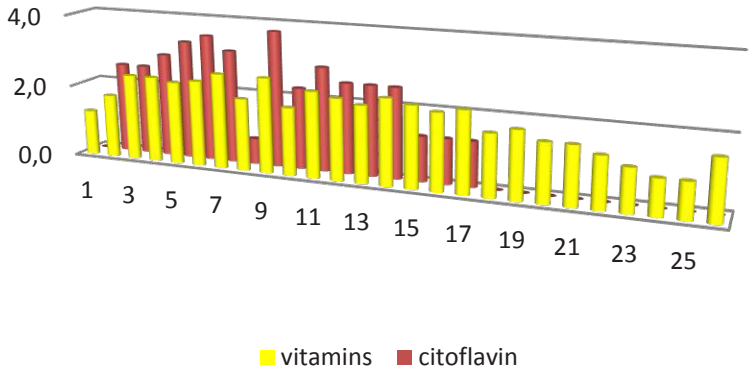


Figure 5. *The frequency of administration of ascorbic acid and cytoflavin*

On the basis of clinical experience, vitamin C and cytoflavin were chosen as supporting intracellular metabolism in conditions of severe burn injury and the corresponding systemic inflammatory response of the body. If ascorbic acid was used in most children throughout the entire period of toxemia, then the introduction of cytoflavin, despite a single positive response, was carried out in "courses" of 6-8 days. Perhaps the obligatory administration of cytoflavin in severe toxemia would increase the effectiveness of general complex intensive care.

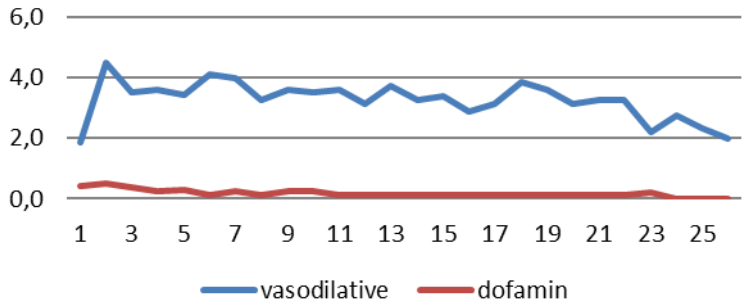


Figure 6. *Dynamics of vasoactive correction*

The combination of dopamine (at a dose of 3-4 μg / kg per minute) and vasodilators (trental, dipyridamole, magnesia, novocaine, droperidol) had a positive effect on the adaptation of hemodynamics to increased loads in connection with the introduction of parenteral nutrition, colloidal solutions, and blood preparations. As the condition improved, the wound surface was well healed, the frequency of administration of vasoactive drugs decreased to 2 on the 26th day, the administration of dopamine was stopped somewhat earlier - on the 24th day (fig. 6).

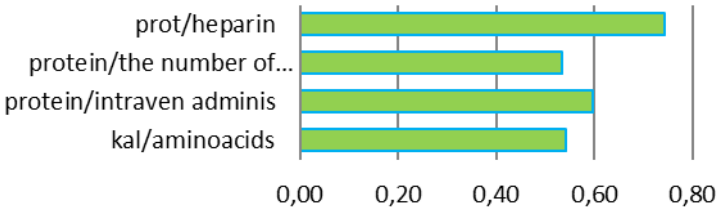


Figure 7. *Correlation links of correction of hypoproteinemia*

Of particular interest is the revealed direct correlation between the volume of injected protein media with heparin (0.74), the number of types of solutions (0.53), the volume of intravenous infusion (0.6), and the number of amino acids (0.54). That is, it was noted that it is advisable to increase anticoagulant therapy in plasma albumin transfusion therapy (fig. 7).

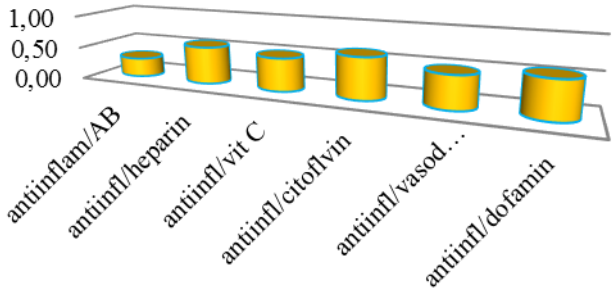


Figure 8. *Impact of anti-inflammatory therapy*

A moderate direct correlation was found between the amount of anti-inflammatory therapy (hormones, non-steroidal drugs, antihistamines) and the administration of heparin, which is due to periods of exacerbation of the body's inflammatory response (fig. 8).

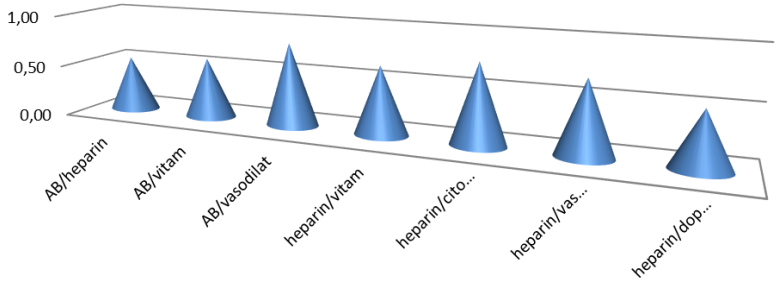


Figure 9. *Correlations between antibacterial and anticoagulant therapy*

Figure 9 shows correlations between antibiotic therapy and heparin, administration of metabolites and vasodilators, as well as a moderate direct correlation between heparin and cytoflavin, vasodilators, and dopamine. The revealed correlations are due to an increase in the intensity of corrective disorders caused by an exacerbation of the wave of the systemic inflammatory response of the body of children during the period of toxemia.

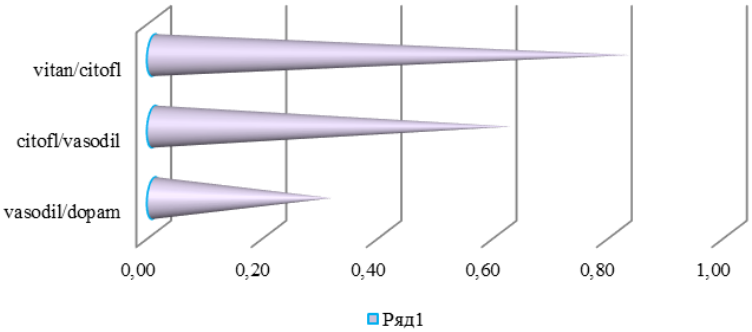


Figure 10. *Correlation links of metabolic therapy*

Direct correlations of metabolic therapy with vasodilators and an insignificant correlation with dopamine (fig. 10) are due to the appropriateness in connection with the clinical efficacy of this combination of drugs in severe burn toxemia in infants. The presented treatment of severe burn toxemia is one of many possible effective options for complex intensive care of infants.

Conclusion

The volume of parenteral fluid administration for burns 2-3A degree is 46.7±8.3%, degree 3B is 17.2±7.2%, IF is 73.4±9.6 units. in the group of children aged 7 months to 3 years was the highest in the first week of toxemia, amounting to 950.2±88.6ml/day, that is, 20% more than in 8-26 days (758.2±42.0 ml/day). Correction of hypoproteinemia in the first 2-8 days averaged 79.7±20 ml per day. The eneteral+parenteral nutritional support allowed to reduce the volume of albumin transfusion by 68 ml/day, that is, by 81.5% after 9 days. The most active anticoagulant therapy was performed on days 2-9. The expediency of increasing anticoagulant therapy in plasma albumin transfusion therapy is noted.

References

1. *https://hpt-kld.ru/tsirkadnyy-ritm-pod-vliyanie-stressa*
2. *https://pediatricsrus.site/prevention/detskij-son-i-cirkadnye-ritmy/https://studfile.net/preview/6159959/page:15/*
3. *https://scienceforum.ru/2016/article/2016021616*
4. *https://vsovetmedik.ru/chastota-dyhanija-u-detej-chdd-norma-po-vozrastam-normalnaja-chastota-dyhanija-u-rebenka.html*

DOI 10.34660/INF.2022.84.79.011

基于步态生物力学的儿童下肢追赶性生长表现
MANIFESTATIONS OF CATCH-UP GROWTH OF THE LOWER EXTREMITIES IN CHILDREN ACCORDING TO GAIT BIOMECHANICS

Dolganova Tamara Igorevna
Doctor of Medical Sciences, Leading Research Officer
Trofimov Anatoly Olegovich
Postgraduate
Smolkova Lidia Vladimirovna
Postgraduate
National Ilizarov Medical Research Center for Traumatology and Orthopedics

抽象。 长骨的异速生长是追赶生长 (CUG) 的生理特征 – 定义为在暂时的生长迟缓状态后生长速度的暂时增加。 对于自然异速生长，检测到的偏差本质上是暂时的，是肌肉骨骼系统补偿-适应机制的一种变体。 根据足部支撑反应数据和步态分析，提出了运动功能代偿和失代偿状态的判据。

关键词：步态分析追赶，线性增长

Abstract. *Allometric growth for long bones is a physiological feature of catch-up growth (CUG) - defined as a temporary increase in growth rate after a temporary state of growth retardation. With natural allometric growth, the detected deviations are temporary in nature and are a variant of the compensatory-adaptive mechanism of the musculoskeletal system. Criteria are proposed for compensated and decompensated states of locomotor function according to the data of support reactions of the feet and gait analysis.*

Keywords: *gait analysis catch-up, linear growth*

Allometric growth and isometric growth are two types of relationship between the growth rates of different parts of the body as compared to the growth rate of the whole body. Long bones have significant catch-up growth (CUG) which is defined as a temporary increase in growth rate after a temporary state of growth retardation [1, 2]. For example, one of the theories of the development of scoliosis is determined by the discrepancy between growth and the rapid restructuring of

the structures of the supporting-motor apparatus of the spine and nervous tissue that arise during a certain period of lifespan development [3]. Also, the mechanism of torsion development of the segments of the lower limb is normally an extremely complex process. Torsion development is carried out due to the tension of the muscles, which contributes to the twisting of the bones around their longitudinal axes and the appearance of various bends on them. All this ensures the development of the necessary anatomical forms for the most beneficial one from the standpoint of biomechanics of the functioning of the lower limb [4]. The posterior muscle group of the external rotators of the thigh, which, attaching to the area of the intertrochanteric fossa, play the role of antagonists of the iliopsoas muscle, causes internal torsion of the thigh and promotes a gradual decrease in the angle of antetorsion. The gradual internal torsion of the thigh and the associated decrease in the angle of antetorsion is a normal physiological process, the knee joint from the varus position passes to the physiological valgus position. In this case, the biomechanical axis of the lower limb passes through the middle of the hip and knee joints and close to the outer trochlea of talus, as a result of which the joints are evenly loaded [5].

With a pronounced allometric growth in the formation of the musculoskeletal system, the locomotor stereotype of patients undergoes changes. The temporal and strength characteristics of the support reactions of the feet are changing to the criteria of pathology. The cyclic characteristics of support reactions become unstable and begin to vary significantly. As a result, the cyclic identity of support reactions is disrupted not only between the limbs, but also in relation to themselves. The observed variability of the monitored parameters in a particular patient is so significant that it requires an appropriate justification for the diagnostic interpretation of the value.

The aim of the study – to determine the diagnostic criteria for the informativeness of the qualitative and quantitative characteristics of podography and video analysis of gait as a manifestation of allometric growth of the lower extremities in children.

Materials and research methods

In 120 children and adolescents aged 6-17 years, who turned to the Center's polyclinic for a preventive examination, the assessment of static and dynamic parameters of gait was performed using the "DiaSled Scan" complex, St. Petersburg [6]. The locomotor profile was assessed using gait video analysis (CGA) in 20 children aged 10-13 years (40 limbs) on an outpatient basis [7].

Research results

In children and adolescents, the asymmetry of temporal (from 7% at the age of 7 to 3% by the age of 14) and strength (from 25% at the age of 7 to 15% by the age of 14) indicators of the step cycle decreases with age.

During the examination, when walking, in 60% of observations in the age group 6-9 years old, in 50% - 10-13 years old and in 23% - 14-17 years old, a pronounced roll of the foot according to the valgus type with a change in the trajectory of the common center of pressure (CCP) was detected on a horizontal plane. Roll over the foot was recorded concave towards the center (medial displacement) either on one or on both sides. To quantify the maximum values of the medial displacement, its value was estimated by the dX parameter (% of the foot width). In the absence of clinical deviations in orthopedic status, with age, the number of cases of medial displacement of the CCP decreases from 60% to 23% and its value does not differ significantly, not exceeding 10% for dX at the usual pace, and 25% for dX at a fast pace of ambulation. Analysis of the podograms did not reveal an increase in the asymmetry of the temporal and power parameters of the step cycle from the value of the medial displacement of the CCP.

The medial displacement of the CCP increased both with the usual (dX up to 30%) in case of pronounced asymmetries of the power parameters of the step cycle (more than 25%) and postural disturbances. Moreover, in case of the possible fast pace of walking (dX up to 40%), it had a different degree of severity on the right and left lower extremities, which allows us to interpret it as a compensatory and adaptive response in pathological walking [8].

We believe that the revealed medial displacement of the CCP trajectory on the horizontal plane reflects the age-related process of torsion development of the lower limb. Therefore, in the process of the child's growth, its decrease is recorded. In 5% of cases, in the absence of dynamics of decrease in the value of the medial displacement of the CCP with the growth of the child, according to the data of clinical and instrumental examination, orthopedic pathological changes were revealed: violations of postural movement pattern (maintaining body balance in the normal stand position) and locomotor (maintaining body balance when walking), manifested in the form of stable talipes valgus (medial displacement of the CCP) and the progression of postural disorders in the frontal (scoliotic) and sagittal (round-concave back) planes.

According to 3D video analysis of gait, an early plantar flexion position (up to 5.00) is observed with an additional wave on the ankle kinetics graph. The premature moment of plantar flexion forms contact with the forefoot (additional wave) with a decrease in the duration of the roll phase over the foot, the preserved amplitude of the dorsal and pronounced functional asymmetry of the flexor / extensor muscles of the lower leg (more than 25%) is compensated by the adaptive mechanisms of the “optimal gait rule”, and in locomotor pattern does not manifest itself in the meanings of motor pathology. The symmetrical support impulse is preserved.

At the control examination after 0.5 - 1 year, the absence of detected deviations

of kinematics and kinetics is recorded, which indicates the temporary nature of the revealed pathology.

Long-term violations of postural and locomotor patterns were accompanied by the progression of postural disorders in the frontal (scoliotic) and sagittal (round-concave) planes. According to ultrasound data, during the clinical observation of children, hip displasia was recorded in 5% of cases.

According to the literature [9], in the absence of orthopedic pathology, changes in postural and locomotor patterns are possible due to the processes of pronounced allometric growth, which is one of the factors in the occurrence of a predisposition to the development of orthopedic diseases in childhood. Pronounced allometric growth at the initial stages leads to lateral asymmetries, changes in supporting biomechanics and abnormality of movement patterns. Subsequently, if, under the influence of allometric processes, the disturbed movement patterns do not exceed the compensatory and adaptive capabilities of the locomotor apparatus, then they do not manifest themselves clinically. If, under the influence of excessively prolonged or excessively increasing loads, the arising functional decompensations increase the movement pathology, then there are processes leading to the formation of detected diseases at the organ level.

Conclusions

1. The revealed pathological deviations in the kinetics and kinematics of gait in children and adolescents during the period of growth spurts should be observed in dynamics. The detected deviations are temporary and are a variant of the compensatory and adaptive mechanism of the musculoskeletal system in case of natural allometric growth.

2. Indication for an in-depth study of the patient's orthopedic status is: roll over the foot according to the valgus type with a medial displacement of the CCP projection from 26% to 40%, a small equinus setting of the foot (up to 50), functional asymmetry of the flexors / extensors of the muscles of the foot more than 25% at symmetric support push and the fact of the absence of positive dynamics with the age of the child in controlled quantities.

3. Signs of decompensated states of locomotor function of movement pathology are: pronounced roll over the foot according to the valgus type (medial displacement of the CCP projection trajectory more than 40%), asymmetry of the support push-off (more than 25%).

References

1. Caroline C de Wit, Theo C J Sas, Jan M Wit, Wayne S. Cutfield Patterns of catch-up growth. J Pediatr. 2013;162: 415–420. DOI: 10.1016/j.jpeds.2012.10.014

2. Roselló-Díez A., Joyner A.L. Regulation of Long Bone Growth in Vertebrates; It Is Time to Catch Up. Endocr Rev., 2015 Dec; 36(6): 646–680. DOI: 10.1210/er.2015-1048

3. Wong C. Mechanism of right thoracic adolescent idiopathic scoliosis at risk for progression; a unifying pathway of development by normal growth and imbalance. Scoliosis 2015, 10:2 DOI: 10.1186/s13013-015-0030-2.

4. Nikolenko V.N., Fomicheva O.A., Zhmurko R.S, Yakovlev N.M, Bessonova O.S., Pavlov S.V. Individual and typological morphogeometric features of the proximal of femoral bone. Saratov Journal of Medical Scientific Research, 2010, vol. 6, № 1, p. 36–39.

5. Angel J.L. Physical Anthropology and Medicine. J Natl Med Assoc. 1963 Mar; 55(2): 107–116.

6. Smirnova L.M. Hardware-Software complex for assessment of anatomic-functional disturbances and orthesis efficiency in patients with foot pathology. Biomedical Engineering. 2009. T. 43. № 6. C. 260-264.

7. Aksenov A.Yu., Heath G.H., Klishkovskaya T.A., Dolganova T.I. Optimising video-based data capture for pathological gait analysis in children with cerebral palsy using a limited number of retro-reflective cameras (literature review). Genij Ortopedii, 2019, T.25, No 1, pp.102-110 . DOI 10.18019/1028-4427-2019-25-1-102-110 . (In Russian)

8. Skvortsov D. V. The clinical conception of analysis of abnormal walking. Gait and Posture., 1997. Vol.6, N3. P.264.

9. Dolganova T.I., Dolganov D.V., Menshchikova T.I., Sazonova N.V. Diagnostic informative potential of the medial displacement of the trajectory projection of overall center of pressure in children and adolescents during walking. Russian Journal of Biomechanics, 2011. v.15, №2. 91-99.

DOI 10.34660/INF.2022.59.38.012

9-14岁健康儿童血液中瘦素和胰岛素水平的变化取决于身体发育指标和性别
CHANGES IN THE LEVEL OF LEPTIN AND INSULIN IN THE BLOOD IN HEALTHY CHILDREN AGED 9-14 YEARS DEPENDING ON THE INDICATORS OF PHYSICAL DEVELOPMENT AND GENDER

Panova Irina Vitalievna
Doctor of Medical Sciences, Full Professor
Letifov Gadzhi Mutalibovich
Doctor of Medical Sciences, Full Professor, Head of Department
Dombayan Svetlana Khristoforovna
Candidate of Medical Sciences, Associate Professor

抽象的。 9-14岁健康儿童外周血瘦素和胰岛素水平研究及人体测量学参数评估。 在身体发育高于平均水平的儿童中发现了更高水平的瘦素。 发现瘦素水平的变化与脂肪褶皱的厚度之间存在直接相关性。 男孩的体重和胰岛素水平高于女孩，并且瘦素和胰岛素之间存在显着的直接相关性（r = 0.7; p≤0.05）。

关键词：瘦素，胰岛素，人体测量指标，健康儿童。

Abstract. *The study of the level of leptin and insulin in the peripheral blood and the assessment of anthropometric parameters in healthy children aged 9-14 years. A higher level of leptin was found in children with above average physical development. A direct correlation was found between changes in leptin levels and the thickness of the fat fold. Higher body weight and insulin levels were found in boys than in girls, as well as a significant direct correlation (r = 0.7; p≤0.05) between leptin and insulin.*

Keywords: *leptin, insulin, anthropometric indicators, healthy children.*

Introduction

Adipose tissue is a multifunctional endocrine organ that secretes adipokines that affect the function of various organs and systems [1-3]. Particular attention is paid to the study of the role of leptin in the regulation of energy homeostasis. As a high molecular weight polypeptide, leptin is synthesized mainly in adipocytes, participates in the regulation of eating behavior and energy balance, inhibiting neuropeptide-Y in the arcuate nucleus of the hypothalamus and causing a decrease in appetite. The presence of specific leptin receptors in many peripheral organs (endothelial cells, thyroid gland, adrenal glands, kidneys, placenta, lungs, gastric

and intestinal mucosa) allows leptin to influence the functions of these organs [4].

Insulin is also a hormone of a peptide nature, its action is aimed at accelerating anabolic processes: increasing the supply of glucose, fatty acids and amino acids in tissues, glycogen synthesis in the liver and muscles, synthesis of fatty acids and triglycerides in the liver and adipose tissue, protein synthesis in many tissues. In adipose tissue, insulin stimulates fat synthesis and inhibits lipolysis [5].

According to the literature data, both leptin and insulin act on receptors in the same lobe of the hypothalamus and lead to a decrease in appetite. When insulin and glucose interact on adipocytes, leptin synthesis can increase, an increase in the level of leptin in the blood plasma leads to a decrease in insulin secretion [6]. However, there is no data on the ratios of these hormones depending on the characteristics of physical development and gender in healthy children, which served as the basis for this study.

Objective: to assess changes in leptin and insulin levels in healthy children depending on gender and physical development indicators: body weight and length, body mass index (BMI), waist circumference (WT), fat fold thickness (FFT).

Materials and methods

The study group included 19 children aged 9-14 years; of them 6 children had average indicators of physical development (25 - 75 percentiles) (group 1), 13 - above average (75 - 90 percentiles) (group 2). Patients were included in the study on the basis of the informed consent of the parents, whose children took part in the scientific study.

All children underwent an assessment of anthropometric indicators: length and body weight, BMI (ratio of body weight (kg) to the square of body length in m2), waist circumference, as well as the thickness of the fat fold using a caliper. The study of insulin in peripheral blood was carried out by the enzyme multiplied immunoassay method using kits from "Monobind Inc." (USA), and leptin by using test systems manufactured by DRG (Germany) under standardized conditions after an overnight fast.

Statistical processing of the study results was carried out using the Statistica for Windows software packages (version 6.1) using nonparametric statistics methods (Mann-Whitney test, Spearman's correlation coefficient), taking into account that the distribution of insulin and leptin values did not correspond to the law of normal distribution. Data are presented as the median (Me) and quartile 25 and 75 [25% -75%]. The significance level was considered significant $p \leq 0.05$.

Research results and their discussion

The assessment of anthropometric data established higher indicators in children of the second group in comparison with the first. This concerned body length: 158.5 (147-165) cm and 151 (147-157.5) cm, $p \leq 0.05$; body weight: 48 (45-51) kg and 38 (34.5-47.5) kg, $p \leq 0.05$, as well as BMI: 19.19 (16.79-21.91) and 16.51 (

16.51-20.46, respectively, for groups 2 and 1, p≤0.05 (Table 1). The same ratios remained in relation to the waist circumference: 67 (65-71) cm and 58.5 (56.5-61.5) cm, respectively, for 2 and 1 groups, p≤0.05, as well as the thickness of the fat fold: 21 (14-21) mm and 10 (10-21.5) mm, respectively for 2 and 1 groups, p≤0, 05) (Table 1).

Table 1.

Distribution of children, taking into account age and indicators of physical development

Groups / Indicators	Study group (n =19)	
	1 group Physical development Average	**2 group Physical development Above average**
n (number of children)	6	13
Age (years) Me Quartiles [25-75]	 11,5 [11-13]	 11 [10-13]
Body weight (kg) Me Quartiles [25-75]	 38 [34,5-47,5]	 48* [45-51]
Body length (cm) Me Quartiles [25-75]	 151 [147-157,5]	 158,5* [147-165]
BMI (kg/m^2) Me Quartiles [25-75]	 16,51 [16,51-20,46]	 19,19* [16,79-21,91]
WC (cm) Me Quartiles [25-75]	 58,5 [56,5-61,5]	 67* [65-71]
FFT (mm) Me Quartiles [25-75]	 10,5 [10-21,5]	 21* [14-21]

Note: * - the differences are statistically significant in comparison with the 1st and 2nd groups of children (p≤0.05).

The leptin level in children of group 2 was 13.78 (1.79-49.59) ng/ml, which significantly exceeded the value of the indicator in group 1 - 3.8 (2.17-80.33) ng/ml, p≤ 0.05. The study of the level of insulin in children did not reveal significant differences depending on the characteristics of their physical development, namely: 8 (8.0-9.15) μmU/ml and 7.9 (7.2-9.0) μmU/ml on 1 and 2 groups, respectively (p> 0.05) (Table 2).

Table 2.

Serum leptin and insulin levels in children of 1 and 2 groups

Indicators \ Groups	1 group Physical development average	2 group Physical development Above average
Leptin (ng/ml) Me Quartiles [25-75]	 3,8 [2,17-80,33]	 13,78* [1,79-49,59]
Insulin (μmU/ml) Me Quartiles [25-75]	 8 [8,0-9,15]	 7,9 [7,2-9,0]

Note: * - the differences are statistically significant when comparing 1 and 2 groups of children ($p \leq 0.05$).

The study of anthropometric data depending on gender revealed significantly higher values of indicators in boys. So, the body weight for boys was 45 (44.0-51.0) kg, and for girls - 41 (38.5-50.75) kg, $p \leq 0.05$. Similar ratios applied to other indicators, namely: body length - 156 (148-165) cm and 150.5 (144-159.25) cm, respectively, for boys and girls, $p \leq 0.05$. BMI was 18.51 (16.18-21.91) kg/m^2 and 17.99 (16.68-22.65) kg/m^2, respectively, for boys and girls, $p \leq 0.05$; FFT - 20 (10-24) mm and 20.5 (17-21 mm), respectively, for boys and girls, $p \leq 0.05$; WC - 65 (61.0-67.0) cm and 65.5 (60.5-70.0) cm, respectively, for boys and girls, $p \leq 0.05$ (Table 3).

Table 3.

Indicators of physical development depending on gender

Indicators \ Gender	Girls of I-II health groups	Boys of I-II health groups
n (number of children)	6	13
Age (years) Me Quartiles [25-75]	 10 [10-12,25]	 12 [10-13]
Body weight (kg) Me Quartiles [25-75]	 41 [38,5-50,75]	 45* [44,0-51,0]
Body length (cm) Me Quartiles [25-75]	 150,5 [144-159,25]	 156* [148-165]
BMI (kg/m^2) Me Quartiles [25-75]	 17,99 [16,68-22,65]	 18,51* [16,18-21,91]

WC (cm) Me Quartiles [25-75]	 65,5 [60,5-70,0]	 65* [61,0-67,0]
FFT (mm) Me Quartiles [25-75]	 20,5 [17-21]	 20* [10-24]

Note: * - the differences are statistically significant when comparing boys with girls, p≤0.05.

The study of the dynamics of leptin levels depending on the gender factor did not establish statistically significant differences in the indicator in the group of girls 22.6 (12.225-72.96) ng/ml and boys 3.81 (1.32-17.09) ng/ml, p> 0.05 (Table 4).

Table 4.

Indicators of leptin and insulin levels in children of I-II health groups depending on gender

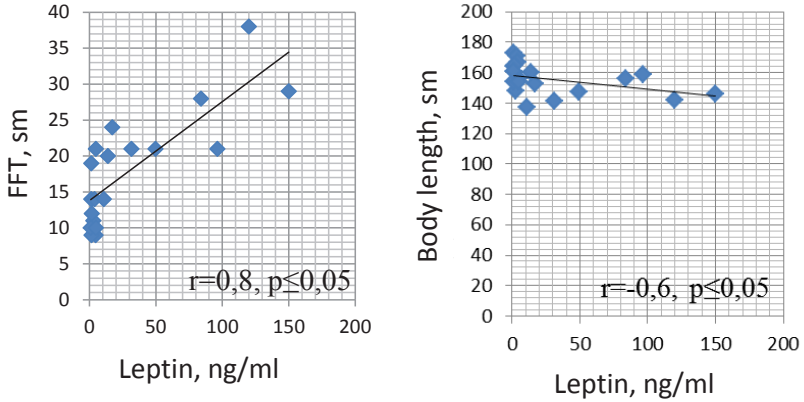
Gender / Indicators	Girls of I-II health groups	Boys of I-II health groups
n (number of children)	6	13
Leptin (ng/ml) Me Quartiles [25-75]	 22,6 [12,225-72,96]	 3,81 [1,32-17,09]
Insulin (μmU/ml) Me Quartiles [25-75]	 7,65* [7,4-8,4]	 8* [7,2-9,5]

Note: * - statistically significant differences when comparing boys with girls, p≤0.05.

The results obtained differ from the data of other studies indicating a higher concentration of leptin in the blood serum in women compared with men, both with normal body weight and obesity, which is associated with the distribution of subcutaneous fat and the stimulation of leptin production by estrogens in women [6, 7]. The tendency established in our work is probably associated with the characteristics of childhood and the revealed higher body weight indices in the surveyed boys in comparison with girls (Table 3).

The study of the level of insulin taking into account the gender factor established higher values of the studied indicator in boys 8 (7.2-9.5) μU/ml in comparison with girls 7.65 (7.4-8.4) μU/ml, p ≤0.05 (Table 4).

The analysis of the obtained results revealed the presence of a strong direct correlation between the level of leptin and FFT (r = 0.8; p ≤ 0.05), and the feedback between the level of leptin and body length (r = - 0.6; p ≤ 0.05) (fig. 1).



А Б

Figure 1. *Correlation of leptin level and fat fold thickness (A), leptin level and body length (B).*

The presence of a direct correlation between the levels of leptin and insulin in patients with average indices of physical development ($r = 0.8$, $p \leq 0.05$) was also revealed. A multidirectional correlation was established between the studied hormones in the group of girls ($r = -0.8$; $p \leq 0.05$) and boys ($r = 0.7$; $p \leq 0.05$).

Conclusions

1. The conducted study of anthropometric indicators of healthy children aged 9-14 stated the presence of average and above average physical development.

2. It was found that boys have higher indicators of physical development in comparison with girls aged 9-14 years.

3. The revealed higher level of leptin in children with physical development above average. In addition, the presence of a direct correlation between the values of the hormone and the thickness of the fat fold may indicate the possibility of hyperleptinemia with the likelihood of developing insulin resistance in the future. Also, taking into account the higher body weight and insulin levels found in our study in boys compared with girls, as well as the presence of a significant direct correlation ($r = 0.7$; $p \leq 0.05$) between leptin and insulin, it is probably worth considering gender factor (male gender) as a risk factor for the development of metabolic syndrome.

References

1. Peterkova V. A. On the issue of a new classification of obesity in children and adolescents / V. A. Peterkova, O. V. Vasyukova // Problems of endocrinology. – 2015. – V. 61. – No. 2. – P. 39-44.

2. Panova I. V. Features of the endocrine status in girls with chronic gastroduodenitis during puberty [Electronic resource] / I. V. Panova, T. A. Afonina, E .A. Ryabkina, I. B. Semenchenko // Modern problems of science and education. – 2015. – No. 4. – Access mode: http://www.science-education.ru/ru/article/view?id=21105

3. Panova I. V. Features of the endocrine status in boys with chronic gastroduodenitis in combination with gastroesophageal reflux disease in the I-III stages of sexual development [Electronic resource] / I. V. Panova, T. A. Afonina // Modern problems of science and education. – 2016. – No. 2. – Access mode: http://www.science-education.ru/ru/article/view?id=24218

4. Severin Y. S. Biochemistry with exercises and tasks: textbook + CD. – M.: GEOTAR-Media. – 2010. – 384 p.

5. Panova I. V. The role of insulin in the development of chronic inflammatory diseases of the upper gastrointestinal tract in children / I. V. Panova // International Journal of Experimental Education. - No. 11 (part 1). – 2015. – P.106-109

6. A. V. Shestopalov Leptin level in children with chronic gastroduodenitis and different types of food behavior [Electronic resource] / A. V. Shestopalov, O. V. Trofimenko, I. V. Panova et al. // Modern problems of science and education. – 2012. – No. 5. – Access mode: http: www.science-education.ru/105-7221.

7. Chubenko E. A. The value of leptin in the formation of metabolic syndrome / E. A. Chubenko, O.D. Belyaeva, O.A. Berkovich et al. // Problems of women's health. – 2010. – No. 10. – V.5. – P. 46-60.

DOI 10.34660/INF.2022.14.94.013

Noopept课程接收背景下的认知过程动力学

THE DYNAMICS OF COGNITIVE PROCESSES AGAINST THE BACKGROUND OF THE COURSE RECEPTION OF NOOPEPT

Slobodenyuk Tatyana Fedorovna
Candidate of Medical Sciences, Associate Professor
Chita State Medical Academy

抽象的。 该研究对 20 名健康志愿者进行。 使用综合能力电池评估应用 Noopept 前后的认知功能。 受试者以 20 毫克的每日剂量使用 Noopept 一个月。 在实验中发现，Noopept 对具有认知活动特征的人的处方有效地改善了工作状态、短期、长期记忆、语言学习过程和语义信息系统中语义信息的处理。 记忆。

关键词：noopept，轻度认知障碍，健康患者，认知测试，治疗。

Abstract. *The study was carried out on 20 healthy volunteers. A comprehensive ability battery was used to assess the cognitive functions before and after the application of Noopept. The subjects used Noopept for a month at a daily dose of 20 mg. As it was found in the experiment, the prescription of Noopept to persons with a cognitive activity profile effectively improves the state of working, short-term, long-term memory, the processes of verbal learning and processing of semantic information in the system of semantic memory.*

Keywords: *noopept, mild cognitive impairment, healthy patients, cognitive testing, therapy.*

The spectrum of conditions in which there are impairments to basic cognitive functions is very wide. It includes cognitive deficits in brain trauma, strokes, chronic cerebrovascular insufficiency [2]. Mild cognitive impairments can also occur in healthy patients against the background of mental and physical stress, asthenia, and stress insomnia. They are manifested by forgetfulness, increased fatigue during mental work, slight difficulties in concentration [4, 8, 11]. Mild cognitive impairments do not affect every day, professional and social activities, but often cause subjective anxiety in a person. Therefore, it is extremely important to identify such conditions and conduct correction.

For the treatment of cognitive impairment, nootropic drugs are widely used, compounds that act on the central nervous system, enhancing cognitive capabilities (improve memory, attention, orientation, etc.). The main characteristic of

nootropics is an activating specific effect on the higher integrative functions of the brain and the restoration of disorders of higher nervous activity. The main mechanisms of the therapeutic action of nootropic drugs are: increased synthesis of adenosine triphosphoric acid (ATA), increased absorption of glucose by brain cells; strengthening the processes of synaptic transmission in the central nervous system; normalization of neurotransmitter disorders (the effect of a number of nootropic drugs is mediated through the neurotransmitter systems of the brain, among which the most important are monoaminergic, acetylcholinergic, glutamatergic, GABAergic); membrane stabilizing action [3]. The mechanisms of action of nootropics have been intensively studied at the neurophysiological level. The effect of nootropics on the late components (400–800 ms) of evoked potentials in people in solving problems was shown, which is considered as a direct confirmation of the effect of nootropics on cognitive processes [5]. Considering that in clinical practice the need for nootropics is great, the production and implementation of new highly effective nootropic drugs in practice is an important and urgent task. Medicines of peptide nature are interesting as potential nootropics, since neuropeptides play the main role in the regulation of cognitive functions, and in most cases peptide drugs are more effective than drugs of other chemical groups [1]. Noopept is an ethyl ester of N-phenylacetyl-L-prolylglycine, a dipeptide with nootropic and neuroprotective properties [6, 7, 9]. The neuroprotective (protective) effect of Noopept is manifested in an increase in the resistance of the brain tissue to damaging influences (trauma, hypoxia, electroconvulsive and toxic damage). The drug reduces the volume of the focus in the thrombotic model of stroke in the experiment and prevents the death of neurons in the tissue culture of the cerebral cortex and cerebellum exposed to toxic concentrations of glutamate and free radical oxygen [6]. Noopept has an antioxidant effect, antagonistic influence on the effects of excess calcium intake into cells, and improves the rheological properties of blood. The nootropic effect of the drug is associated with the formation of cycloprolylglycine, which is similar in structure to an endogenous cyclic dipeptide, which has antiamnestic activity, and is also characterized by the presence of acetylcholinergic action. The presence of a wide spectrum of nootropic activity in Noopept was the basis for experimental studies.

Objective

To investigate the dynamics of cognitive processes against the background of the course use of Noopept in healthy subjects.

The tasks included: 1) to determine mnemotropic activity in healthy subjects with a cognitive activity profile; 2) to study the spectrum of changes in the indicators of cognitive status after the use of Noopept.

Materials and methods

The studies were conducted in 20 volunteers who agreed to participate in a

psychological examination. To assess the state of cognitive functions, the following tests were used: "reproduction of a list of 30 monosyllabic words without and with reverse arithmetic counting", characterizing the state of working, short-term and long-term memory, "memorization of 30 monosyllabic words" used to assess the effectiveness of learning processes with the participation of semantic memory. In addition, the “Test for reproduction of the word-number list after 3-fold subvocal repetition”, test “countdown in threes” was carried out to identify the speed of elementary thinking. The study of cognitive functions was carried out before using the drug (control) and after using Noopept 10 mg twice a day for one month.

Statistical data processing was performed using the Microsoft Office 2000 software package. The significance of the differences (control-experiment) was assessed using the Student's (t) test and the Mann-Whitney test (U).

Results

As it was found in the experiment, the course use of Noopept significantly increases the working memory index up to 36.2%, which is 7% more than the control indicators (Table 1).

Table 1.

Influence of Noopept on the cognitive functions of healthy patients

Group	SMI, %	WMI, %	LMI, %	ICI, %	The speed of elementary thinking (the number of arithmetic operations per minute)
Control	40±2,01	29,3±1,02	25,4±1,39	24,0±1,5	30,0±1,08
Noopept	62,2±2,2*	36,2±1,69*	34,9±0,79*	25,8±2,07	30,22±1,8

Note: * - the significance of differences control-experience at P <0.05; SMI-short-term memory index, WMI- working memory index, LMI- long-term memory index, ICI - information coding index

Along with this, indicators of short-term memory improved. The index of short-term memory against the background of the use of Noopept increased from 40% to 62%.

Analysis of the influence of Noopept on individual mechanisms of information processing in working memory showed that the drug activates the processes of preserving semantic information in long-term memory, as evidenced by a significant increase in the long-term memory index (i.e., the total number of words reproduced after counting down in triplets) by 9.5 %.

When memorizing 30 monosyllabic words in four sessions of verbal learning, it was found that the number of reproduced words in 2, 3, 4 training sessions significantly increased by 10%, 10.7% and 11.3%, respectively (Table 2).

Table 2.

Influence of Noopept on the process of verbal learning

Group	Monosyllabic word recall index, %			
	1 session	2 session	3 session	4 session
Control	25,2±1,04	40,7±1,14	54,7±1,19	66,1±1,8
Noopept	28,05±1,28	50,5±1,24*	65,4±0,82*	77,4±1,38

Note: * - significance of differences control - experience at P <0.05

During the experiment, it was found that noopept does not improve the processing of information in the process of verbal and digital coding (Table 1), and also does not affect the speed of elementary thinking.

Conclusion

Thus, the course prescription of Noopept in a daily dose of 20 mg to persons with a cognitive activity profile effectively improves the state of working, short-term, long-term memory, the processes of verbal learning and processing of semantic information in the system of semantic memory.

References

1. Avedisova A. S., Yastrebov D. V. Comparative efficacy of Noopept and piracetam in the treatment of asthenic disorders and disorders of organic genesis // Russ. Med. Magaz. 2007. No. 5. P. 434–437. Arsenyeva K. E. Nootropic drugs in the treatment of cerebrovascular diseases // Russ. Med. Magaz. 2007. No. 4. P. 225-228.

2. Amelin A. V., Ilyukhina A. Yu., Shmonina A. A. Noopept in the treatment of moderate cognitive impairment in patients with ischemic stroke // Journal of Neurology and Psychiatry. S. S. Korsakov. 2011. V. 111. No. 10. P. 44-46.

3. Voronina T. A., Seredenin S. B. Nootropic drugs, achievements and new problems // Expert. and clin. pharmacol. 1998. V. 61, No. 4. P. 3–9.

4. Damulin I. V. Mild cognitive impairment // Consilium Medicum. 2004. V. 6. No. 2. P. 149-153.

5. Krapivin S. V. Neurophysiological mechanisms of action of nootropic drugs // Neuropathol. and Psychiatry Magaz. 1993. V. 93, No. 4. P. 104-107.

6. Neznamov G. G., Teleshova E. S. Results of a comparative study of noopept and piracetam in the treatment of patients with mild cognitive impairments in organic diseases of the brain of vascular and traumatic genesis // Neuropathol. and Psychiatry Magaz. 2008. V. 108, No. 3. P. 33–42.

7. The original nootropic and neuroprotective drug Noopept / R. U. Ostrovskaya, T. A. Gudasheva, T. A. Voronina et al. // Experimental and Clinical Pharmacology. 2002. V. 65. No. 5. P. 66-72.

8. Preobrazhenskaya I. S. Mild and moderate cognitive impairments: clinical manifestations, etiology, pathogenesis, approaches to treatment // Neurology, neuropsychiatry, psychosomatics. 2013. No. 1. P. 59-63.

9. Sturov N.V. The use of the drug noopept for cognitive impairments of various origins. // Difficult patient. 2012. V. 10. No. 11, pp. 28-32.

10. A computerized test for the assessment of mild cognitive impairment subtypes in sentence processing / S. Segkouli, I. Paliokas, D. Tzovaras et al. // Neuropsychol Dev. Cogn. Aging. Neuropsychol. Cogn. 2017. N 15. P. 1-23.

11. Cognitive and imaging markers in non-demented subjects attending a memory clinic: study design and baseline findings of the MEMENTO cohort // C. Dufouil, B. Dubois, B.Vellas et al. // Alzheimers Res Ther. 2017. V. 9. N 1. P. 1365-1372.

DOI 10.34660/INF.2022.12.88.007

外乌拉尔的牧场湖泊养鱼作为增加粮食产量的一个例子
PASTURE LAKE FISH FARMING OF TRANS-URALS AS AN EXAMPLE OF INCREASING FOOD PRODUCTION

Mukhachev Igor Semyonovich
Doctor of Biological Sciences, Full Professor
Honored Worker of the Fisheries of the RF
Tyumen State University

文章在改进适销鱼一年和二年养殖养殖技术的基础上，介绍了外乌拉尔森林草原湖泊养鱼发展的特点。 得益于在外乌拉尔地区引入了复杂的海外湖泊填海造地技术，以及利用冬季水库曝气的填海效应、开放水域期间底部淤泥沉积松动的创新养鱼技术，湖泊的自然生产潜力 使增加捕鱼量成为可能。

Abstract. *The article provides a characteristic of the development of pasture lake fish farming within the forest-steppe Trans-Urals on the basis of improving the technologies of the fish-breeding process of one-year and two-year cultivation of marketable fish. Thanks to the introduction of complex reclamation of overseas lakes in the Trans-Urals and innovative fish farming technologies that use the reclamation effect of aeration of reservoirs in winter, loosening of bottom silt deposits during the open water period, the natural production potential of the lakes made it possible to increase fish catches.*

The purpose of the analytical review is to characterize modern technologies of pasture lake fish farming within the forest-steppe zone of the Trans-Urals, illustrating a dynamic real increase in the overall fish productivity per 1 ha of lake fish farms based on the improvement of fish breeding and reclamation work and an increase in the total fish catch in the Trans-Urals. To do this, we used the annual reporting data on the actual catches of fish in the lakes of different fish farms of the Chelyabinsk, Kurgan and Tyumen Oblasts, as well as materials from personal monitoring of the ecological and fishing situation of a large number of lakes [1-6] over a long period of time.

The fish farms of the Chelyabinskrybprom and the Kurgan Fish Processing Plant were one of the first, starting from the 50s of the last century, to systematically work to increase the fish productivity of the lakes, which introduced the

technology of annual rearing of whitefish based on the peled priority. In the process of scientific generalization of the practice of the Ural lake fish farming [7-12], it is recommended to use shallow lakes of the forest-steppe for the production of valuable food fish, experiencing periodic freezing phenomena (acute oxygen deficiency in the water) accompanied by the process of water aeration in winter. In the first years, the fish productivity of lakes of the crucian ichthyological type for the whitefish raised by the one-year feeding method was 25-50 kg/ha.

Within the West Siberian Plain, due to the variability of climatic indicators with a cyclicity of 20-50 years [13-14], the level regime of lakes in the forest-steppe and steppe natural zones changes, which significantly affects the efficiency of fisheries based on water bodies subject to periodic fluctuations in water levels. As a result, the composition of the fish population changes dramatically up to the complete disappearance of fish due to the salinity factor and a sharp deficiency of oxygen in the water [15]. Much earlier, this zonal problem predetermined the need to substantiate specific improvements in the ecological environment on the basis of landscape reclamation methods [16-19] and the use of aeration technology.

According to the recommendations of the zonal fisheries science, one of the first in Russia was established in 1968 the Kazan Lake Fish Farm (KLFF) in the forest-steppe southeast of Tyumen Oblast. The joint work of production workers and scientists substantively proved in practice that the "average annual" fish productivity of shallow lakes of the Trans-Urals, subjected to landscape reclamation [11-12], can reach 100-130-200 kg/ha per year due to the joint cultivation of peled and carp, in comparison with the previously existing annual commercial catches of gold and silver carp 20-35 kg/ha.

However, in order to stabilize high catches, it is necessary to comply with a number of requirements, and first of all, on the selection of reservoirs, which will ensure high-quality cultivation of marketable fish using the polyculture method. And this requires a comprehensive ecological and fishery study of reservoirs and the determination of suitable for fish farming, because, in fact, for a number of reasons, not every lake can be used for growing marketable fish due to extreme ecology (shallow water - depths less than 2 m, high mineralization water of sodium chloride class).

Using the developments of zonal science, modern users of the lakes of the Trans-Urals in Kurgan, Tyumen, Chelyabinsk Oblasts based on the methods of loosening silt when growing polyculture of whitefishes and carp in reclaimed reservoirs, and using aeration equipment in winter, consistently receive 130-200 kg/ha of valuable fish per year (fish farms: "STRKH", "Siberian theme", "Perspective-Plus", "Balyk", "Alternative" and many others). However, when viable planting material of grass carp, silver carp and pilengas - fish actively consuming aquatic vegetation, bottom detritus - appears in abundance in the Trans-Urals re-

gion, 350-400 kg/ha will be grown in eutrophic lakes with sapropel silts annually, since whitefish and carp already make up half of the possible catch due to feeding on organisms of zooplankton and zoobenthos. Other producers of lake ecosystems are subject to the annual process of destruction and replenishment of bottom sediments.

In our opinion, the zoned complex of lacustrine poly-culture within the forest-steppe zone of the West Siberian Plain, in addition to whitefish, must include carp, carp, herbivorous grass carp and silver carp. Such a complex of fast-growing fish polyculture will allow users of the region's lakes to grow marketable fish in reservoirs with depths of 2.8-4.0 m and more under different natural and ecological conditions of the aquatic environment. Moreover, users of the region's lakes should be more focused on growing larger fish by the method of two-year and long-term feeding using pasture technology, as indicated by the authors of a new, very objective publication by D.I. Naumkina et al. [20].

In the Trans-Urals region, for the successful implementation of the process of mass development of the lake fund and the intensification of commercial pasture fish farming, it is necessary to provide all existing fish-processing enterprises and farms with viable fish seed material produced (grown) in close proximity to the feeding pasture farms of each Subject of the Federation. The main thing in the progress of pasture fish farming is the full and effective use of the self-renewable food base of the lakes for the formation of the ichthyomass of farmed fish. For this, it is necessary to fully introduce (use) various methods of fishery reclamation, contributing to the intensification of this process.

In particular, the large-scale introduction of detritus feeders and herbivorous fish into the daily practice of domestic commercial pasture fish farming is facilitated by studies of ecologists-hydrobiologists substantiating promising technologies for the use of the production of macrophytes, phytoplankton, detrital suspension of silts and a decrease in their biomass in water bodies [21-25] on the formation of edible fish. The zoned polyculture of fish can significantly increase the results of their cultivation using progressive pasture technology and reduce the effect of the factor of reducing oxygen in the water of fishery reservoirs. This topic is the subject of research by B.V. Verigin [26], G.G. Vinberg [27] and other specialists. They especially drew the attention of fishery managers to the need to enrich the ichthyofauna of local water bodies at the expense of phytophagous fish. Moreover, the cultivation of silver carp in the regionalized complex of lake polyculture of fish from 4-5 objects of cultivation will allow utilizing the excess biomass of phytoplankton and accelerate the turnover of nutrients in the ecosystem of the reservoir on the basis of recycling [28], [29], [30], and as a result - increase fish productivity of lakes, increasing the economic results of fish farming [20].

This approach to the large-scale practice of pasture lake fish farming in a num-

ber of regions of Russia objectively corresponds to the sustainable development of agricultural production in a complex hydrobiocenosis [31] in accordance with the laws of hydrobionomy [32], [33], [34]. And this is a class-based approach, supported by economic science [35], capable of increasing the efficiency of fisheries in inland water bodies of Russia.

A full-fledged polyculture in pasture lake fish farming will bring Russian fish farming closer to the style of intensive fish farming in modern China, where polyculture is an obligatory technology supported not only by scientists, practitioners, fishermen, but also by all administrative and managerial regulations of the state and its main working link - municipalities [36], [37].

Issued by the Ministry of Agriculture of the RF Order № 124 dated March 15, 2017 "On approval of the "Methodology for determining the minimum volume of aquaculture objects subject to breeding and (or) maintenance, cultivation, as well as release into a water body and withdrawal from a water body within the boundaries of a fish farm" provides for a differentiated regional approach to the implementation of aquaculture in local water bodies, indicating the average annual yield (catch) of rearing objects within the Trans-Urals in the amount of 25-30 kg/ha per year. And this is a completely objective value for novice users of fish-breeding sites in the region, taking into account the real-life indicators of the development of the natural food base of local reservoirs with a tense ecological situation (oxygen deficiency in water; increased and high water salinity; shallow water). However, this Order does not provide for the cultivation of fish (aquaculture) in the hyperhaline lakes of the Trans-Urals, as it is taken into account for the conditions of the Astrakhan Oblast and the Republic of Kalmykia.

The modern practice of commercial fish farming in 2010-2021 objectively showed that ignoring the natural climatic factors characteristic of about 50% of the lake stock of the forest-steppe Trans-Urals, which have salt water, is fraught with a number of negative consequences:

- a waste of expensive fish seed (larvae, fry, and other juveniles) of fish introduced into shallow-water lakes of the overwater type with highly mineralized water, leading to a quick or slow death of the invaders;

- causing economic damage to users of extreme lakes, which are only periodically suitable for fish farming due to the dynamics of climatic conditions that increase or decrease the level of lakes and the mineralization of their water, into which juveniles of valuable fish have been introduced for feeding;

- the emergence of mistrust among entrepreneurs and enterprises of the fish-breeding process in the activities of the State regulatory and supervisory bodies and services issues of fish farming in inland waters of the RF;

- a real avoidance of objectively necessary reclamation measures by methods of hydrotechnical watering due to the accumulation of spring floods in the

catchment area adjacent to the lake, as it was successfully done on the lakes of JSC "Kazan Fish". Carrying out "landscape reclamation" realistically and for a long time contributes to an increase in fish productivity of local water bodies and "to produce" food, ecologically clean "organic products", which will increase the balance of "food security" in the Trans-Urals region.

At present, based on the progressive practice of fish farms in the Kurgan and neighboring Tyumen and Chelyabinsk Oblasts of the Trans-Urals in lake farms assigned to users for 25 years, it is necessary to introduce technological methods of the current quickly and efficiently operating amelioration, the results of which are immediately apparent. These include the following ongoing land reclamation:

Aeration of lakes in winter to preserve fish that have not reached marketable conditions and are able to form additional marketable ichthyomass for the next growing (feeding) period, usually 2-3 times higher than the amount of feeding according to one-year technology. This is how the modern lake fish farm JSC "Kazan Fish" works, where in specially prepared reservoirs they organized the cultivation of the necessary amount of viable planting material for peled and other whitefishes up to the age of a young of the year with an average weight of 15-20 g/pc, ensuring its full wintering. In the spring, these juveniles are transported to feeding lakes in the amount of the actual food supply for a particular reservoir and are raised (obtained) commercial two-year-olds weighing 250-400 g/pc. Large fish farms operate on this technological basis: "Kazan Fish", "Sladkovskoe Commercial Fish Farms", NPF "Siberian Theme", "Rybkhoz "Balyk" and others.

Harrowing of bottom sediments with special equipment. For loosening (roiling) the upper layer of bottom sediments, quite a lot of variants of technical devices have been created, allowing, on the basis of the mechanical involvement of nitrogen-phosphorus biogens of bottom sediments during the period of open water (end of May; end of July-beginning of August; beginning of September) within the middle part (zone) a feeding lake, free from thickets of rigid macrophytes. Loosening of silt significantly - increases the food supply for zooplanktophagous fish and, marketable fish, respectively, increases the overall increase in the ichthyomass of marketable fish by 2-3 times.

Figure 1. Sludge ripper designed by Sladkovo fish farm. The length of the sharpened edge of the unit is 3 m.

The reclamation effect is obvious on the example of lakes that exceed the water area of 400-500 hectares and more, and have significant thickets of reeds and other macrophytes.

Fig. 2. The beginning of the process of loosening the bottom sediments of the frozen lake.

For example, "Sladkovskoe Commercial Fish Farming" 8 years ago (since 2013) started mechanical removal of hard vegetation - reeds on lake Tavolzhan (fig. 3), which ultimately made it possible to significantly clear the middle zone of the lake, on the forage base of which large commercial peled underyearlings and a hybrid of pelchir are grown (fig. 4).

In the first years, 30-50 tons were grown, in 2016-2021 whitefish production reached 200-300 tons per year.

Fig. 3.Lake Tavolzhan, the middle zone of which has been cleared of reed thickets, since 2013.

Fig.4 Marketable peled underyearlings from the non-aquatic catch on lake Tavolzhan (October 2020)

Reclamation of the floodplains is necessary on each lake according to the rules of fishing, which is carried out during the open water period for the unhindered passage of the seine net, both in summer and in winter, which is carried out on the basis of the use of various techniques.

A highly effective biotechnical reclamation technique for the creation of local areas (places) with a high concentration of small food organisms available in size for larvae and fry of fish before their introduction into feeding lakes (which are not drinking water for the population). This technology has been created and has been used for a long time in intensive-type fish farms [38], [39].

The essence of this technology is as follows. Agricultural straw bales in the amount of 40-50-100 pieces and more are placed compactly along the edge of reed thickets from their inner side to the center of the lake. The depth of the lake in the area for placing agricultural straw bales should be 15-20 cm less than the bale height. Since the top of the bales placed on the surface of the ice (March), when it melts in April and sinks to the bottom of the reservoir, should be above the water, since the upper and middle parts of the bale are pre-saturated with organic matter. When submerged to the bottom of the lake, its top under the influence of the sun warms up and becomes a substrate for the formation of "hay infusion" with multiplying positive bacteria, which, in turn, feed on Paramecia ciliates that inhabit all continental water bodies and are an obligatory (necessary) food for small forms of zooplankton eaten by the larvae of the introduced whitefish. This has been repeatedly emphasized in the works of hydrobiologists [21-35]. Consequently, the larvae of peled and other whitefishes should be infused in the places where bales of straw are located, charged with various "organic substrates". And the very process of stocking the lake should take place no later than 5-6 days after the submersion of the straw substrate (bales) through the ice onto the ground (bottom) of the reservoir.

Soon, all the introduced mass of agrosol is decomposed by useful microbial decomposers. Consequently, this fertilizing technology repeats the natural processes that constantly occur in water bodies, but in a more concentrated (intensive) form in a small area of the lake, and does not create any negative consequences in the fishery water body at all.

Universe of the crustacean Gammarus. An effective biomeliorative technique for increasing the feeding capacity of lakes and increasing their fish productivity is the transplantation of the crustacean Gammarus - *Gammarus lacustris*, which lives in many lakes of the Trans-Urals, but has decreased its numbers in the process of growing whitefish and other fish.

This technology has been used in Western Siberia and the Trans-Urals since the 1950s; it has been patented by Omsk specialists [40]. The practice of users of fish breeding sites within the Kurgan, Chelyabinsk, Tyumen, Omsk and other

Oblasts of the RF, using scientific and technological developments to strengthen the food base of feeding reservoirs by the method of introducing the amphipod crustacean (Gammarus), gives positive results everywhere and is recommended as biological reclamation [41; 42].

Recommendations for the use of fish-breeding technologies in order to increase the commercial productivity of feeding lakes - fish-breeding grounds. Fish stocking in the spring of lakes intended for fish breeding with whitefish polyculture: river and lake peled, hybrids: pelchir, pelmuk, pelnel, is carried out by whitefish larvae at the age of 3-5 days. in an amount from 2 to 5-6 thousand pcs./ha (depending on the lake's feeding capacity for zooplankton). Loosening of sapropel-type silt deposits in late May-early June and re-loosening at the end of July-August increases the total biomass and production of zooplankton by 2-2.5 times, which stimulates an increase in the stocking density of whitefish larvae in spring. Instead of the normative 2-3 thousand pcs./ha, it is possible to infuse up to 5-6 thousand pcs./ha. In addition, the Gosrybtsentr Institute (Tyumen branch of VNIRO) has developed a technology for early hatching of whitefish larvae (at the end of March) and rearing the larvae in the workshop using live and artificial feed.

Thus, by the time of invasion of feeding lakes in late April or early May, larvae at the age of 1-1.5 months with a greater body weight begin to grow more intensively in natural conditions in the presence of an accessible food base for zooplankton organisms, and reach by the middle September, as a rule, weights over 150 g/pc. The stocking density of grown whitefish larvae is reduced by 25-40% in comparison with unforgiven ones, since their vitality index is higher.

In the presence of lakes that allow for a two-year feeding of whitefish (with average depths of 2.6-2.8 m and more), it is carried out with the help of aeration equipment. Consequently, in lakes with optimal depths and salinity of chloride-sodium water during the entire winter period no higher than 2-2.5 g/dm^3, the technology of growing commercial two-year-old whitefish can be implemented. This technology is used in case of reaching a small (non-commercial) mass (weight) of whitefish (40-60 g/pc), or, conversely, in the case of planning the production result of obtaining two-year marketable whitefish weighing 350-400 g/pc.

According to the technology of growing marketable two-year-olds, they work in the lake fish farm JSC "Kazan Fish", where in specially prepared "growing" lakes (with a depth of 2.8-3.8 m), the required amount of viable planting material of peled and other whitefishes is grown until the age of the autumn fingerling weighing 15–20 g/pc, then ensuring its full wintering on the basis of the use of high-quality water aeration throughout the winter. In spring, juvenile whitefish aged one year old are promptly caught with a small-mesh net and transported to feeding lakes in an amount (250-400 pcs./ha) based on knowledge of the real status of the food base of a particular reservoir, and according to the technology of

one-year feeding, commercial two-year-olds weighing 250-450 g/pc.

Particularly important is the work of fish-farming enterprises to create reproduction complexes to provide the existing feeding areas with high-quality fish stock. The fish farms of the Trans-Urals - "STRKH", "Kazan Fish", "Siberian Theme", "Chelyabrybkhoz" purposefully carry out work on the formation of brood stocks of whitefishes, carp and other fish. The presence of "our own", not purchased on the "side" of fish planting material increases the quality of work on pasture cultivation of marketable fish and reduces the cost of its production.

"Environmentally friendly" fish - peled, goldfish, carp, corresponding to the quality of organic bioproducts, the enterprises of the Trans-Urals sell not only in their region, but also in Central Russia.

Fig.5. Concentration and inspection of captured peled breeders before planting in cages for temporary holding from lake Bolshoy Kurtal of Sldadkovsky fish farm (October 2020)

Fig.6. Peled producers on the lake Bolshoi Kurtal of the Sladkovsky fish farm for transplanting into the pools of the fish breeding workshop.

Conclusion

Monitoring of the current variability of the ecological and fishery conditions of the lakes of the forest-steppe zone of the Trans-Urals, especially in the face of a tendency to increase air temperatures and, accordingly, the water of all fish-producing reservoirs, predetermines the need for timely expansion of pasture polyculture complexes at the expense of herbivorous fish - grass carp and silver carp, as well as a consumer of silt - pilengasa. Consequently, the operational task of the zonal fisheries science is the development of modernized technologies for growing marketable fish in the lakes of the Urals and Western Siberia, accompanied by a complex of landscape reclamation and an increase in the scale of food production.

So, the progress of Russian commercial fish farming can be accelerated through the effective use of the numerous lakes of the West Siberian Plain on the basis of the introduction of integrated technical and biological reclamation. Moreover, the lake, as a natural object with complex dynamic abiotic and biotic processes, located in a certain area of the physical and geographical landscape, should be perceived as a single entity, which obliges the user of a reservoir engaged in the cultivation of marketable fish to know and take into account limnological and biological production processes in practice. The total annual fish catch (2018-2021) is:

- JSC "Kazan Fish" in the water area of 5.5 thousand hectares of lakes, previously equipped with water regulators - 1000-1100 tons, or an average of 190-210 kg/ha per year;

- "Sladkovskoe commercial fish farm": a) on the intensively developed water area of 8700 hectares the average fish productivity is 135-140 kg/ha, b) taking into account the water area of 8300 hectares - two lakes overgrown with reed, in which fish productivity is on average 75 kg/ha per year, and only on 17.0 thousand hectares of lakes annually produce –1200-1300 tons.

The indicator of labor productivity in terms of the amount of marketable fish catch per one average employee working at the enterprise for a full year is:

- JSC "Kazan Fish" 14-16 tons, in Sladkovo commercial fish farm 11-13 tons. Close to the above-mentioned indicators of average annual fish productivity and labor productivity are approaching in fish farms "SibTheme" and "Fish factory Balyk". It is important to note that the listed fish farms in the Trans-Urals region are large, showing all other modern users the prospect of progress in the "blue field". The majority of users of the "fish breeding grounds" of the Trans-Urals, which have small water areas typical of the region, have integral indicators of catches and fish productivity so far significantly lower.

Thus, in approximately the same natural and ecological conditions of the landscape of the forest-steppe zone of the West Siberian Plain, the production of marketable fish is differentiated on the basis of a set of indicators of zonal fishery bonitet, also on the volume and quality of reclamation and fish breeding works.

Our analysis of the current situation in pasture lake fish farming in the Trans-Urals is focused on increasing the number of effectively operating lake fish farms by introducing new enterprises and modernizing existing ones, and this will allow additional cultivation of:

Tyumen Oblast:

a) realistically, the creation and commissioning of the Bolsheuvat full-system fish farm on the basis of 20 thousand hectares of feeding lakes, which, with the introduction of a zoned polyculture complex, will make it possible to grow 1.6-1.8 thousand tons of marketable fish annually;

b) the creation of the Armizonsky fish farm on the basis of lake Chernoe and adjacent reservoirs with a total water area of more than 25 thousand hectares, will allow to grow annually 1.8-2.0 thousand tons of marketable fish;

c) modernization of low-capacity fish hatcheries operating in STRKH and "Kazan Fish" on lakes Bolshoy Kurtal, Bolshoy Glyaden, Sladkoye and Yarovskoye in order to fully provide the feeding areas available in fish farms with viable fish stock, will ensure the achievement of annual catches of up to 2.0-2.3 thousand tons in each fish farm.

Moreover, in each newly created large fish farm and operating fish farms of

Tyumen Oblast, geothermal waters everywhere in the region should be used to intensify the fish breeding process, as it was long and effectively introduced in the fish farm "Pyshma-96" of Sibrybprom, located in the Tyumen region.

Kurgan Oblast:

a) the creation of a reproduction center for herbivorous fish in Nizhneobrybvod on the basis of lake Orlovo, a cooling reservoir of the Kurgan CHPP, will allow many pasture-type feeding farms to increase their catches of marketable fish;

b) modernization of the Kurgan fish processing plant by creating a pond-basin reproduction center on the basis of lake Shchuchye, will increase the production of marketable fish by 2.0 thousand tons annually;

Chelyabinsk Oblast:

a) the creation of a pond-basin reproduction complex on the basis of lake Treustan will ensure an increase in the annual catch (production) of marketable fish by 1.5-2.0 thousand tons;

b) the creation of a pond-basin reproduction complex on the basis of the Argazinsky reservoir will provide an increase in the annual catch (production) of marketable fish by 2.5-3.0 thousand tons due to the stocking of numerous lakes of the Chelyabinsk Oblast with a high-quality ecological and fishery regime.

Omsk Oblast:

a) it is necessary to create a pond-basin reproduction complex of herbivorous fish and carp on the shore of lake Saltaim-Tenis with an area of 20 thousand hectares, which will increase the production of marketable fish by pasture method by 2.0-2.5 thousand tons per year;

b) the introduction and cultivation of a polyculture complex in the lake with a predominance of carp and grass carp, will make it possible to effectively use the bioproduction process that occurs in the lake along the macrophytic pathway, which prevents the migration of detrital mass into the water column due to the growth of a thick bottom layer of soft aquatic vegetation. These recommendations are presented in works [43-46]. New technological approaches to the fishery use of the biological production process of lake Saltaim-Tenis make it possible to significantly increase the natural fish productivity of the lake ecosystem and increase the catches of farmed fish polycultures using cost-effective pasture technology.

The large-scale development of lake grazing fish farming in the regions of Russia with the presence of favorable ecological and fishery conditions fully corresponds to the tasks of the Federal Agency for Fisheries of the RF, which allows accelerating progress in the "blue field" of our large country [47], shaping the development of national aquaculture and increasing high-quality food, meeting the requirements of the regulation of organic products.

References

1. Mukhachev I.S. Fish farming changes the structure of fishing // Fish industry. 1965. № 12. P. 14-16.

2. Mukhachev I.S. On the principles of selection of fish complexes for growing in lakes of different landscape zones // Proceedings of the Ural branch of SibrybNIIproekt. 1975. V. 9. P. 103-107.

3. Mukhachev I.S. Lake fish farming. M.: VO "Agropromizdat". 1989. 161 P.

4. Mukhachev I.S. Lake commercial fish farming. SPb: Publishing house "Lan". 2013. 400 P.

5. Mukhachev I.S. Increase in fish productivity - a tendency in the development of lake fish farming in the Trans-Urals // Fish farming. 2014. № 6. P. 79-82.

6. Mukhachev I.S. Ecological and Fisheries monitoring of lakes fish farming in the forest-steppe Trans-Urals // International Conference Progress Management and Scientific Developments / Birminfham United Kingdom, December, 19, 2019. Part 2. P. 148-155.

7. Kuchin I.V. Fish farmer's memo. M.-L.: Selkhozgiz, 1931. 152 P.

8. Podlesny A.V. Acclimatization of fish in the Urals and its results // Proceedings of the Ural branch of VNIORKH. 1939. V. 1. P. 86-141.

9. Tironov M.D. On the work of VNIORKh on the acclimatization of fish in the lakes of the Urals // Bulletin of VNIORKH. 1957. V. 39. P. 3-9.

10. Kozmin Yu.A. Thirty years of the Ural branch of GosNIORKh // Proceedings of the Ural branch of GosNIORKh. 1964. Volume 6. P. 3-11.

11. Burdiyan B.G., Mukhachev I.S. Cultivation of marketable fish in lakes (the experience of the Kazan experimental demonstration lake fish farm). M.: Food industry, 1975.-63 P.

12. Mukhachev I.S., Burdiyan B.G., Kugaevskaya L.V. Experience of commercial fish farming in the lakes of Tyumenskaya and neighboring Oblasts. M.: Survey information TSNIITEIRKH, series / Fisheries use of inland water bodies, 1977. Iss. 3. P. 1-100.

13. Shnitnikov A.V. Intrasecular fluctuations in the level of steppe lakes in Western Siberia and Northern Kazakhstan and their dependence on climate fluctuations // Proceedings of the Laboratory of Lake Studies AS USSR. 1950. V. 1. M.-L. P. 129.

14. Shnitnikov A.V. The intrasecular variability of the components of the total moisture content. L.: Science. 1968.- 246 P.

15. Yadrenkina E.N. Structural and functional organization of the fish population in the frozen lakes of Western Siberia. Diss. dr. biol. sci. Tomsk, 2011. 418 P.

16. Berezovsky A.I. Melioration in fisheries. M.-L.: VKOI, 1935.-76 P.

17. Cherfas B.I. Fundamentals of sustainable lake management. M.-L.: KOIZ, 1934. 109 P.

18.Cherfas B.I. Fish farming in natural reservoirs. M.: Pishchepromizdat, 1956. 468 P.

19.Pirozhnikov P.L. Exploration and use of reservoirs in Siberia. M.-L.: Publishing house "Soviet Asia", 1932. 175 P.

20.Naumkina D.I., Rostovtsev A.A., Abramov A.L. Digital heterogeneous dynamic model of growing peled Coregonus peled Gmelin // Rybnoe khozyaistvo. 2020. № 5. P. 80-85.

21.Bagrov A.M., Bogeruk A.K., Verigin B.V., Vinogradov V.K., Gepetskiy N.E., Erokhina L.V., Zolotova Z.K., Kalmykov L.V., Krivtsov V.F., Makeeva A.P., Melnichenkov E.A., Savin G.I., Panov D.A., Chertikhin V.G. A guide to the biotechnology of breeding and rearing of Far Eastern herbivorous fish. M.: VNIIPRKH "IP Complex", 2000. 211 P.

22.Avinsky V.A. Influence of seston-feeding fish (silver carp and silver carp) on ecosystems of water bodies // Rybnoe khozyaistvo. Aquaculture series. TsNITERKH. M. 1991.-Iss. 5. P. 2-49.

23.Levich A.P., Bulgakov N.G., Zamolodchikov D.G. Optimization of forage phytoplankton communities. M.: KMK Ltd., 1996.-137 P.

24.Matishov G.G., Ponomareva E.N., Kovalenko M.V., Tazhbaeva D.S. The practice of aquaculture for pike perch, pilengas, pike of the Azov Sea. Rostov-on-Don: Publishing house of the SSC RAS, 2017. 80 P. ISBN 978-5-4358-0159-0.

25.Dubov V.E. Pilengas – a promising object of fish farming in reservoirs with high salinity // "State and prospects for the development of fish farming in the arid zone": Abstracts. int. scientific. conferences (Azov, June 2006) Rostov-on-Don: Publishing house of the SSC RAS, 2006. P. 42-44.

26.Verigin B.V. General scheme for the development of the principles of fishery intensification and research planning // Issues of ichthyology. 1973. V. 13. Iss. 3 (80). P. 395-407.

27.Vinberg G.G. Goals and objectives of freshwater hydrobiology in the integrated use of water resources. Water resources. 1972. № 3. P.76-102.

28.Kopylov A.I., Kosolapov D.B. Microbial "loop" in planktonic communities of marine and freshwater systems. Izhevsk: LLC "KnigoGrad", 2011. 332 P.

29.Sadchikov A.P., Kozlov O.V. Production of nano and net phytoplankton in three water bodies of different trophicity // Hydrobiological journal. 1993. V. 29 № 1. P.3-9.

30.Sadchikov A.P., Ostroumov S.A. Utilization of dissolved organic matter by microorganisms: the formation of water quality in a high-trophic pond // Fish farming. 2020. № 5. P.25-29.

31.Mirkin B.M., Khaziev F.Kh., Khaziakhmetov R.M. Sestining of agroecosystems: history, concept, constructive approach. Ufa: BNTs UB RAS, 1992. 36 P.

32.Burmakin E.V. On studies of the fishery transformation of lakes by the chemical method. // L.: Bulletin of GosNIORKh. 1967. V. 64. P. 5-18.

33.Kozlov V.I. Agrohydrobiocenoses: terminology, theory, methodology, development in production // Fisheries development of reservoirs for complex purposes. M.: VNIIR. 1990. P. 4-40.

34.Servetnik G.E. Ways of developing agricultural reservoirs), M.: VNIIR, 2004.130 P.

35.Lvov Yu.B. Cluster fish farming as a way to increase the intensity of fish production // Vestnik AGTU. Fisheries series. 1915. № 4. P. 109-120.

36.Zhao Zhiyuan. The future of China is modern ecological fish farming // Materials of scientific events dedicated to the 15th anniversary of the Southern Scientific Center of the Russian Academy of Sciences / All-Russian Scientific Conference. "Aquaculture: world experience and Russian developments. Rostov-on-Don: Publishing house of the SSC RAS, 2017. P. 380-384.

37.Kozlov V.I., Kozlov A.V. Analysis of modern technologies in aquaculture: domestic developments and the experience of China // Fisheries, 2018.- № 1.- P.73-76.

38.Evropytseva N.V., Isakova-Keo M.M. The experience of growing juvenile whitefish, trout and salmon in the ponds of the Keksholm fish hatchery // Proceedings of the laboratory of fish breeding. L.: LSU. 1949. V.2. P.208-228.

39.Bogatova I.B. Fish culture hydrobiology. M.: Food industry, 1980. 168 P.

40.Fedyushin A.V. Possibility of using aquatic invertebrates as forage in animal husbandry // Issues of fisheries in Western Siberia: Abstracts. Omsk, 1959. P. 61-68.

41.Rudenko G.P. Handbook on lake and cage fish farming M.: Light and food industry. 1983. 312 P.

42.Kozlov O.V. Crustaceans of ecosystems of small lakes under conditions of anthropogenic load (on the example of reservoirs of the Ishim plain). Thesis dr. biol. sci. M.: MSU, 2005. 314 P.

43.Sherenkova I.P., Chernukho A.A. Lakes of the Krutinskaya system of Omsk Oblast as a basis for organizing a highly productive fish industry // Lake and pond economy in Siberia and the Urals. Tyumen: SibNIIRKH. 1967.- P. 133-140.

44.Mukhachev I.S., Pivnev I.A., Rybkin V.P. Development of a biological justification for increasing the fish productivity of lakes Ik and Saltaim-Tenis / Report of the SibNIIRKh. Tyumen: SibNIIRKH. 1974. 116 P.

45.Rybkin V.P. Food base of lakes Ik and Saltaim-Tenis and its use by fish // Abstracts of the scientific-practical conference SibrybNIIprokt on the development of the Tyumen fisheries complex. Tyumen: SibrybNIIproekt. 1975. P. 102-103.

46.Mukhachev I.S. Justification of industrial pasture technology for growing marketable fish on the ecological and production potential of Lake Saltaim-Tenis // International Scientific and Practical Conference "Environmental Readings-2018". Part. 2. Omsk, 2018. P. 211-214.

47.Sokolov V.I. Aquaculture: new horizons // RUSSIAN FISH / Yesterday. Today. Tomorrow / № 4 September October 2020. P. 8-15.

DOI 10.34660/INF.2022.41.68.014

人体状态声学分析的新方法

NEW APPROACHES TO THE ACOUSTIC ANALYSIS OF THE STATE OF THE HUMAN BODY

Tikhonenko Daniil Olegovich
CEO BodyVo Technology Ltd
Kalachev Aleksandr Viktorovich
Candidate of Physico-mathematical Sciences, Associate Professor
Altai State University
Tikhonenko Zlata Olegovna
Engineer
BodyVo Technology Ltd

注解。 本文致力于制定一种使用数字医学数学化方法研究人体声学图像的新方法。 特别注意获取与声振动辐射相关的人体内部过程信息的被动方法。

关键词：声学、听诊器、超声（超声波）、相控声天线阵列（PAAA）。

Annotation. *The article is devoted to the formulation of a new approach to the study of the acoustic picture of the human body using mathematized methods of digital medicine. Special attention is paid to passive methods of obtaining information about internal processes in the human body associated with the radiation of acoustic vibrations.*

Keywords: *acoustics, stethoscope, ultrasound (ultrasound), phased acoustic antenna array (PAAA).*

Introduction

As has been repeatedly noted, the implementation of digital technologies in medicine is primarily associated with the" digitization " of data and the accumulation of big data.

On the one hand, this is an understandable trend of medical digitalization, and on the other, it is just a qualitative change, not yet associated with a new approach to the diagnosis of various conditions. In addition, it should be noted that acoustic analysis of medical conditions is usually performed by professional doctors, and for ultrasound – by narrow specialists, while stethoscopy is available to a wide range of medical professionals.

Acoustic analysis, due to its versatility, is a very effective tool for both gen-

eral practitioners and specialists. We distinguish two classes – active research-ultrasound diagnostics (location) and passive listening (stethoscopy). In the future, we will focus on passive methods of analysis due to the fact that they produce a minimal effect on the body. It should be noted that both ultrasound examination and listening (auscultation) is a fairly conservative field and the use of new methods for analyzing audio signals is associated both with this factor and with the lack of models and practices for receiving and analyzing sounds that require high computing power.

ULTRASOUND SCANNERS

Signos RT

Signostics is a pioneer in the field of ultrasound diagnostics and developed its first handheld ultrasound scanner in 2009. The company calls its Signos RT device "the smallest and most convenient handheld ultrasound device in the world." The device has a good image quality with a screen size of 2.7 inches (11.5 x 6.8 x 2.0 cm) and weighs only 400 g. It can be used for obstetric examinations, scanning of the abdominal cavity and heart organs, individual peripheral vessels, determining pneumothorax and pleural effusion. The device can work independently, using its screen, or, if you need a larger display, connect to a laptop or tablet using its own software.

Sonimage P3

Konica Minolta Medical Imaging released its version of the Sonimage P3 miniature ultrasound scanner in 2013. Basically, this is the same Signos RT system, only under a different trademark, released under a license agreement.

DIGITAL STETHOSCOPES

AUMCARDIO

https://aumcardio.com/

The CADence™ system transforms the diagnostic sorting process for clinicians. It is a non-invasive, radiation-free, fast, and portable tool to assist clinicians in evaluating sounds associated with clinically significant coronary artery obstruction, congestive heart failure, and heart valve abnormalities.

The CADence™ system consists of a digital stethoscope used to record heart tones, built-in sensors used to record the electrical activity of the heart (ECG), a one-time patient brochure, and the CADence™ software application. CADence™ software is a clinical decision support tool designed to assist a qualified clinician

in analyzing normal/physiological and pathological heart murmurs after the simultaneous recording of heart tones and ECG.

The device must be used in a clinical setting by trained personnel. CADence's automated heart tone analysis is only important if it is used in conjunction with a doctor's supervision, as well as taking into account all other relevant information about the patient. All corresponding information about the patient should be taken into account before making a diagnosis. The CADence™ system is not supposed to be used as a stand-alone diagnostic device.

Stethee Pro

https://www.stethee.com/

Smart

Easily record and compare heart, lung, and other organ sounds with the Stethee app. Stethee is a powerful tool that helps improve efficiency, productivity, and quality of care.

Versatile

Stethee is very easy to use. Connect the Stethee directly to any wired or wireless Bluetooth headphones. Connect Stethee to your mobile device to instantly record the sounds of your heart, lungs, or other organs. Choose the headphones that best suit your listening style, from extra bass, noise-cancelling, earmuffs, or earplugs. Experience the freedom and versatility the way you want.

Powerful

Inherently powerful, but ultimately easy to use. Stethee devices are equipped with dual-core processors, real-time signal processing, dual-quad heart and respiratory filters, and airlock noise reduction technology that works collectively to deliver incredible amplification for a truly outstanding listening experience. With a lithium-ion rechargeable battery that lasts up to two days of normal use on a single charge, the Stethee is without a doubt the most technologically advanced stethoscope ever created.

Thinklabs One

https://www.thinklabs.com/

The Thinklabs One digital stethoscope revolutionizes the teaching of medicine. A powerful tool for learning the art and science of auscultation, used in leading medical schools all across the country, gives educators the freedom to create new ways to teach this crucial skill.

Project history: from CARDIOM to THE VOICE OF THE BODY
(BodyVo)

CARDIOM

The primary project, in fact, the development of an economical model of a digital stethoscope, was the **CARDIOM** project. The essence of the project was to listen to the sounds of the heart through the microphone of a mobile device and save audio recordings corresponding to the sounds of the heart.

Then the matching of the heart sounds and the ECG was created. Primary data were collected from cardiologists. The patient came to the doctor for an ECG, the doctor used an electronic stethoscope to record the sound of the heart and the current ECG of the patient's heart. But since one doctor could provide data for 30-50 patients, and for a high-quality database of matches, data from tens of thousands of patients was needed, the project turned out to be technically difficult to implement.

Echograph "RuCore 24/7"

Further development of the project was to create a device with three microphones to place it on the stomach of a pregnant woman. With the help of the received sounds, a 3D model of the baby's fetus was made, its location in the womb. This device was named **RuCore** - a universal passive echograph with a wide range of applications from personal to specialized clinics. The echograph provides the doctor with the recorded audio information to listen to and provides an integrated set of information for the doctor and the patient (for home use). The device is suitable for telemedicine when sending an audio file for analysis to a specialist.

The following layout of the device was developed which consisted of jockstrap or boxer briefs, containing three microphones with nonspherical radiation pattern (to determine the exact direction of the sound (plus the light phase), the ultra-low frequency sensor, the body contact the sensor, the wheel with the opisometer to determine the movement of the body sensor block in space and the data transmission unit and the button "Start measurement".

All measurements are displayed on a three-dimensional figure of a person and the places of recommended application of the device are displayed on the figure in colour.

The measurements are carried out with the movement of the device through the body and with the accumulation of data on the figure, starts to dynamically display the heart and lungs, and major blood vessels, giving the sound and echo, displays the fetal heart that allows you to simulate the position of the fruit in the space. Additionally, the fetal and maternal pulse correlations are measured and a Doppler model of blood flow is built.

Initially, the device is calibrated - it moves around the body and gives the layout real dimensions (this makes it possible to record changes in the figure during pregnancy).

The difference from the existing device is the visualization of the organs (including the heart of the mother and fetus for pregnant women) in understandable for layman graphical model.

There are technical differences such as determining the direction to the sound source, taking into account the position of the device in space, high sampling rate to preserve the signal characteristics.

The project of a phased acoustic antenna array

The development of the project is a precision study of the parameters of acoustic signals. The technical implementation is carried out by placing an array of **n** by **m** compact microphones on the body-fitting t-shirt (in the case of the layout-21 microphones). The sound from these microphones is transmitted to the smartphone and processed on it.

Initially, for receiving acoustic signals, a microphone array of 7×3 microphones is used that is in tight contact with the body.

The resulting device is a phased acoustic antenna array (PAAA) for the acoustic signal. The signal is recorded at a frequency of at least 44 kHz with a bit depth of 8 and stored on external storage. The data volume is approximately 1 MB/min.

Analysis of the spectrum (primarily the phase of the signal) will allow you to determine the direction and distance to all sound sources. Thus, **the following important parameters of the internal organs can be determined:**

- the main heart rate and pulse variability;
- work of the ventricles of the heart;
- basic breathing cycle for each lung;
- inhomogeneities and fluids in the lungs;
- movement of blood in the aorta and arteries.

After processing the signals, you can build:

- dynamic 3D model of the heart and lungs;
- blood circulation model with a calculation of blood pressure function.

For pregnant women:

- the heartbeat of the fetus and its position.

In the future, by studying the harmonics of the spectrum of acoustic signals of PAAA signals, we can determine the places of reflection of sound waves and establish:

- places of the appearance of tumours;
- problems with the intestines,
- blood clots in the blood vessels.

The analysis of the sources of acoustic signals

The phased array acoustic antenna (PAAA) allows you to accurately set the direction of the audio signal while operating with a part of the array makes it possible to calculate the points of intersection of the directions in space. To do this, you need to divide the PAAA into three (at least) sublattices. Then the intersection of the three rays in space will accurately give the location of the sound source.

These sources are:

- the ventricles and valves of the heart;
- bronchial channels;
- areas of sound abnormalities of blood vessels (narrowing or dilation), which give a pulse wave difference and are also the source of the sound.

When the body moves (walking, running, exercise), the position of the sound sources (the heart and its parts) changes, which allows you to create a dynamic three-dimensional model, which is also fundamentally new.

For pregnant women, you can create a unique picture of the change in the position of the fetus over time, focusing on the position of its heart.

The synphase of the heart of the mother and fetus is very important, according

to this parameter at an early stage, you can diagnose many problems of growth and development of the fetus, as well as the post-natal period of its life.

The reflections of sound waves are easily identified by the phase change. Reflections will allow you to see:

- fluid in the lungs;
- heterogeneities in the tissues;
- seals in the liver and kidneys.

This solves the problem of early diagnosis:

- tumours;
- intestinal obstruction and adhesions;
- the presence of cysts.

Fundamentals of a mathematical model of the antenna array

We will consider PAAA as an analogue of a digital antenna array (DAA) (antenna array with digital signal processing) which is an antenna array[1] [1] with element-by-element signal processing, in which the signals from the emitting elements are subjected to analogue-to-digital conversion with subsequent processing according to certain algorithms [2].

A more general definition of DAA involves digital diagramming for both reception and transmission of signals.

Thus, a digital antenna array (DAA) is a passive or active antenna system, which is a set of digital analogue (digital-to-analogue) channels with a common phase centre, in which the radiation pattern is formed digitally, without the use of phase shifters [2]. In foreign literature, the equivalent terms *digital antenna array* or *smart antenna* are used [3].

In our case, the DAA works in the acoustic range and on reception.

The difference between a DAA and a type of active phased array antenna (APAA) is in the methods of information processing. The APAA is based on the receiving and transmitting module (RTM), which includes two channels: receiving and transmitting. Each channel has an amplifier, as well as two devices for controlling the amplitude-phase distribution: a phase shifter and an attenuator.

In digital antenna arrays, a digital transceiver module is installed in each channel, in which the analogue signal amplitude and phase control system is replaced by a digital signal synthesis and analysis system (DAC/ADC) [2][4][5][6][7].

The theory of digital antenna arrays (DAA) was born as a theory of multichannel analysis (Multichannel Estimation) [8] [9]. Its origins date back to the 1920s with methods for determining the directions of arrival of radio signals by a combination of two antennas based on the phase difference or amplitudes of their

[1]An antenna array is a set of emitting (in our case, receiving) elements arranged in a certain order, oriented and stimulated so as to obtain a given radiation pattern.

output voltages. At the same time, the directions of arrival of a single signal were estimated based on the indications of arrow indicators or the shape of Lissajous figures on the oscilloscope screen.

In the late 1940s, this approach led to the emergence of the theory of three-channel antenna analyzers, which provided a solution to the problem of separating the signals of an aerial target and the "antipode" reflected from the underlying surface by solving a system of equations formed from the complex voltages of a three-channel signal mixture [11]. The results of experimental measurements using a similar three-antenna device were published by Frederick Brooks in 1951[12].

The growing complexity of solving such radar problems by the end of the 1950s created the prerequisites for the use of electronic computer technology in this field [8]. [9].

In 1957, an article was published by Ben S. Melton and Leslie F. Bailey [13], which proposed options for implementing algebraic operations for signal processing using electronic circuits that are their analogues, in order to create a machine correlator (a machine correlator) or a mechanical computer for signal processing based on an analogue computer.

The arrival of digital technology to replace analogue computing means literally three years later, in 1960, was embodied in the idea of using a high-speed computer to solve the direction-finding problem, initially in relation to determining the location of the epicentre of an earthquake [8] [9]. Among those who first implemented this idea in practice, it should be attributed to B. A. Bolt [14], who wrote a program for IBM 704 on seismic direction finding based on the least squares method. Almost synchronously with him, a similar approach was used by an employee of the Australian National University, Flynn [15].

Apparently, in the USSR first drew attention to the potential of multichannel analyzers Polikarpov B. I. [16] He considered the analyzers phase-type with equal or a multiple of the distance between the phase centres of channels, the outputs of which voltage are subjected to correlation processing, and use of computers is determined by the angular coordinates of the sources. Polikarpov B. I. pointed out the fundamental possibility of resolving signal sources with an angular distance less than the width of the main lobe of the antenna system radiation pattern [8] [9].

However, a concrete solution to the problem of superrayleigh resolution of radiation sources was proposed only in 1962 by Varyukhin V. A. and Zablotsky M. A., who invented an appropriate method for measuring the directions to the sources of the electromagnetic field [17]. This method was based on processing the information contained in the distribution of complex voltage amplitudes at the outputs of amplitude, phase, and phase-amplitude multichannel analyzers, and allowed determining the angular coordinates of sources located within the width of the main lobe of the receiving antenna system [8] [9].

Later, V. A. Varyukhin developed a general theory of multichannel analyzers based on the processing of information contained in the distribution of complex voltage amplitudes at the outputs of the antenna array [9]. This theory considers ways to determine the angular coordinates of sources depending on the angular distances between them, the phase and energy relations between the signals, as well as the functional schemes of devices that implement theoretical conclusions. The source parameters are determined by directly solving systems of high-order transcendental equations describing the response function of a multichannel analyzer. The difficulties encountered in solving systems of high-order transcendental equations were overcome by V. A. Varyukhin by "separating" the unknowns, in which the determination of angular coordinates is reduced to the solution of two or even one equation, and the determination of complex amplitudes is reduced to the solution of linear systems of equations of order N [18].

Of course, concluding the priority and importance of certain scientific approaches in the process of forming a general theory of the DAA is a thankless task, given the closed nature of most of the works and the lack of opportunities for detailed acquaintance with the scientific heritage of that time. The historical excursus described here only lifts the veil of time over the development of scientific research and was intended to indicate the general niche and time frame of the origin of the theory of multi-channel analysis against the historical background. A detailed description of the historical stages of the development of the theory of DAA deserves separate consideration.

Here we briefly consider the receiving channel of the DAA and PAAA. The basis of the receiving channel is the ADC [21] [22]. The analogue-to-digital converter replaces two devices in the analogue implementation of the active module: a phase shifter and an attenuator. The ADC allows you to switch from analogue to digital representation of the signal for further analysis in the digital signal processing scheme.

For the correct operation of the ADC, there are also two more devices in the channel.

Low Noise Amplifier (LNA) [21][22] raises the signal amplitude to the required level for further digitization.

A receiver protection device in the simplest case is a conventional spark gap or limiter that does not allow to overload the receiving channel with a high signal level (interference).

Frequency conversion in the DAA.

When working with signals whose digitization or digital-to-analogue conversion at the carrier frequency is inefficient (insufficient bit depth and channel capacity of the existing ADC/DAC, their high power consumption, etc.), one or more intermediate frequency conversions can be performed in the CAR [21] [22].

It should be noted that any frequency conversion introduces additional errors in signal processing and reduces the potential characteristics of the DAA.

Conclusions

A new approach to acoustic analysis allows us to solve a lot of problems in the field of medical diagnostics. In particular, for acoustic DAA and PAAA, it is possible to identify and locate objects inside the body, the size of which is much smaller than the length of sound waves, which is quite a revolutionary result.

This is the advantage of digital medicine, which relies on mathematical methods, including in the field of signal processing – to get outstanding results of accuracy and depth of diagnostics, which will not only improve the quality of diagnostic procedures but also make them more understandable and accessible.

References

1. Inter-State standard 23282-91. Antenna arrays. Terms and definitions.

2. Slyusar, V. I. Basic concepts of antenna theory and technology. Antenna systems of Euclidean geometry. Fractal antennas. SMART antennas. Digital antenna arrays (DAA). MIMO systems based on the DAA. Sections 9.3 - 9.8 in the book "Broadband wireless data transmission networks". / Vishnevsky V. M., Lyakhov A. I., Portnoy S. L., Shakhnovich I. V.-M.: Technosphere. – 2005. C. 498 – 569 (2005).

3. Slyusar, V. I. Smart-antennas went into the series. Electronics: science, technology, business. - 2004. - No. 2. C. 62-65 (2004).

4. Slyusar, V. I. Digital diagram formation - basic technology of advanced communication systems. Radioamator. - 1999. - No. 8. C. 58-59 (1999).

5. Slyusar, V. I. Digital beam formation in communication systems: the future is born today. Electronics: science, technology, business. - 2001. - No. 1. C. 6-12 (2001).

6. Slyusar, V. I. Digital antenna arrays: the future of radar. Electronics: science, technology, business. - 2001. - No. 3. C. 42-46. (2001).

7. Slyusar, V. I. Digital antenna arrays: aspects of development. (link not available). Special equipment and weapons. - February, 2002. - No. 1,2. p. 17-23. (2002). Accessed June 4, 2014. Archived from the original on December 23, 2018.

8. Slyusar V. I. Origins of the Digital Antenna Array Theory. // International Conference on Antenna Theory and Techniques, 24-27 May, 2017, Kyiv, Ukraine. — Pp. 199—201. [1]

9. Slyusar V. I. Development of CAR circuit engineering: some results. Part 1. / / The first Mile. Last mile (Appendix to the journal "Electronics: Science, Technology, Business"). — N1. — 2018. — C. 72 — 77 [2]

10.H. T. Friis. Oscillographic Observations on the Direction of Propagation and Fading of Short Waves. // Proceedings of the Institute of Radio Engineers. — May 1928. — Volume16, Issue 5. — Pp. 658—665

11.E. W. Hamlin, P. A. Seay, •W. E. Gordon• A New Solution to the Problem of Vertical Angle-of-Arrival of Radio Waves. // Journal of Applied Physics. — 1949, Vol. 20. — Pp. 248—251)

12.Frederick E. Brooks. A Receiver for Measuring Angle-of-Arrival in a Complex Wave. // Proceedings of the I.R.E.- April, 1951. — Pp. 407—411)

13.Ben S. Meltont and Leslie F. Bailey. Multiple Signal Correlators. // Geophysics. — July, 1957. — Vol. XXII, No. 3. — Pp. 565—588

14.B. A. Bolt. The Revision of Earthquake Epicentres, Focal Depths and Origin-Times using a High-speed Computer. //Geophysical Journal. — 1960, Vol. 3, Issue 4. — Pp. 433—440

15.E. A. Flinn. Local earthquake location with an electronic computer. //Bulletin of the Seismological Society of America. — July 1960. — Vol. 50, No. 3. — Pp. 467—470

16.Polikarpov B. I. On some possibilities of using independent channels for receiving signals and using electronic computing equipment to improve the noise immunity and resolution of radar measurements//Collection "Express-information", BNT, No. 23, 1961

17.A. S. USSR No. 25752. A method for measuring the directions to the sources of the electromagnetic field. //Varyukhin V. A., Zablotsky M. A.-1962

18.Varyukhin V. A., Kasyanyuk S. A. On a method for solving nonlinear systems of a special type. - Journal of Computational Mathematics and Mathematical Physics, Edition of the USSR Academy of Sciences, No. 2, 1966

19.Marple-ml. S. L. Digital spectral analysis and its applications. Trans. from English. - Moscow, Mir, 1990. - 584 p.

20.Minochkin A. I., Rudakov V. I., Slyusar V. I. Fundamentals of military-technical research. Theory and Applications.Vol. 2. Synthesis of information support tools for weapons and military equipment. //Edited by A. P. Kovtunenko. - Kiev: "Granmna". - 2012. - p. 7-98; 354-521 [3]

21.Slyusar, V. I. Ideology of building multi-standard base stations of broadband communication systems. Izvestiya vuzov.Ser. Radio electronics. - 2001. - Volume 44, No. 4. C. 3-12. (2001).

22.Slyusar, V. I. Multistandard communication: problems and solutions. Radioamator. - 2001. No. 7-C. 54-54, No. 8. - C. 50 - 51. (2001).

23.Method of acoustic analysis of the state of the body. Application for the invention PCT/RU2021/000156, PCT/RU2021/000444, PCT/RU2021/000457.

DOI 10.34660/INF.2022.36.49.015

铝土矿渣（赤泥）中铝的非高压釜碱浸
NON-AUTOCLAVE ALKALINE LEACHING OF ALUMINUM FROM BAUXITE RESIDUE (RED MUD)

Htet Ye Aung
postgraduate
Boyarintsev Alexander Valentinovich
Candidate of Chemical Sciences, Associate Professor
Stepanov Sergey Illarionovich[3]
Doctor of Chemical Sciences, Full Professor
Mendeleev University of Chemical Technology
Moscow, Russia

抽象的。 本文介绍了在包括初步机械活化在内的各种条件下，使用氢氧化钠溶液对 Bogoslovsky 铝厂（俄罗斯）填埋赤泥样品中的铝进行非高压釜碱性直接浸出的实验室测试结果。 已经建立了一个基本的可能性，并且已经确定了允许从赤泥中额外提取多达 20–25% 的铝的条件。

关键词：铝、铝土矿渣、赤泥、氢氧化钠、浸出

Abstract. *The article presents the results of laboratory tests on non-autoclave alkaline direct leaching of aluminum from samples of landfilled red mud of the Bogoslovsky Aluminum Plant (Russia) with sodium hydroxide solutions under various conditions, including preliminary mechanical activation. A fundamental possibility has been established and conditions have been determined that allow for the additional extraction of up to 20–25% of aluminum from red mud.*

Keywords: *aluminum, bauxite residue, red mud, sodium hydroxide, leaching*

Currently, it seems relevant to solve the problem of involving alternative, man-made, raw materials sources of rare earth elements and other metals in the reprocessing, in particular, waste from the wet magnetic separation of iron-vanadium ores, red mud (RM), ash-and-slag waste produced during the combustion of coal, and many others technogenic mineral raw materials.

Red mud is a toxic, insoluble waste of alumina production, which is a significant problem for both the manufacturer and neighboring territories, posing a threat to the population and the environment. On the one hand, there is currently no ef-

fective technology for the utilization of RM. On the other hand, there is a steady trend towards increasing alumina production and, consequently, an increase in the volume of RM. At this time, over 1.5 billion tons of RM have already accumulated in the world [1]. Such volumes pose a real environmental threat to the territories adjacent to the tailing ponds.

In several works [2–4], RM is considered raw material for producing compounds of aluminum, iron, titanium, scandium, zirconium, yttrium, and other metals. Initially, the main research was carried out in the direction of the development of new methods of RM reprocessing for improved recovery of alumina and alkali [2]. It was proposed to carry out special operations with additives at the stage of bauxite ore leaching or to apply the hydrothermal treatment of the RM itself. Currently, the focus is on issues related to the complex reprocessing of RM, with the recovery of the most valuable useful components. The most significant efforts are being paid to the recovery of scandium. This metal has not only a high economic value but is also extremely important in terms of technical application [3,4]. Red mud can serve as an important industrially significant source not only scandium (0.010%) but also of titanium (TiO_2 – 2.65%), vanadium (V_2O_5 – 0.15%), niobium (0.002%), zirconium (ZrO_2 – 0.12%), gallium (0.005%), yttrium (0.030%), lanthanides (Ln_2O_3 – 0.14%), the recovery of which can be cost-effective only with complex processing. There is a need to develop such a technology, which will allow the recovery of the maximum number of valuable components from the RM and direct the very basis for use in related industries.

A significant contribution to alumina production economics can be made by the additional recovery of alumina from RM, which contains about 13.5% $A1_2O_3$. When part of alumina is extracted in the process of alkaline reprocessing of RM, there is an increase in the scandium, iron, and other valuable components content that is not soluble in NaOH solutions will occur, which can be simplifying their further reprocessing. For example, partially dealuminated RM with an iron content of 50–60% can be directed to the production of pellets in ferrous metallurgy. Autoclave processes are used to recovery aluminum from bauxite and red mud in alkaline media. Autoclave processes are characterized by increased energy costs. Non-autoclave processes can be considered alternative processes. Such processes make it possible to extract an additional part of aluminum from the source material.

This research aimed to study the process of non-autoclave leaching of aluminum from red mud with aqueous solutions of sodium hydroxide.

The raw material used for this research was represented by air-dried, landfilled RM of the Bogoslovsky Aluminum Plant (SUAL Branch), obtained during the reprocessing of bauxites from the Sredne-Timansky field (Komi Republic, Russia) by the combined Bayer sintering process. The chemical composition was deter-

mined by the ICP–MS method in the unit of iCAPTM Q (Thermo Fisher Scientific, USA). The major elements in the original RM sample used are Fe, Al, Si, Ca, Na, and Ti, whose content (expressed in terms of oxides) are shown in Table 1. Residual water content in the RM sample was not higher than 0.5 wt.%.

Table 1.

Major components composition in the original red mud sample

Compound	**Fe_2O_3**	**Al_2O_3**	**SiO_2**	**CaO**	**Na_2O**	**TiO_2**
wt., %	42.1	12.7	9.4	7.8	4.8	4.3

The red mud sample also contained trace elements, including Sc, Y, Ln, Zr, Nb, Hf, and Ga (see Table 2).

Table 2.

Micro-components composition (g ton^{-1}) in the original red mud sample

Zr	**Nb**	**Hf**	**Sc**	**Y**	**Ce**	**La**	**Pr**	**Nd**	**Sm**	**Gd**
1036.6	83.1	25.7	86.0	145.4	507.5	234.4	57.5	222.4	42.6	43.5
Eu	Tb	Dy	Ho	Er	Tm	Yb	Lu	Ga	Th	U
8.0	5.2	31.0	5.7	16.6	2.3	15.0	2.2	51.4	65.1	14.6

The granulometric composition of RM was as follows: 180 microns – 36.6%, 125–180 microns – 29.2%, 90–125 microns – 17.0%, 63–90 microns – 15.4%, 45–63 microns – 2.6%, 45 microns – 0.2%.

According to XRD data, the presence of the following mineral phases in the RM composition was identified: hematite, perovskite, titanium dioxide, diaspore, calcite, laumontite, sodium alumino-silicate hydrate of cancrinite type, and mineral phases of calcium sodium aluminum oxide, calcium aluminum oxide silicate hydrate.

Aluminum leaching from the RM samples with NaOH solutions was carried out in a stainless steel reactor equipped with a mechanical stirrer lined with fluoroplastic. The rector was installed in a glycerin bath, heated by an electric stove. The temperature was monitored and maintained using a contact thermometer and an electric heating interrupter relay. The reactor was also equipped with a reverse refrigerator. The required amount of NaOH solution was placed in the reactor, heated to a temperature of 85–120°C, and, with intensive stirring, an RM was added in portions. The RM suspension temperature was maintained with an accuracy of ±1–5°C. A part of RM suspension for analyses was unloaded from the reactor through the outlet without stopping the agitator in kinetic experiments. The

total volume of all samples of the selected suspension did not exceed 10% of the bulk of the reaction mixture.

The aluminum concentration in alkaline solutions was determined by the titrimetric method with zinc acetate. The concentration of silicon in alkaline solutions was determined by the spectrophotometric method, based on the formation of a yellow silicon-molybdenum complex, its reduction by ascorbic acid to silicon-molybdenum blue complex, and measurement of the optical density of the colored solution. The optical density was measured at 825 nm. The equation [Si] = 10.3·Di + 0.98, R = 0.98 was used to calculate the silicon concentration.

When studying the kinetics of aluminum leaching from RM with NaOH solutions, it was found that in 240–300 min, the system reached equilibrium, Table 3. It was also found that aluminum leaching yield (α_{Al}) increases from 5% to 16% with an increase in NaOH concentration from 0.5 mol/L to 4.0–7.0 mol/L.

Table 3.

Kinetic data of aluminum leaching from red mud with aqueous NaOH solutions at S/L = 1/5 and 85°C

τ, min	α_{Al}, wt%				
	0,5 mol/L NaOH	1,0 mol/L NaOH	2,0 mol/L NaOH	4,0 mol/L NaOH	7,0 mol/L NaOH
0	0.0	0.0	0.0	0.0	0.0
15	3.5	4.0	4.7	5.8	5.9
30	4.0	4.4	5.3	7.0	7.8
45	4.5	4.9	6.6	7.3	8.3
60	4.8	5.3	6.8	8.4	9.9
90	4.9	6.0	7.0	10.2	11.5
120	5.2	6.3	8.0	11.5	12.7
150	5.3	6.7	8.4	13.2	14.1
180	5.4	6.8	8.9	14.4	14.7
240	5.4	6.7	9.4	15.7	16.1

When the process temperature increased from 85°C to 100–120°C, the α_{Al} per step increased by 2–5% (see Table 4). An increase in NaOH concentration from 4.0 mol/L to 10 mol/L did not significantly rise in α_{Al}. With 2-stage leaching, the α_{Al} for two stages was 20–25% under conditions of 4.0 mol/L NaOH and 100°C. Also, when studying leaching at various solid-to-liquid mass ratios (S/L), it was found that with changes in S/L from 1/3 to 1/10 in favor of the liquid phase, α_{Al} increased by 5–7%.

Table 4.

Kinetic data of aluminum leaching from red mud with aqueous solutions of NaOH at S/L = 1/5

τ, min	α_{Al}, wt%										
	0	**15**	**45**	**75**	**105**	**135**	**165**	**195**	**225**	**255**	**285**
4,0 mol/L NaOH, 100°C	0,0	4,7	6,3	6,8	7,9	9,4	11,5	14,2	15,3	16,3	16,8
10,0 mol/L NaOH, 120°C	0,0	10,5	13,1	13,6	14,7	15,2	16,0	16,8	16,8	16,9	16,8

Preliminary mechanical activation of RM leads to an increase in α_{Al} up to 24%. At the same time, the processing time is reduced to 30 min. The kinetic curve of aluminum leaching passes through the maximum at 10–25 min (see Table 5).

Table 5.

Kinetic silicon and aluminum leaching data from mechanically activated red mud with aqueous NaOH solutions. Conditions: 7.0 mol/L NaOH at S/L = 1/5, 85°C. Mechanical activation conditions: Pulverisette 5, mass ratio grinding bodies/sample RM = 10/1, activation time 30 min, centrifugal acceleration – 20g, grinding bodies – steel balls with D = 25 mm

τ, min	**[Si], g/L**	**α_{Si}, wt%**	**[Al], g/L**	**α_{Al}, wt%**
0	0.0	0.0	0.0	0.0
5	0.6	13.1	1.0	14.0
10	0.7	15.8	0.9	15.2
15	0.6	14.2	0.9	19.0
20	0.6	12.9	1.2	20.5
25	0.5	11.5	1.3	22.8
30	0.6	11.0	1.3	21.7
60	0.4	9.8	1.1	19.3
90	0.4	9.3	1.1	18.8
120	0.4	9.1	1.1	18.0
150	0.4	8.4	0.7	16.0
180	0.4	8.3	0.9	14.8
210	0.3	7.5	0.9	14.8
240	0.4	7.7	1.3	14.8

The decrease in the aluminum content in the alkaline solution with an increase in the mixing time of the RM suspension is apparently due to the formation of

poorly soluble hydroaluminosilicates that fall out as secondary precipitation [5]. This is confirmed by the data on silicon leaching in this system.

The developed option of alkaline leaching allows for the additional extract of up to 20–25% of aluminum from the red mud. The resulting aluminum-containing alkaline solutions can be used in the main Bayer process. In addition, aluminum from alkaline solutions can be extracted by hydrolytic polymerization during CO_2(gas) saturation of the red mud suspension and obtaining sodium hydroaluminocarbonate, suitable for further processing into aluminum-based products. The developed stage of alkaline leaching of aluminum from red mud is one of the main stages of the alternative complex reprocessing of Bogoslovsky Aluminum Plant red mud, which is being developed in the Russian Federation [6,7].

Acknowledgments

The work was supported by the Mendeleev University of Chemical Technology. Project № T–2020–009.

References

1. Hausberg J. et al. Evaluation of bauxite availability, in Anjier, T.L. (ed.): Proceedings Light Metals 2001/TMS. Warrendale, USA. 2001. pp. 91–96.

2. Grachev V. V. Opredelenie razlichnyh form sery v gidroalyumosilikatah natriya i krasnyh shlamov. Cvetnaya metallurgiya. 1986. № 1. pp. 30–32. (in Russian)

3. Sabirzyanov N. A.; Yatsenko S. P. Hydrochemical methods of complex processing of bauxite. URO RAS: Yekaterinburg, Russian Federation. 2006. (in Russian)

4. Anashkin V. S., Fomin E. S., Yatsenko S. P. Development of technological schemes for waste-free and complex processing of low-quality bauxite and red mud, in Proc. II International Scientific practice Conferences "Metallurgy of light metals, problems and prospects, Moscow, 22-23 November, 2006, pp. 41–45. (in Russian)

5. Tumanov Yu. N. New generation electrical technologies in the production of inorganic materials: ecology, energy conservation, quality. Fizmatlit: Moscow, Russian Federation. 2013. (in Russian)

6. Alexander Boyarintsev, Htet Ye Aung, Sergey Stepanov, Andrei Shoustikov. Complex reprocessing of industrial alkaline waste of alumina production (red mud) for solving raw materials and environmental problems. E3S Web of Conferences. 2021. Vol. 258. Article number 08026. DOI: 10.1051/e3sconf/202125808026.

7. Alexander V. Boyarintsev, Htet Ye Aung, Sergei I. Stepanov, Andrei A. Shoustikov, Pavel I. Ivanov, Vladimir G. Giganov, Evaluation of main factors for improvement of scandium leaching process from Russian bauxite residue (red mud) in carbonate media, ACS Omega, 2021. DOI: 10.1021/acsomega.1c04580.

DOI 10.34660/INF.2022.64.38.016

二氧化锰电化学控制方法的开发
DEVELOPMENT OF METHODS FOR ELECTROCHEMICAL CONTROL OF MANGANESE DIOXIDE

Lipliavka Miroslav Viktorovich
Undergraduate

Lipkin Mikhail Semyonovich
Doctor technical sciences, Full Professor, Head of Department

Lipkina Tatyana Valeryevna
Candidate technical sciences, Associate Professor

Platov South-Russian State Polytechnic University, Novocherkassk, Russia

抽象的。已经提出并测试了一种基于二氧化锰与有机络合剂 N-甲基吡咯烷酮溶液相互作用的二氧化锰电化学控制技术。研究了两种不同二氧化锰样品的相组成，发现它们属于不同的结晶变体，即 ε-MnO2（阿钾锰矿）和 β-MnO2（软锰矿）。通过循环伏安法对锰与 N-甲基吡咯烷酮的络合物在铂和石墨上的溶液中的阴极和阳极过程进行伏安法研究。已经测量了锂-二氧化锰电池中阿赫金钛矿和软锰矿的比容量，并且已经做出假设来解释二氧化锰的各种晶体学变体的特定电化学特性的差异。

关键词：循环伏安法，ε-MnO2 (achtenskite)，β-MnO2 (pyrolusite)，晶体学修饰，锂-二氧化锰，N-甲基吡咯烷酮配合物，锰配合物，电化学控制。

Abstract. *A technique for the electrochemical control of manganese dioxide based on its interaction with a solution of the organic complexing agent N-methylpyrrolidone has been proposed and tested. The phase compositions of two different manganese dioxide samples were investigated, and it was found that they belong to different crystallographic modifications, ε-MnO_2 (akhtensite) and β-MnO_2(pyrolusite). Voltammetric studies of cathodic and anodic processes in a solution of a complex of manganese with N-methylpyrrolidone on platinum and graphite were carried out by the method of cyclic voltammetry. The specific capacities of akhtinskite and pyrolusite in a lithium - manganese dioxide cell have been measured, and assumptions have been made to explain the difference in the specific electrochemical characteristics of various crystallographic modifications of manganese dioxide.*

Keywords: *cyclic voltammetry, ε-MnO_2 (achtenskite), β-MnO_2 (pyrolusite), crystallographic modifications, lithium - manganese dioxide, N-methylpyrrolidone complex, manganese complex, electrochemical control.*

Introduction

Manganese dioxide is a cathode material of widespread primary elements manganese dioxide-lithium [1]. The specific characteristics of these elements, as well as self-discharge during storage, are determined by the operation of the cathode material[2]. Manganese dioxide can exist in the form of several crystallographic modifications (α-, β-, γ-, δ-, λ-, ε-, η-) [3]; the structure of many of them includes water molecules and ions of other metals (primarily alkaline) [4], located in tunnels or between layers formed by [MnO_6] octahedra. The specific capacity and self-discharge of the cathode depend on the crystal-chemical structure of the dioxide used, and to a large extent on the phase and chemical composition of the surface layers of the material. This part of the material turns out to be especially problematic for the application of many modern physicochemical methods of analysis, but it is this part that determines the electrochemical activity of the cathode material. [5–7] The surface of manganese dioxide particles can contain excess oxygen and defects in the manganese sublattice, which affects the formation of a polyfunctional layer during operation and can, on the one hand, limit the specific capacity for kinetic reasons, and on the other hand, lead to self-discharge during storage with decomposition of the electrolyte, the action of decomposition products on the lithium anode and an increase in pressure inside the cell body The currently existing methods for measuring the specific capacity are based on the discharge of cell layouts, which is a rather laborious procedure, depending on the macrostructure of the cathode and the purity of the electrolyte used. In this regard, it is of interest to develop methods for monitoring manganese dioxide, which would use less labor-intensive operations and exclude the influence of the macrostructure on the test results. Such methods can be based on electrochemical phase analysis using paste electrodes or cells of a clamping structure, however, methods based on the preliminary chemical interaction of the test material with a complexing aqueous-organic medium with subsequent voltammetric analysis of the products seem to be no less interesting. One of the variants of the complexing medium is a mixture of N-methylpyrrolidone with hydrochloric acid. Complexes of NMP with cadmium [8], and iron [9], ions are known, and, therefore, can be considered as a complexing agent for manganese ions. The aim of this work was to test this technique in comparison with the results of XRD and cycling in the model of the element.

Experimental part

The measurements were carried out on a P-40X digital potentiostat in the cyclic volt-ampere sweep (CVA) mode [10]. The electrolyte was a 1:1 mixture of

0.1 M hydrochloric acid and n-methylpyrrolidone, where n-methylpyrrolidone is a complexing agent, and hydrochloric acid is an electrically conductive additive.

The applied electrochemical cell consisted of a platinum and glassy carbon working electrode, a glassy carbon auxiliary electrode, and a silver chloride reference electrode. A 100 mg weighed portion of manganese dioxide was poured into the cell, poured with electrolyte, stirred for 12 hours, and after complete precipitation of the solid phase of the suspension, measurements were made.

Specific capacity measurements and calculations were also carried out, and X-ray phase analysis (XPA) was performed on ARLX'TRA Thermo Fisher Scientific.

We investigated enriched natural pyrolusite, which is (XPA) ε-MnO_2, (achtensite) and electrolytic manganese dioxide, EDM, identified by XPA as β-MnO_2 (pyrolusite) according to X-ray phase analysis (XPA) data.

Results and discussion

The investigated materials about the discharge in the model of the lithium-manganese dioxide cell showed significantly different specific discharge capacity. According to the measurement data of the specific capacity, β-MnO_2 has a specific capacity of 126 Ah/kg, and ε-MnO_2 – 207 Ah/kg.

In measurements in a solution of NMP - hydrochloric acid on the cathode part of the CVA of the background electrolyte (fig. 1), two maxima are observed at potentials of about -0.1 and -1.5 V, corresponding to the cathodic reduction of NMP. After the interaction of the solution with a weighed portion of manganese dioxide, a maximum appears on the curve at much more negative potentials, about -2 V and at high currents, which can be associated with the reduction of complex manganese ions with NMP. On the anodic branch in the background solution and in solutions after interaction with manganese dioxide, the limiting current corresponds to potentials of 1 V, which refers to the oxidation of manganese obtained in the cathode part together with the anodic oxidation of NMP.

As follows from the data presented, the limiting currents both at the cathodic and anodic parts of the CVA in the region of the potentials for the reduction of complex manganese ions and subsequent oxidation are higher for β-MnO_2 than for ε-MnO_2. This means that β-MnO_2 dissolution occurs to a greater extent than ε-MnO_2, which is associated with the peculiarities of its crystal chemical structure. It can be assumed that ε-MnO_2, as a more dispersed material, has a greater disorder of the surface towards an increased oxygen content, which contributes to obtaining a higher specific capacity and correlates with its greater solubility in the electrolyte.

For both materials under study, CVAs were recorded in the range of 2.5–2.5 V at a sweep rate of 20 mV/s, 4 cycles each, on platinum (fig. 1), graphite (fig. 4) and carbon fiber.

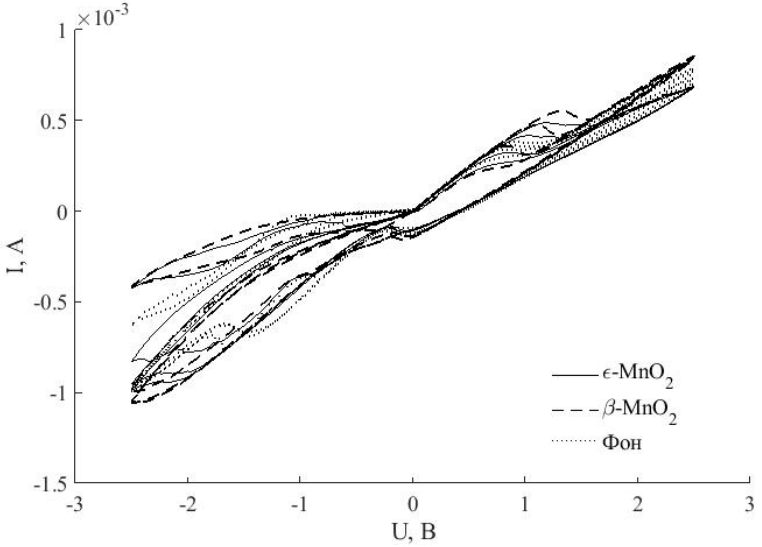


Figure 1. *Cyclic voltammograms on platinum in NMP-hydrochloric acid solution*

As follows from the data presented, manganese dioxide reacts with NMP to form a manganese complex. With cathodic polarization, the manganese complex is reduced to metallic manganese, with anodic polarization, manganese (II) is oxidized to dioxide. Since manganese dioxide is added in excess, a saturated solution of a manganese complex is obtained, therefore, manganese dioxide accumulates on the electrode, and upon further cycling, it is reduced to manganese through an intermediate stage of complex manganese ions and back against the background of NMP decomposition, as evidenced by an increase in the maximum currents by each next cycle:

$$Mn \leftrightarrow \text{complex}\, Mn \leftrightarrow MnO_2$$

In addition, there is an accumulation of electrolyte decomposition products, which subsequently take an active part in subsequent cycles, this can be judged by an increase in the cathodic and anodic peaks of the background.

A more detailed examination of CVA (fig. 2, fig. 3) shows that ε-MnO_2 has two small peaks in the cathodic and anodic regions, relative to the background, and β-MnO_2 has one, more pronounced one. This indicates the presence of several structural varieties in ε-MnO_2 that is, a greater structural disorder of the material, leading to an increase in its specific capacity.

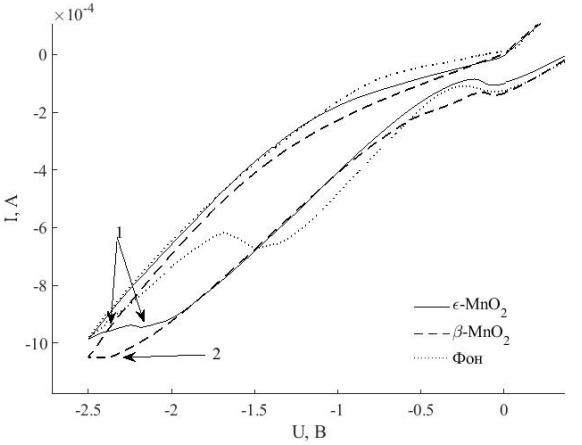


Figure 2. *Cathodic region of CVA on platinum in NMP-hydrochloric acid solution 4 cycle; 1 – peaks ε-MnO_2; 2 – peak β-MnO_2*

When measured on graphite (fig. 4), due to its lower electrocatalytic activity, the electrolyte decomposition reactions proceed less intensively, as a result of which the differences between the materials under study are manifested to a greater extent. Cathodic and anodic peaks of β-MnO_2 are much larger than those of ε-MnO_2.

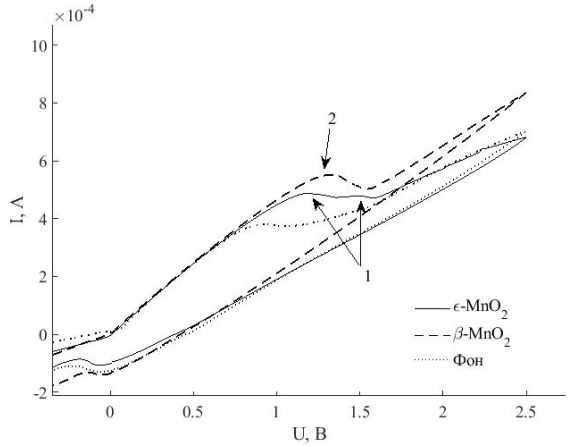


Figure 3. *CVA anodic region on platinum in NMP-hydrochloric acid solution, cycle 4; 1 – peaks ε-MnO_2; 2 – peak β-MnO_2*

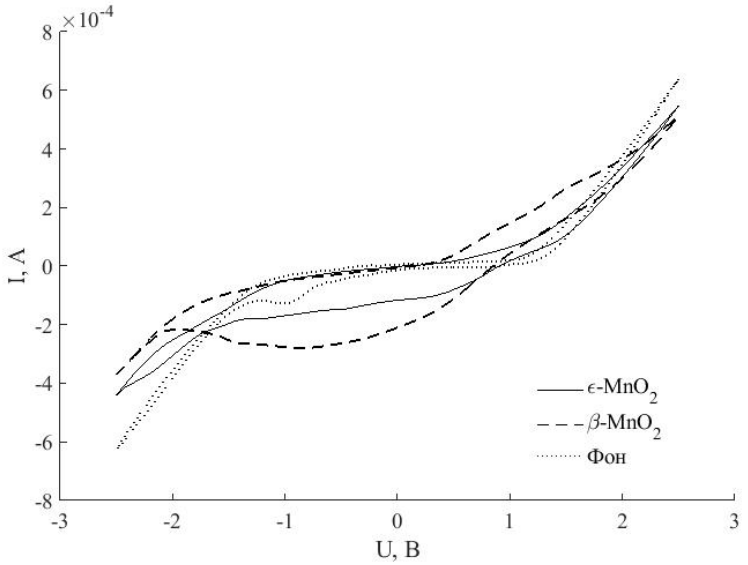


Figure 4. *CVA solutions of NMP-hydrochloric acid on graphite 4 cycle*

Thus, it follows from the data obtained that ε-MnO_2 has a more defective crystal-chemical structure than β-MnO_2, which is practically impossible to detect using XPA, since such defects can be associated with the presence of manganese vacancies and the corresponding violation of stoichiometry, the presence of bound water and hydroxyl groups, as well as impurities of other crystalline modifications. The presence of several phase varieties on the ε-MnO_2 surface significantly increases the specific capacity of the material. The advantage of the proposed technique is its rapidity, lack of dependence of the result on macrokinetic factors, and ease of implementation.

References

1. Serbinovsky M.Yu. Lithium current sources: designs, electrodes, materials, manufacturing methods and devices for the manufacture of electrodes. Rostov-on-Don: Rostov University Publishing House, 2001.

2. Kedrinsky I.A., Yakovlev V.G. Li-ion batteries. Krasnoyarsk: Platinum, 2002. - 269 P.

3. Korotkov R.F. etal. Selective hydrothermal-microwave synthesis of various polymorphic modifications of manganese dioxide // Journal of Inorganic Chemistry, 2016, Vol. 61, № 2,

4. de Wolff P.M. Interpretation of some γ-MnO2 diffraction patterns: 4 // Acta Crystallogr. International Union of Crystallography, 1959. Vol. 12, № 4. P. 341–345.

5. Gibson A.J. et al. A synchrotron X-ray powder diffraction and step potential electrochemical spectroscopy study on the change in manganese dioxide capacitive behaviour during cycling // Electrochimica Acta. 2018. Vol. 260. P. 630–639.

6. Koyanaka H. et al. Effect of crystal structure of manganese dioxide on response for electrolyte of a hydrogen sensor operative at room temperature // Sens. Actuators B Chem. 2013. Vol. 183. P. 641–647.

7. Ivanova N.D. etal. Composition, Properties and Electrochemical Behavior of Nonstoichiometric Manganese Dioxide Obtained from Fluorine-Containing Electrolytes // Electrochemistry. 2002. Vol. 38, № 9.

8. Skibina L.M. etal. Influence of complexation of cadmium ions with n-methylpyrrolidone on the kinetics of their electroreduction in sulfate electrolyte // Electrochemistry. 2013. Vol. 49, № 2.

9. Ding K. et al. Coordination of N-methylpyrrolidone to iron(II) // J. Organomet. Chem. 2009. Vol. 694, № 26. P. 4204–4208.

10. Plamback J. Electrochemical Methods of Analysis. Fundamentals of theory and application. Moscow: Mir, 1985.

DOI 10.34660/INF.2022.63.16.017

基于电镀和复合涂层的锂离子电池负极材料
ANODE MATERIALS FOR LITHIUM-ION BATTERIES BASED ON GALVANIC AND COMPOSITE COATINGS

Voloshin Vadim Aleksandrovich
Undergraduate

Lipkin Valery Mikhailovich
Senior Lecturer

Korbova Ekaterina Vadimovna
Postgraduate

Platov South-Russian State Polytechnic University, Novocherkassk, Russia

抽象的。 这项工作的目的是研究基于电镀锡涂层和超细锡粉复合锡涂层的锂嵌入电极的规律。 结果表明，电偶涂层和复合涂层是比容量高达 1600 mAh/g 的有前途的锂离子电池负极材料； 复合涂层的电化学活性在嵌入过程中增加，扩散系数达到 10−10 cm2/s，这与将锂引入材料不断增长的介孔中的额外可能性有关。

关键词：电位法，锡粉，复合电极，结构，电化学诊断。

Abstract. *The aim of this work was to study the regularities of lithium intercalation into electrodes based on galvanic tin coatings and a composite tin coating with ultrafine tin powder. It was found that galvanic and composite coatings are promising anode materials for lithium-ion batteries with a specific capacity of up to 1600 mAh/g; the electrochemical activity of composite coatings increases during intercalation, the diffusion coefficient reaches* 10^{-10} *cm*^{2}*/s, which is associated with additional possibilities for the introduction of lithium into the growing mesopores of the material.*

Keywords: *potentiometric methods, tin powder, composite electrodes, structure, electrochemical diagnostics.*

Introduction

Lithium-ion batteries are becoming the primary power source for communications, laptops, mobile phones and other portable devices in the civilian and military sectors. The growing functionality of modern portable devices makes ever-growing demands on the capacity of rechargeable batteries. A significant increase in specific capacity, in particular, can be achieved by replacing carbon anodes with

more efficient materials [1-3]. One of the areas of research in this area is the use of tin-containing materials as anodes for lithium-ion batteries. These are tin oxides and oxide composites; metal systems; other materials, composites with the participation of carbon [4-7]. The mechanism of lithium incorporation into various oxide structures containing tin has been studied in a large number of experimental studies [8–10]. Materials with the participation of SnO, SnO_2, $LiSnO_3$, $SnSiO_3$, glasses of the $SnO–B_2O_3–P_20_5$, system, and other compositions were studied using various methods. It is generally accepted that the general model of processes involving tin oxides includes the reduction of tin (II) and (IV) oxides at the first cathodic polarization with the formation of dispersed particles of tin and lithium oxide, the incorporation of lithium into tin particles with the formation of an alloy

$$Sn + xLi+ + xe \rightarrow Li_xSn.$$

The coefficient x can reach 4.4, the lithium oxide formed at the first stage contributes significantly to the stabilization of tin particles. The main problem that arises when using metallic tin is a significant increase in the volume of the alloy when lithium is incorporated into tin, which leads to the destruction of the metal matrix [11-13]. It is known that the stability of an electrode with respect to such destruction increases with a decrease in the size of tin particles and becomes acceptable in the transition to nanoscale objects [14–17].

Earlier it was reported (Abstr.) about the possibility of obtaining nanosized metal tin powders, the electrodes of which, prepared using a binder, PVDF, had a specific capacity of up to 800 mAh/g [18-20]. Earlier it was reported [21] about high specific characteristics of electrodes based on composite electrochemical coatings. From the data obtained, it followed that it was important to study the regularities of lithium intercalation into these electrodes.

Research methodology

Tin powders were obtained from an electrolyte of the composition $(NH_4)_2SO_4$ 1M, ethylene glycol 1:1, HCl 0.5M. The main component was obtained by anodic dissolution of a tin anode. After working out the electrolyte, the concentration of tin ions was 0.01 M. Tin powder was obtained on a vibroelectrode with a vibration frequency of 50 Hz on a corrugated titanium cathode. The resulting powder was washed with distilled water until the electrolyte salts were completely removed, dried, and sieved through a sieve with a mesh size of 40 μm.

The particle size distribution of the resulting powders was determined using an analyzer using a MicrotracBluewaveS3500 device at the Nanotechnology Center for Collective Use of Platov South-Russian State Polytechnic University (NPI).

Electrodes for research as an anode of a lithium-ion battery were obtained by electrodeposition of a composite coating with tin powder from an electrolyte of the following composition: $SnCl_2$ 50-60 g/l, NaF 35 g/l, HCl 4 g/l, gelatin 2 g/l, tin powder 7 g/l. The coating was obtained by stirring with a tin anode. The cathode

was deposited on a copper substrate at a current density of 0.034 A/dm^2.

The specific capacity of the composite electrode was determined by the galvanostatic method in a sealed fluoroplastic cell with a lithium auxiliary electrode in a TCE 2016 electrolyte.

Results and its discussion

As follows from the results of cyclic voltammetry (fig. 1a) for the coating, the predominance of anodic currents over cathodic ones means that the coating undergoes anodic oxidation with the formation of solid phase products, which are organotin compounds. For a composite electrode (fig. 1b), the introduction of lithium occurs at a potential value below -3 V and, when repeated, the sweep cycle mixes to positive potentials, increasing in amplitude. The anode maximum appears at a potential of -1200-1800 mV, shifts somewhat in the positive direction and increases in magnitude with a cyclic repetition of the sweep. From the data obtained, it follows that during cycling, the electrochemical activity of the material increases.

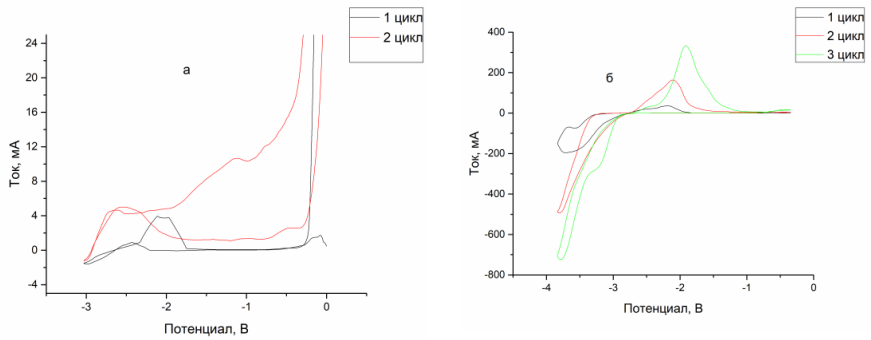


Figure 1. *Cyclic voltammetry of electrodes: tin coating (a), composite electrode (b)*

The shape of the charge-discharge curves of the composite electrode (Fig. 2) corresponds to a small slope of the dependence of the EMF - the composition of the intercalate. For coatings, since there is no pronounced end section on the discharge curves, a significant excess of the charging capacity over the discharge capacity is observed, which corresponds to the previously stated assumptions about the formation of organotin films.

The results of electrode cycling (fig. 3) indicate a significant discharge capacity of the galvanic coating, however, these indicators are achieved only at a low current density, at a current density of 4 mA/cm^2, the electrode completely loses its performance. The composite coating at high current densities turns out to be efficient, but shows a low specific capacity, which is associated with its partial destruction during cycling.

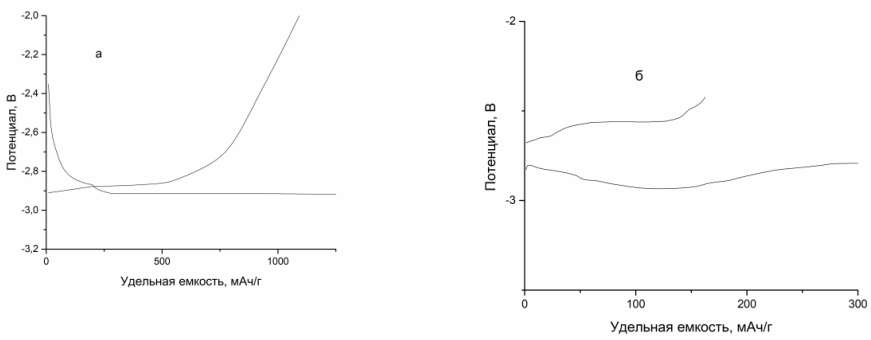


Figure 2. *Dependence of the electrode potential on the specific capacity: tin coating (a), composite electrode (b)*

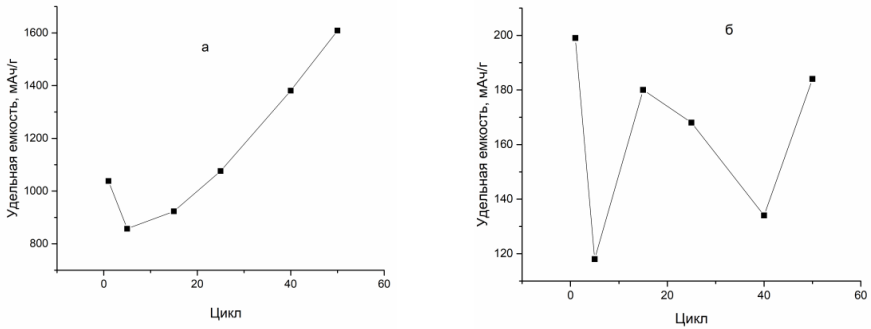


Figure 3. *Dependence of the specific discharge capacity on the number of cycles: coating (a), composite electrode (b)*

The dependence of the amount of electricity on the potential for stepwise potentiostatic polarization (fig. 4) for the coating has a continuous character up to a potential of -3 V, at which the amount of electricity begins to increase sharply. For a composite coating, the dependence has several break points, which show that in this case there are several varieties of positions for the incorporation of lithium. These positions are associated with: the incorporation of lithium into polyfunctional surface films, the incorporation of lithium into the crystal structure itself, and the incorporation of lithium into the mesopores of the composite coating (fig. 5), which provide a significant increase in the electrode surface, which explains the significantly higher permissible current densities for the composite in relation to the coating.

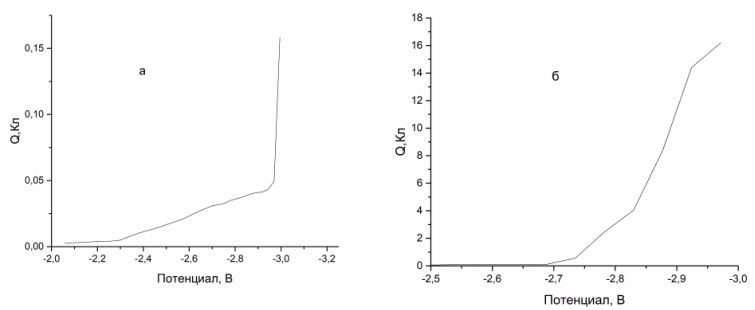


Figure 4. *Dependences of the amount of electricity on the potential at stepwise potentiostatic polarization: coating (a); composite electrode (b)*

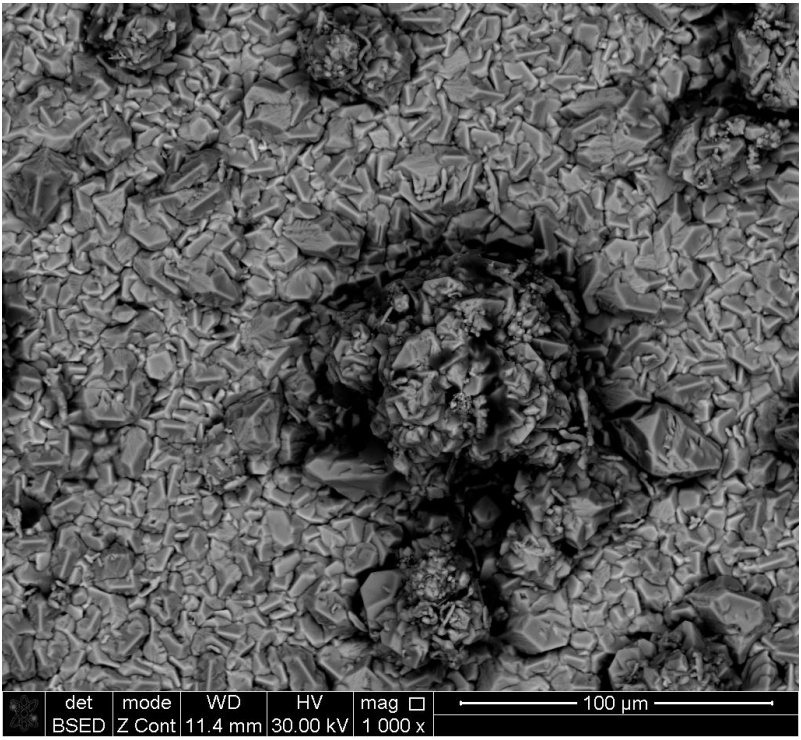


Figure 5. *SEM image of the surface of the composite coating*

The dependence of the diffusion coefficient of lithium on the potential (fig. 6) shows that, in contrast to the coating for the composite electrode, an increase in the diffusion coefficient is observed, which is a sign of the structure being completed.

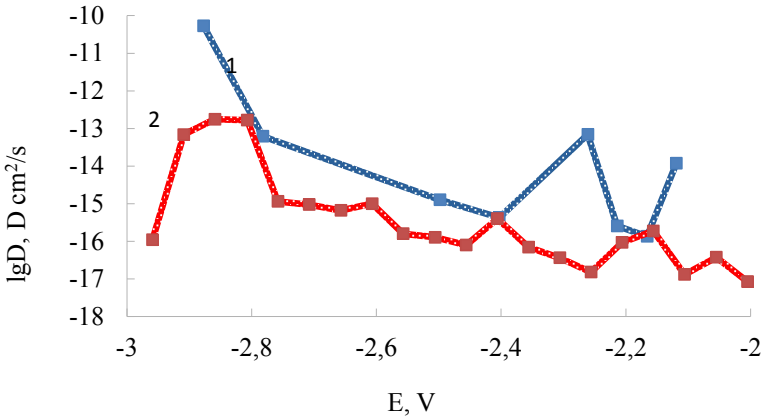


Figure 6. *Dependence of the diffusion coefficient on the potential for coating (1) and composite electrode (2)*

Conclusions

1. Galvanic and composite coatings are promising anode materials for lithium-ion batteries with a specific capacity of up to 1600 mAh/g.

2. The electrochemical activity of composite coatings increases in the course of intercalation, the diffusion coefficient reaches 10-10 cm2/s, which is associated with additional possibilities for the introduction of lithium into the growing mesopores of the material.

3. Further trends in the improvement of tin-based anode materials are the optimization of their macrostructure by varying the fineness of the tin powder and the conditions for obtaining composite coatings.

References

1. Kedrinsky I.A., Yakovlev V.G. Lithium-ion batteries. Krasnoyarsk: IPK "Platina", 2002. 266 P.

2. Chemical current sources: Handbook / Ed. By N. V. Korovin and A. M. Skundin. M.: Publishing house of MEI, 2003. 740 P.

3. Dyadin Yu.A. Graphite and its inclusion compounds// Sorosovskiyobrazovat. Journ. 2000.V. 6, №10. P. 43-49.

4. Lithium Batteries: Science and Technology / Ed. G.-A.Nazri, G. Pistola. Boston: Kluwer Acad. Publ., 2004.

5.Winter M., Besenhard J. O., Spahr M. E., Novak P. Insertion electrode materials for rechargeable lithium batteries//Advanced Mater. 1998. V. 10. N 10. P. 725–763.

6.Scrosati B., Garche J.Lithium batteries: Status, prospects and future// J. Power Sources. 2010. V. 193.P. 2419–2430.

7.Idota Y., Kubota T., Matsufuji A. Et al.Tin-Based Amorphous Oxide: A High-Capacity Lithium-Ion-Storage Material // Science. 1997.V. 276. P. 1395–1397.

8.Brousse T., Retoux R., Herterich U., Schleich D. M. High-Resolution Electron Microscopy Investigation of Capacity Fade in SnO2 Electrodes for Lithium-Ion Batteries//J. Electrochem. Soc. 1998. V. 145. N 1. P. 1–4.

9.Foster D. L., Wolfenstine J., Read J. R.,Behl W. K.The Electrochemical Society Nanocomposites of Sn and Li2 O Formed from the Chemical Reduction of SnO as Negative Electrode Material for Lithium-Ion Batteries//Electrochem. A. Solid-State Lett. 2000. V. 3. N 5. P. 203– 204.

10.Morimoto H., Tatsumisago M., Minami T.Anode Properties of Amorphous 50SiO-50SnO Powders Synthesized by Mechanical Milling // Electrochem. A. Solid-State Lett. 2001. V. 4. N 2. P. A16– A18.

11.Courtney I. A., MckinnonW. R., Dahn J. R.On the Aggregation of Tin in SnO Composite Glasses Caused by the Reversible Reaction with Lithium// J. Electrochem. Soc. 1999. V. 146. N 1. P. 59–68.

12.Kulova T.L., Skundin A.M., Roginskaya Yu. E., ChibirovaF. H. Intercalation of lithium into nanostructured films based on tin and titanium oxides // Electrochemistry. 2004. V. 40. № 4. P. 484– 492.

13.Kulova T.L., Roginskaya Yu. E., Skundin A.M. Potentiodynamic study of nanostructured material based on tin and titanium oxides // Electrochemistry. 2005. V. 41. № 1. P. 76–82.

14.VassilievS. Yu., YusipovichA. I., RoginskayaYu. E. etal. Nanostructured SnO2-TiO2 films as related to lithium intercalation// J. SolidStateElectrochem. 2005. V. 9. N 10.P. 698–705.

15.Roginskaya Yu. E., Chibirova F. Kh., Kulova T. L., Skundin A. M. Products of interaction of lithium with nanostructured oxides SnO2 – TiO2 and the mechanism of charging and discharging electrodes of a lithium-ion battery // Electrochemistry. 2006. V. 42. № 4.P. 406–413.

16.Fung Y. S., Zhu D. R. Electrodeposited tin coating as negative electrode material for lithium-ion battery in room temperature molten salt// J. Electrochem. Soc. 2002.V. 149. N 3. P. A319–A324.

17.Hosono E., Matsuda H., Honma I. Et al. Nanosize Effect on High-Rate Li-Ion Intercalation in LiCoO2 Electrode// J. Electro-Chem. Soc. 2007. V. 154. N 2. P. A146–A149.

18.Bazin L., Mitra S., Taberna P. L. Et al.High-rate capability pure Sn-based nano-architectured electrode assembly for rechargeable lithium batteries // J. PowerSources. 2009. V. 188. P. 578–582.

19.Ui K., Kikuchi I., Kadoma Y. Et al.Electrochemical characteristics of Sn film prepared by pulse electrodeposition method as negative electrode for lithium secondary batteries// J. Power Sources.2009. V. 189. P. 224–229.

20.Li Q., Wang P., Feng Q. Et al. In Situ TEM on the Reversibility of Nanosized Sn Anodes during the Electrochemical Reaction // Chem. Mater. 2014.V. 26. P. 4102–4108.

21. Lipkin M.S., Lipkin V.M., Lipkina T.V., Korbova E.V., Voloshin V.A., Liplyavka M.V., Moskalev Yu.G., Semenkova A.V. Selection of modes for obtaining electrolytictin powders for use in lithium-ion batteries // Izvestiya vuzov. North Caucasian region. Technical science, 2021, №4, P. 23-28.

DOI 10.34660/INF.2022.45.36.018

20 世纪中叶至 21 世纪初南乌拉尔气候指标的变化
CHANGES IN CLIMATIC INDICATORS IN THE SOUTHERN URALS FROM THE MIDDLE OF THE XX TO THE BEGINNING OF THE XXI CENTURY

Yantser Oksana Vasilievna
Candidate of Geographic Sciences, Associate Professor
Laptev Nikita Andreevich
Student
Ural State Pedagogical University

抽象的。 本文介绍了 1950 年至 2020 年期间南乌拉尔和邻近低地地区 72 个气象站的日平均气温线性趋势和大气降水量动态的分析结果。 揭示了平均气温的趋势。 它们的增长率在夏季最低，在冬季最高。 在研究区域的南部地区，温度指标的增幅最大。 该地区西部、中部和东北部郊区的降水量增加是典型的。 冬季和春季降水量增加，而夏季和秋季则减少。

关键词：气候，日平均气温，降水，趋势，南乌拉尔。

Abstract. *The article presents the results of the analysis of linear trends in average daily air temperatures and the dynamics of the amount of atmospheric precipitation at 72 meteorological stations in the Southern Urals and adjacent lowland territories in the period from 1950 to 2020. A positive trend of linear trends in average air temperatures was revealed. Their growth rates are minimal in summer and maximum in winter. In the southern regions of the studied region, the maximum increase in temperature indicators is noted. An increase in precipitation is typical for the western, central and northeastern outskirts of the region. An increase in the amount of precipitation is observed in winter and spring, while it decreases in summer and autumn.*

Keywords: *climate, average daily temperatures, precipitation, trends, Southern Urals.*

Climate change in Russia is uneven, it is less significant in some regions than in others. The climate of the territory is moderately continental with an increase in the degree of continentality from northwest to southeast. The relief of the Southern Urals is distinguished by its complexity and diversity. Therefore, its features

must be taken into account when identifying the patterns of dynamics of climatic indicators [5].

The main source of climatic indicators is a regularly operating network of meteorological stations. The obtained averaged indicators of temperatures and precipitation are analyzed and published in climatic reference books and atlases [3]. However, annual average data should be considered as a summary characteristic of each indicator: it is not a stable and firm norm, in some years the values of the values differ markedly from the average for a certain long-term period [1]. To study climate changes in the Southern Urals, an analysis of meteorological data presented on the site www.pogodaiklimat.ru was carried out [8]. The period covered by our research is determined by the availability of meteorological data on the site. To study the change in temperature indicators, the period from 1951 to 2020 was adopted, the dynamics of the amount of atmospheric precipitation is considered from 1959 to 2020.

Based on the scheme of physical and geographical zoning of the Novozemelsko-Ural plain-mountainous country, V. I. Prokayev and A. M. Olenev [6], a list of the main meteorological points located in the Southern Urals was determined: Verkhniy Ufaley, Zlatoust, Troitsk, Verkhneuralsk, Tukan, Zilair, Akyar. As additional points, the data of meteorological points of the Orenburg, Chelyabinsk, Sverdlovsk, Kurgan, Tyumen Oblast, Bashkiria, Perm Krai, as well as the northern and northeastern regions of Kazakhstan: Kustanai, Aktobe, West Kazakh oblasts were analyzed. In total, the data of 72 meteorological stations have been studied [8]. The amount of precipitation by years, seasons and months were obtained (tables 1, 2) using the trend line method (moving average lines), indicators of changes in the dynamics of the temperature regime.

The main trend in the development of a long-term series of climatic indicators reflects a change that determines the general direction of development; linear trends in average air temperatures in mountainous and lowland areas have a growth trend (Fig. 1). The temperature regime has changed the least in Verkhneuralsk (<+ 1 °C). The maximum values of temperature changes during the period under study were recorded in Zilair (from + 2.2 °C to + 2.3 °C) and Akyar (from + 2.1 °C to + 2.2 °C). There is an increase in the average annual temperature from Verkhneuralsk (<+ 1.1 ° C) to the north (from + 1.8 °C to +2 °C), to the east (+ 1.8 °C), south (from + 2.1 °C to + 2.2 °C), and to the west (+ 2.4 °C). In more detail, changes in the temperature regime by seasons and months are presented in Table 1.

Table 1.

Dynamics of average air temperatures (ºC/10 years) by seasons in the Southern Urals from 1951 to 2020

CITY	Verkhny Ufaley	Zla-toust	Troitsk	Verkhneu-ralsk	Tu-kan	Zilair	Akyar	TO-TALLY
Year	1,84	1,72	1,9	1,03	1,66	2,26	2,16	1,89
January	1,56	2,33	2,34	-0,1	2,52	2,8	2,94	2,06
February	4,32	4,3	4,08	2,65	3,4	4,19	4,3	3,89
March	4,69	3,89	4,47	3,17	3,85	4,82	5,17	4,3
April	1,2	0,84	1,48	0,53	0,84	1,86	2,23	1,28
May	0,99	0,75	0,66	0,28	0,44	0,88	0,78	0,7
June	2,89	0,42	0,9	0,43	0,33	1,17	0,75	1
July	0,51	0,63	0,43	0,23	0,74	1,27	0,46	0,6
August	1,72	1,51	1,79	1,01	1,7	2,28	1,96	1,7
Septem-ber	0,75	0,58	0,72	0	0,97	1,55	1	0,8
October	2,53	2,21	2,51	1,93	2,09	2,67	2,44	2,3
Novem-ber	2,84	2,33	2,49	2,38	2,14	2,59	2,89	2,5
Decem-ber	0,53	0,94	0,96	-0,1	0,57	1,27	0,77	0,7

An increase in temperatures is observed at all meteorological points, its rates are minimal in summer (by 0.98 °C on average), maximum in winter (by 2.22 °C on average), with the exception of Verkhneuralsk (0.82 °C). In spring, the average temperature rose by 2.09 °C, in autumn, by 1.88 °C. The maximum increase in air temperatures was found in February (3.89 °C), March (4.3 °C), in late winter and early spring. The minimum temperature is in May (0.68 °C), July (0.61 °C), September (0.79 °C) and December (0.71 °C). In general, in the Southern Urals in the period from 1951 to 2020, there is a general tendency towards an increase in the average air temperature. The maximum temperature rise was noted in the southern regions of the studied region. An unambiguous correlation between the change in the temperature regime and the relief was not revealed.

Changes were also revealed in the mode of average annual precipitation (Table 2). Two centers can be noted where the average annual precipitation is maximally reduced: Zilair-Akyar (from -40 mm to -100 mm) and Zlatoust-Verkhniy Ufaley (from -20 mm to -40 mm).

Table 2.

Dynamics of the amount of atmospheric precipitation (mm/year) in the Southern Urals from 1959 to 2020

	Verkhny Ufaley	Zlatoust	Troitsk	Verkhneuralsk	Tukan	Zilair	Akyar	TOTALLY
Year	-56,26	-32,52	-31,88	-5,59	14,62	-113,05	-41,71	-38,06
January	0,7	-9,77	1,44	-3,62	4,83	-0,73	-0,7	-1,12
February	-1,81	-3,26	6,01	6,3	10,51	12,2	9,98	5,7
March	-0,39	4,58	12,58	10,6	25,9	17,9	7,5	11,24
April	-7,51	2,03	5,37	8,53	7,87	13	2,21	4,5
May	8,52	2,27	-2,9	1,1	7,31	-2,5	7,34	3,02
June	-36	-6,7	-22	-26	-27	-41	-30	-27
July	-15,2	-8,31	-33,3	2,08	-10,7	-22,9	-14,5	-14,7
August	-13,4	-2,99	4,61	8,7	-1,8	-23,9	-11,1	-5,7
September	-3,79	-0,98	0,56	-2,16	-7,74	-14,9	-15	-6,28
October	4,97	1,27	-0,3	-5,8	-14	-36	4,21	-6,5
November	4,86	-6,1	-6,6	-2,7	10,6	-7,5	-4,5	-1,7
December	2,84	-5,2	2,22	-2,5	9,16	-7,5	2,4	0,21

An increase in precipitation was detected in the western, central regions of the region (from 0 mm to 20 mm) in the direction of the East European Plain, as well as in the northeastern part of the region, near the border of the West Siberian Plain (from 0 mm to 20 mm) (Fig. 2). The amount of precipitation decreases (from -15.16 mm to -36.25 mm), with the exception of Zlatoust and Verkhniy Ufaley in all meteorological stations in summer and autumn. The maximum reduction in the amount of atmospheric precipitation in summer is observed in Verkhny Ufaley (-64.48 mm), Akyar (-55.16 mm), Troitsk (-50.34 mm), in autumn - Zilair (-57.87 mm). In general, an increase in precipitation in winter and spring was revealed (from 9.68 mm to 13.49 mm). The maximum increase is in the winter in Tukan (24.49 mm), and in the spring in Zilair (28.4 mm). The maximum increase in precipitation is observed in the territory in March (11.24 mm), February (5.9 mm),

April (4.5 mm): at the end of winter, at the beginning and in the middle of spring. The maximum amount of precipitation decreased in June (-26.83 mm) and July (14.69 mm), at the beginning and in the middle of summer. When comparing the two indicators, it was revealed that in February and March, the maximum increase in air temperatures and the amount of precipitation were found.

In general, winter, early spring and autumn in the Southern Urals and adjacent lowland territories became warmer during the period under study. Winter and spring are characterized by an increase in humidity, while summer and autumn are characterized by less precipitation.

Reference

1. *Bobrov V. Geography of the world. Interesting facts about climate change. - M.: Phoenix, 2010. – 160 p.*
2. *Bondarenko L. V., Maslova O. V., Belkina A. V., Sukhareva K. V. Global climate change and its consequences. Bulletin of the Plekhanov Russian University of Economics. 2018; (2): 84-93.*
3. *Kokorev V. A., Sherstyukov A. B. About meteorological data for the study of current and future climate changes on the territory of Russia. Arctic XXI century. Natural Sciences. 2015. p. 5-23.*
4. *Lenskaya O. Yu., Botova M. G. Features of current climatic changes in the Southern Urals region. Bulletin of the Chelyabinsk State University. Ecology. Natural resource use. 2011. Issue. 5, p. 44-49*
5. *Perevedentsev Yu. P., Naumov E. P., Shantalinsky K. M., Modern global and regional climate change, Geogr. Bullet., Issue. Nov. 2, 2017.*
6. *Shakirov A. V. Physical and geographical zoning of the Urals; Russ. Acad. of Sci., Ural. department, Institute of the steppe. 2011. 619 pp.*
7. *Jacobson AP Weather and Climate / Nature. Climate. - M.: State educational and pedagogical publishing house of the Ministry of education of the RSFSR, 2015. - 621 p.*
8. *www.pogodaiklimat.ru*

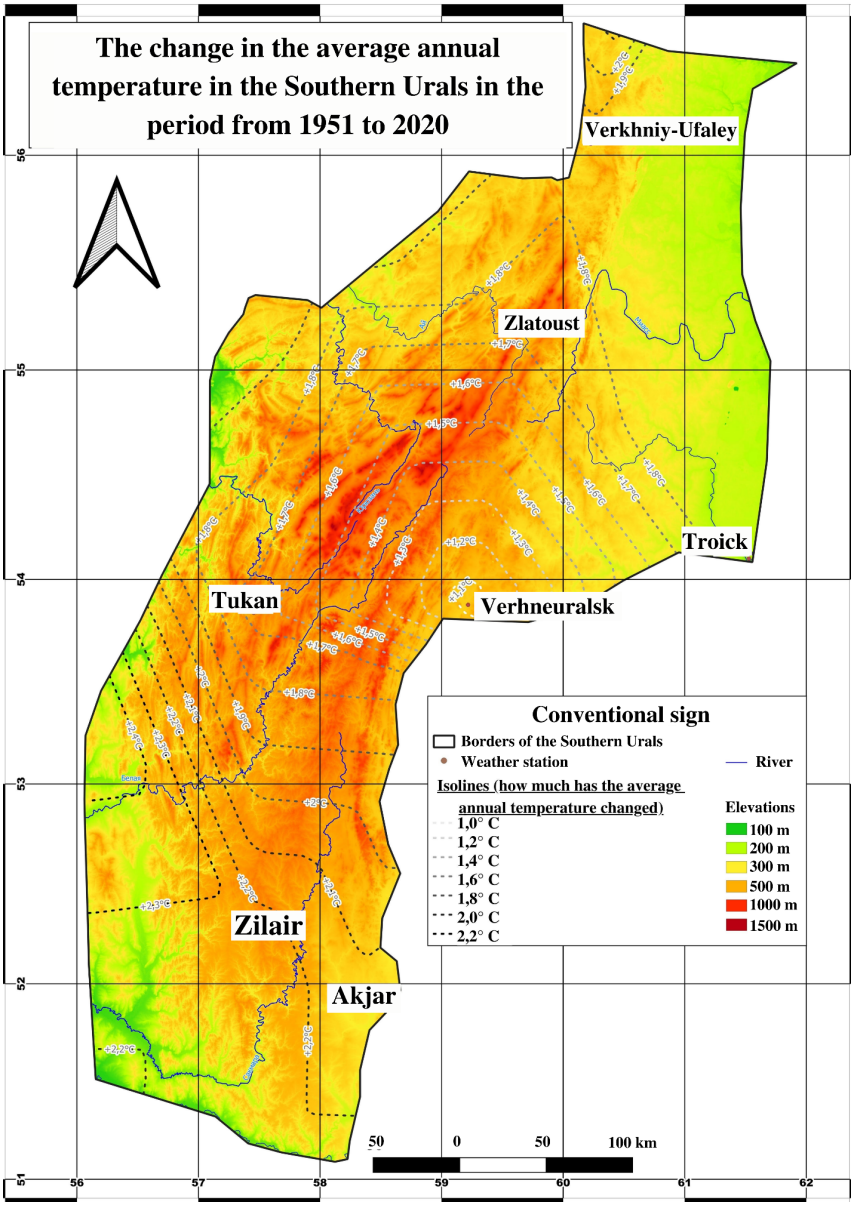


Figure 1. *Change in average annual temperature in the Southern Urals in the period from 1951 to 2020*

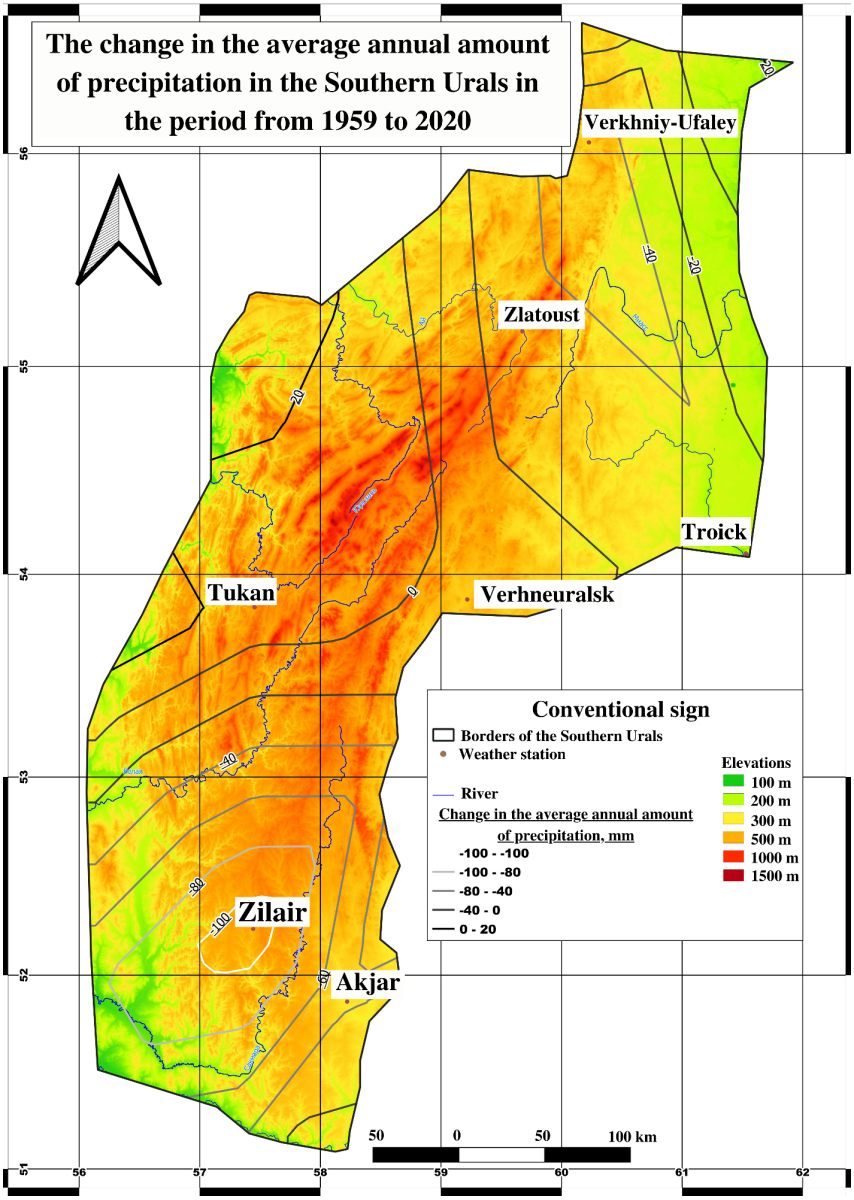


Figure 2. *Change in the average annual amount of atmospheric precipitation in the Southern Urals in the period from 1959 to 2020*

DOI 10.34660/INF.2022.56.45.019

OLAP技术在采矿过程中的应用
APPLICATION OF OLAP TECHNOLOGIES IN MINING PROCESSES

Stepanov Yuriy Aleksandrovich
Doctor of Technical Sciences, Full Professor
Dorn Ekaterina Viktorovna
bachelor
Stepanov Ivan Yurevich
postgraduate
Kemerovo State University

抽象的。本文致力于在采矿业中使用在线分析处理 (OLAP) 技术进行可视化和数据分析的信息技术。这篇文章的相关性是因为有大量信息需要分析并以可理解的形式呈现，因此需要执行此任务的方法和手段。目前有大量应用程序可以解决这个问题，但并非所有应用程序都可供大多数个人计算机用户使用。文章讨论了这个问题的最佳解决方案。该研究还审查了该技术在采矿业中的应用。作为研究对象，考虑提供槽坐标的数据集，为了方便将其划分为区域。基于对所选数据集的研究，以图形的形式对波谷进行了可视化，显示了波谷中间的一段，对图形进行了分析。在决定是否将这项技术用于与挖掘相关的任务时，可以使用文章中提出的结论。

关键词：数据可视化，数据分析，OLAP技术，数据处理

Abstract. *The article is devoted to information technologies for visualization and data analysis using online analytical processing (OLAP) technologies in the mining industry. The relevance of the article is due to the fact that there is a large amount of information that needs to be analyzed and presented in an understandable form, therefore there is a need for methods and means of implementing this task. Currently there is a large selection of applications that solve this problem, but not all of them are available to most personal computer users. The article discusses the best solution to this problem. The study also examined the application of the technology in the mining industry. As an object of research, a dataset is considered that provides the coordinates of a trough, divided into zones for convenience. Based on the study of the selected dataset, the visualization of the trough was made in the form of a graph, a section of the trough in the middle is shown, the analysis of the graphs is done. The conclusions presented in the article can be used when deciding whether to use this technology for tasks related to mining.*

Keywords: *data visualization, data analysis, OLAP technologies, work with data*

Analysis of visualization tools for large datasets

Nowadays big data are gaining more and more practical application [1]. But since their volume increases every year, it becomes more difficult to analyze them. To somehow facilitate this task, data visualization can be used before the analysis of the result [2].

The use of visualization in the task of analyzing big data is justified for the following reasons:

1) When viewing reports and tables, you can misinterpret the data. Visualization will help eliminate this problem and see previously hidden patterns.

2) Visualization can represent graphically hundreds and thousands of lines of data on one screen, which is much more informative than the usual form of data but reduced for their capacity on the screen.

3) It is also impossible to show the value of data through information presented on one screen. An example can be the analysis of a large number of psychophysical parameters of a person in pharmaceuticals, which is very difficult when viewing data in a linear form.

Let us consider the application of visualization in the mining industry.

In the mining industry many excavation works are being carried out, which is accompanied by a change in the landscape of the area [3]. It is important to monitor these changes as they can lead to negative consequences, starting with the subsidence of the soil and ending with the displacement of the foundations of residential buildings located near the work site. The use of a mathematical apparatus in this case reduces possible risks and helps to model and predict soil subsidence.

Results analysis tools

Based on the Magic Quadrant for Analytics and Business Intelligence Platforms, the best ones in 2021 are:

QlikView — business intelligence (BI) platform from QlikTech, designed for self-conduct business analysis. This program offers data analysis and the use of the results obtained to support decisions.

Microsoft has two primary visualization tools, including Power BI at the top level. It provides classic elements of data visualization tools such as interactive dashboards and APIs for integration and is tightly integrated with Microsoft data platforms such as SQL Server and Sharepoint.

The essential thing here is that these are paid products, while the free ones have less functionality and capabilities. In this regard, it was decided to consider the most affordable software products that provide functionality sufficient to solve business problems. Microsoft Excel - a spreadsheet application - is such. The pro-

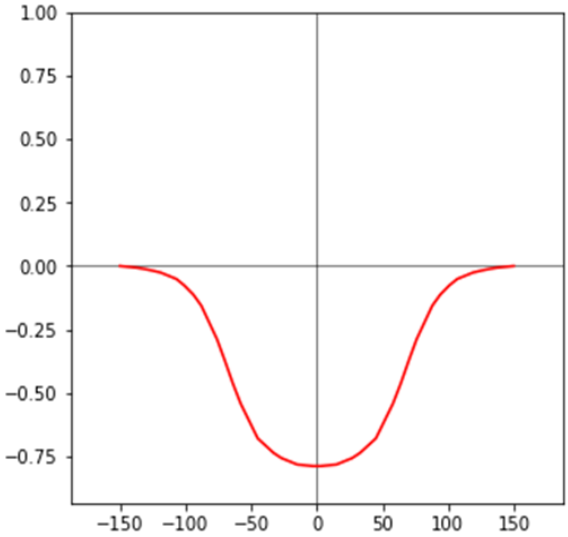
gram is quite easy to learn, and it is the most widespread since most users work with Windows operating system (OS) and most often with the Microsoft Office package.

Microsoft Excel can be considered in this case as an OLAP tool. The purpose of OLAP tools is to make it easier to solve data analysis tasks. In the mining industry the use of specialized OLAP systems is necessary because it offers many advantages over the analysis carried out with improvised tools. For example, their use gives an opportunity to conduct adequate data analysis, which in turn helps to control the quality and time of work. Furthermore, the mechanisms in the OLAP system make it possible to automatically detect any deviations from the specified parameters, organize them by importance and notify interested parties about the found problems, which allows preventing accidents due to the human factor.

There are many tasks typical for organizations in general, but in this case the use of OLAP systems is also possible.

Check calculation

OLAP cube has many attributes that can be divided into 2 groups: a set of dimensions (categories, locators) and measures. A set of dimensions serves as analysis criteria and defines the multidimensional space of an OLAP cube. By fixing the measurement values, cube slices (hyperplanes) are obtained. Each slice is a kind of data query that includes aggregations. A set of measures is functions that map data to every point in space.



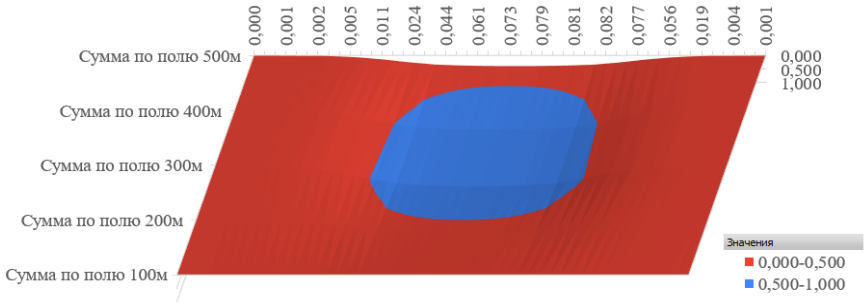
Picture 1. *Middle of the trough, cutaway trough*

The OLAP model is characterized by the specification of aggregation functions. Since the goal of OLAP is to create a multi-level analysis model, data at levels other than the actual level must be aggregated appropriately. For each dimension it is possible to set its own (and more than one) aggregation function [4].

As basic data for the example, a dataset representing soil subsidence during mining operations was taken.

The coordinates of 50 points of the trough were found, then, using a pivot table, the dependence of the coordinates on the slice and the corresponding graph were obtained.

When looking at the table of values, it is impossible to imagine what the resulting trough looks like. Having carried out the previously described actions, small depth and a vast area of soil subsidence are clearly seen.



Picture 2. *Trough model*

Conclusions

When having a large amount of data, the use of OLAP becomes mandatory since it greatly facilitates the work with the data, for example, the use of this technology helps to represent the data structure more easily, which speeds up work with them. Visualization plays an important role when working with large amounts of data because it allows one to visually examine the spatial patterns of heterogeneous data. The mining industry is one of the areas in which OLAP technologies help to significantly improve the quality of mining operations, which in turn will ensure the trouble-free and safe infrastructure on the surface of the earth.

References

1. Ivanov P. D., Lopukhovskiy A.G. Big Data technologies and various methods of presenting big data. Engineering Journal: Science and Innovation, 2014, vol. 9, URL: http://engjournal.ru/catalog/it/asu/1229.html p.1 (in Russian)

2. Averbukh V. L., Manakov D. V. Analysis and visualization of "big data". p.1 (in Russian)

3. Mining industry, 2019 г. Resources for the future. p. 11 (in Russian)

4. Yu. Kudryavtsev OLAP technologies: an overview of the problems being solved and research, 2008. pp. 2, 3 (in Russian)

DOI 10.34660/INF.2022.62.18.020

柴油液压处理应急保护工艺分析综述
ANALYTICAL REVIEW OF EMERGENCY PROTECTION PROCESS FOR DIESEL FUEL HYDRAULIC TREATMENT

Fedorov Andrey Vladimirovich
Doctor of Technical Sciences, Full Professor
Academy of the State Fire Service of the Ministry of Emergency Situations of Russia
Ospanov Kairat Keldenovich
Adjunct
Academy of the State Fire Service of the Ministry of Emergency Situations of Russia
Nehamkin Vitaly Genrikhovich
Master's student
Academy of the State Fire Service of the EMERCOM of Russia

抽象的。 本文概述了对带有自动和（或）自动化控制系统的柴油燃料加氢处理过程设备的主要要求，这些系统确定柴油燃料加氢处理过程的危险以及在处理装置运行期间可能出现的紧急情况。 介绍了柴油加氢装置应急保护系统中使用的主要联锁装置。

关键词：事故、风险、炼油和石化工业、柴油加氢处理、应急保护、保护性阻塞。

Abstract. *The article provides an overview of the main requirements for the equipment of the diesel fuel hydrotreatment process with automatic and (or) automated control systems that determine the danger of the diesel fuel hydrotreatment process and possible emergency cases during operation of the process unit. There are presented the main interlocks used in the emergency protection system of the diesel fuel hydrotreatment unit.*

Keywords: *accident, risk, oil refining and petrochemical industry, hydrotreatment of diesel fuel, emergency protection, protective blocking.*

Oil refining and petrochemical industries are one of the most strategically important sectors of heavy industry for the economy of countries. As a rule, modern enterprises of this industry are recognized as objects of increased danger, due to the nature of petroleum products and their processing technologies. The high level of explosion and fire hazard is due to the energy saturation of process plants and

devices with hazardous substances capable of burning and explosion. The high level of explosion and fire hazard is caused by the energy saturation of technological installations and devices with hazardous substances capable of burning and explosion. For the most part, the risks are well known and users of oil refining and petrochemical facilities (ORNP) have applied significant knowledge and resources in recent decades to control and minimize potential risk. Nevertheless, major accidents at ORNP facilities occur regularly and emergency scenarios usually include fires and explosions, releases of hazardous substances (accidents), thereby affecting not only human health and the environment, but also in many cases the social and economic well-being of the facility, regions, states [1].

Statistics [2] show that in 2018-2019 the damage from accidents of the oil and gas industry in the world amounted to about 4.5 billion US dollars and this amount is a tenth of all losses of the oil and gas industry in the world over the past five decades. It is noted that oil refineries account for 50%, and petrochemicals - 25% of new losses.

The process of hydrotreating diesel fuel fractions refers to the most mass processes of oil refining. Over time, the requirements for the quality of diesel fuel and for the equipment of the plants have changed. The improvement of the production process required the development and implementation of new technical means of protecting equipment, personnel and the environment in the event of an emergency. In this regard, a potential risk assessment and a review of the current system for protecting the process of hydrotreating diesel fuel from emergency situations should be carried out initially.

Diesel fuel hydrotreating plants included in oil refining complexes based on the number of hazardous substances turned into production frequent in their composition have process units of explosion hazard category I. According to clause 226 [3], hazardous production facilities that include facilities with technological blocks of I and II explosion hazard categories must be equipped with automatic and (or) automated control systems built on the basis of electronic controls and automation, including computer equipment. It should also be noted that technological systems should be equipped with means of monitoring the parameters that determine the explosion hazard of the process, with registration of indications and pre-emergency alarm of their values, as well as means of automatic regulation and emergency protection.

The analysis [4] shows that the use of the existing automatic emergency protection system (AEPS) at the hazardous production facility allows to reduce the conditional risk of dangerous events.

Modern AEPS is a logical monitoring and measuring system that detects abnormal events in the technological process and initiates actions to open the energy circulation network and stop the technological facility to bring the violation of

the technological mode to a safe level and thus eliminate possible risks. The main purpose of AEPS is emergency protection of equipment, personnel, and the environment in case of failures of the process control system, monitored equipment, or erroneous actions of personnel.

The main factors determining the risk of the process of hydrotreating diesel fuel are: a large number of reversible explosion and fire hazardous substances, a large concentration of hydrocarbon gases in the mixture, high values of process parameters (temperature, pressure), toxicity of the used products (release of hydrogen sulfide and ammonia) [4].

During operation of diesel fuel hydrotreating unit the following emergency cases are possible:

1. cessation of raw material supply;
2. stopping the supply of fresh hydrogen-containing gas;
3. shutdown of the circulation compressor;
4. pass in coils of furnaces;
5. stopping the supply of the regenerated monoethanolamine solution;
6. shutdown of cooling water supply to system I and II;
7. termination of 6000V power supply;
8. stop of power supply with voltage of 380v;
9. stop of air supply to monitoring and measuring devices;
10. break of flange connection of pressurized pipeline;
11. false actuation of protective interlock;
12. excess of maximum temperature of bearings and vibration of raw pumps.

The presented accidents contribute to the output of technological parameters that determine the explosion and fire hazard of the process beyond critical indicators, as a result of which the combined impact of hazardous factors on technological equipment and appliance is possible, which can lead to a major accident.

In order to exclude the negative consequences of the above-mentioned accidents at the installation and in cases of exceeding the limit values of the controlled parameters, the order provides for pre-emergency and emergency notification, as well as regulated [3] the following protective locks:

1. closing of electric valves on discharge of raw pumps;
2. shutdown of feed pumps;
3. closing the shut-off valve at the supply of direct and reverse liquid fuel in the furnace;
4. shutdown of main and pilot burners with water steam supply to furnace combustion chamber;
5. blocking circulation of hydrogen-containing gas in the high-pressure circuit;
6. emergency pressure relief in the high pressure circuit;
7. closing of shut-off valve at flow between separators;

8. closing of the shut-off valve in the line of sour water outlet from the separator to the tank;

9. closing the shut-off valve on the hydrogenate outlet line from the separators;

10. if the pressure in the system is exceeded, discharge of gas to the flare and to the fuel gas line;

11. reactor unit blowing with inert gas with discharge to the discharge panel plug

The AEPS can consist of any combination of instrumentation and automation (sensors, logic and actuators, telecommunications equipment, instrument power supply, pneumatic-hydro-electric actuators of actuators, etc.), which provide the necessary actions on the transfer process safe state in automatic execution mode. Although the AEPS performs the prescribed protective actions in rare cases, its failure to perform in requesting a shutdown or falsely executed locks can lead to significant technical and economic losses and deaths. Therefore, the automatic emergency protection system shall be properly activated whenever necessary [5].

It should be noted that according to clause 233 [3] methods of AEPS creation shall be determined in accordance with the required level of safety completeness determined at the stage of creation of requirements when designing automated process control systems based on the analysis of safety loop hazard and operability taking into account the risk arising in case of safety loop failure.

When designing AEPS, it is necessary to ensure compliance with all the requirements for the properties and performance indicators of AEPS. The main requirements for ensuring the functional safety of AEPS as an electronic programmable system are set out in the Russian state standard of International Electrotechnical Commission 61508 [6].

In conclusion, it should be noted that the results of the review of the main emergency situations and the corresponding interlocks of the emergency protection system of the diesel fuel hydrotreatment unit included in the oil refining complexes are presented in the work. Further study of protection against emergency AEPS in the process of diesel fuel hydrotreatment requires assessment of functional safety of SIS circuits of the corresponding object of study according to the procedure of the Russian state standard of International Electrotechnical Commission 61508 [6].

References

1. Analysis of statistics and causal relations of accidents at facilities of oil refining and petrochemical industry of Russia and Kazakhstan/A.V. Fedorov, K.K. Ospanov, E.N. Lomaev [et al.]//Technologies of technosphere safety. – 2021. – № 2(92). - P. 156-168. – DOI 10.25257/TTS.2021.2.92.156-168;

2. Marsh JLT Specialty "100 Largest Losses in the Hydrocarbon Industry 1974-2019" 26th edition, March 2020, P.4-16. URL: https://www.marsh.com/bw/insights/research-briefings/100-largest-losses-hydrocarbon-industry.html (date: 26.04.2021);

3. Federal norms and rules in the field of industrial safety "general rules of explosion safety for explosion and fire hazardous chemical, petrochemical and oil refining industries "/Order of the federal service for environmental, technological and nuclear supervision dated December 15, 2020 No. 533;

4. Ospanov, K. K. Accident risk analysis using the example of a diesel fuel hydrotreatment unit /K. K. Ospanov//Automation in industry. – 2021. – № 12. - P. 40-42. – DOI 10.25728/avtprom.2021.12.07.

5. Gromakov E.I., Zebzeev A.G. Designing automatic systems for technological safety control: textbook/Tomsk Polytechnic University. - Tomsk: Publishing House of Tomsk Polytechnic University, 2019. - 8 p;

6. The Russian state standard of International Electrotechnical Commission 61511-3-2018. Security is functional. Instrument safety systems for industrial processes. - M.: Standardized, 2018.

DOI 10.34660/INF.2022.54.47.021

超级电容器蓄能系统与牵引变流器相结合，用于在铁路运输加速过程中积累制动能量并返回

SUPERCAPACITOR ENERGY-ACCUMULATION SYSTEM IN CONJUNCTION WITH A TRACTION CONVERTER FOR THE ACCUMULATION OF BRAKING ENERGY AND ITS RETURN DURING THE ACCELERATION OF RAIL TRANSPORT

Lifshitz Mikhail Valerievich
General Designer, Chairman of the Board of Directors of ROTEC JSC. Distinguished Mechanical Engineer of the Russian Federation

客观的。评估在圣彼得堡有轨电车 27 号线路段上安装和未安装超级电容器蓄能系统（以下简称“EEA”）的有轨电车转向架牵引驱动的技术可行性和成本效益。圣彼得堡；确定 EEA 在电车制动模式下的累积能量量以及在使用 EEA 的情况下节省电能的可能性；并评估有轨电车与 EEA 自主移动的可能性。

方法。在 LM-68M2 型、城市编号 7546 的有轨电车上，第一个转向架 (BSPT-1) 的牵引驱动装置上安装了一个电能蓄电池 (EEA)。电车路线：Babushkina St. - Pribrezhnaya St. 和相反方向。单向路线上的停靠站数 - 10。这辆有轨电车为每个转向架安装了两个牵引驱动器，它们的设置相同，负责货车的牵引特性，从而可以比较有和没有转向架牵引驱动器的能量指标欧洲经济区。为确保充分利用欧洲经济区的电力，第一台牵引变流器 (BSPT) 的 VTOTD 通过软件方法关闭，并将开启制动晶体管的阈值提高到 780 V。普通有轨电车在停止面板处停靠。

结果：能源指标的比较得出的结论是，将 EEA 用作铁路运输的一部分可使接触网系统消耗的电流平均值降低 40%，并消除制动期间向接触网系统注入的反向电流.使用 EEA 作为铁路运输的一部分，可以在制动期间利用牵引驱动产生的能量。每次制动累积的能量为 0.288 kW*h。应该注意的是，在没有 EEA 的情况下，所产生的全部能量都通过耗散到电阻器模块和接触线上而释放为热量。在铁路运输中使用 EEA 可以节省 40% 的能源。使用 EEA 作为铁路运输的一部分支持在接触网系统断电的情况下“自主”运行，从而允许铁路运输离开交叉口或到达接触网系统的下一部分。

实际意义：为了提高再生制动的效率，建议在机车车辆上使用电能蓄能器（EEA），这样可以积累制动能量，然后在启动模式下使用，而无需将再生能量转移到牵引网络。在城市电动地面交通中引入 EEA 作为能量接收器，将有可能将制动能量存储在电池组中并实现自主运行。

关键词：机车车辆制动能量再生，再生电阻制动，蓄能器，城市电动交通。

Objective. To assess the technical feasibility and cost-effectiveness *of the traction drive of a tram bogie with and without an installed supercapacitor energy-accumulation system (hereinafter referred to as an "EEA") on a section of the tram No. 27 route in St. Petersburg; to determine the amount of accumulated energy in the EEA in tram-braking mode and the possibility of electric-energy savings in case of EEA use; and to assess the possibility of the autonomous movement of trams with EEA.*

Methods. *On the tram wagon model LM-68M2, city No. 7546, an electric energy-accumulator (EEA) was installed on the traction drive of the first bogie (BSPT-1). Tram route: Babushkina St. – Pribrezhnaya St. and in the opposite direction. Number of stops on the one-way route – 10. This tram has two traction drives installed for each bogie with identical settings responsible for the wagon's traction characteristics, making it possible to compare the energy indicators of the traction drive of the bogie with and without the EEA. To ensure full utilization of the EEA's power, the* VT_{OTD} *of the first traction converter (BSPT) was turned off by the software method and the threshold for turning on the braking transistor was increased to 780 V. The movement occurred in the operating mode of a regular tram with stops at the stopping panels.*

Results: *a comparison of energy indicators leads to the conclusion that the use of EEA as part of rail transport yields a 40 % reduction in the average value of the current consumed from the catenary system and eliminates reverse-current injection into the catenary system during braking. The use of EEA as part of rail transport makes it possible to utilize the energy generated by the traction drive during braking. Energy in the amount of 0.288 kW*h is accumulated per braking. It should be noted that in the absence of EEA, the entire generated volume of energy is released into heat through dissipation onto the resistor modules and contact wire. The use of EEA in rail transport makes it possible to reap energy savings of 40 %. The use of EEA as part of rail transport supports "autonomous" running in case of a power failure in the catenary system, thereby allowing rail transport to exit a crossing or reach the catenary system's next section.*

Practical importance: *to increase the efficiency of regenerative braking, it is proposed to use an electric energy-accumulator (EEA) on rolling stock, which would make it possible to accumulate braking energy and then use it in starting mode without transferring the regenerative energy to the traction network. The introduction of EEA as energy receivers on urban electric ground transport would make it possible to store braking energy in the battery pack and achieve autonomous running.*

Keywords: *Braking energy regeneration of rolling stock, regenerative-resistor braking, energy accumulators, urban electric transport.*

The constant growth of power rates is making energy savings a critical issue – particularly for urban electric-transport enterprises, which are the most energy-intensive consumers [1]. Effective means of saving energy include the use of regenerative braking on electric rolling stock (ERS). Theoretical and experimental works have made it possible to create domestic ERS with regenerative and regenerative-rheostatic braking [2, 3].

During regenerative braking, the train works in parallel with the traction units of substations. This feature determines the operating conditions of the entire power-supply system [4]. For rail transport, identifying the conditions that ensure the best use of the energy of electric braking, as well as the impact of regeneration on the power-supply modes of trains, is an urgent task [5].

The unique property of the electric motor – the reversibility of energy conversion – goes virtually unused today; the energy is dissipated through the heating of rheostats and turns into "energy waste," heating the atmosphere. Only in the 21st century has a tool emerged allowing for its effective collection. Supercapacitor batteries, with a lifespan of hundreds of thousands of charge cycles, are not a consumable material, but part of the whole system.

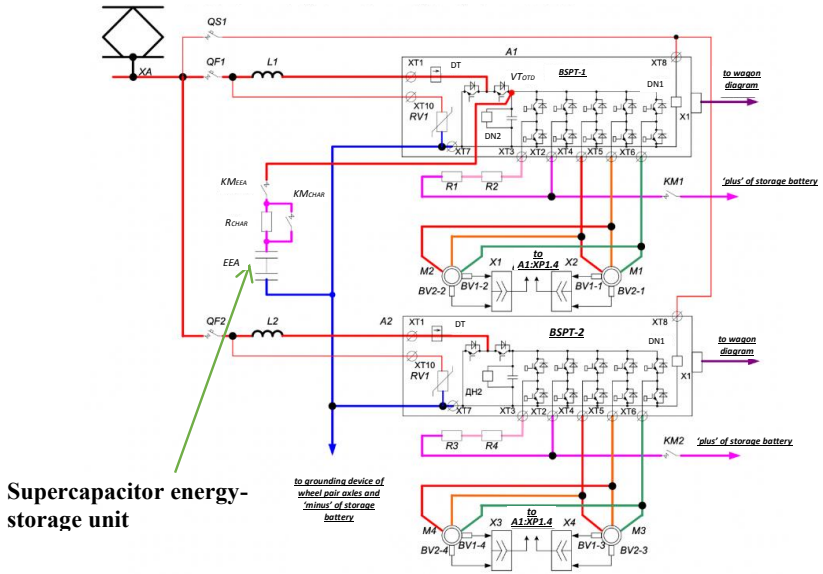
The main producers of "energy waste" are electric (hybrid) transport of all types and lifting mechanisms. This energy can and should be collected and used locally or transferred to the grid. New energy is produced when the generated energy has already been collected [6].

Using the example of a section of the tram No. 27 route in St. Petersburg with an installed supercapacitor energy-storage system, it was proven that one traction wagon generates 142 kW*h of clean energy per day. This is comparable to the operation of a 1,000 sq. meter solar park. The electricity generated by electric rail transport amounted to up to 40 % of the energy it consumes during acceleration.

The options for receiving regenerative energy can be presented in the following order:

- supercapacitor energy-storage unit: 7 serial modules MLSK 56-150, connection 7s1p;
- traction converter BSPT-1;
- tram wagon LM-68M2, city No. 7546.

On the tram wagon model LM-68M2, city No. 7546, an electric energy-accumulator (EEA) was installed on the traction drive of the first bogie (BSPT-1). A diagram of the EEA's electrical connection is presented in **Fig. 1**



Supercapacitor energy-storage unit

Tram route: Babushkina St. – Pribrezhnaya St. and in the opposite direction. Number of stops on the one-way route – 10.

This tram has two traction drives installed for each bogie with identical settings responsible for the wagon's traction characteristics, making it possible to compare the energy indicators of the traction drive of the bogie with and without the EEA. To ensure full utilization of the EEA's power, the $\mathbf{VT_{OTD}}$ of the first traction converter (BSPT) was turned off by the software method and the threshold for turning on the braking transistor was increased to 780 V.

The movement occurred in the operating mode of a regular tram with stops at the stopping panels.

Fig. 2 presents graphs of the change in voltage, current and speed over time during movement

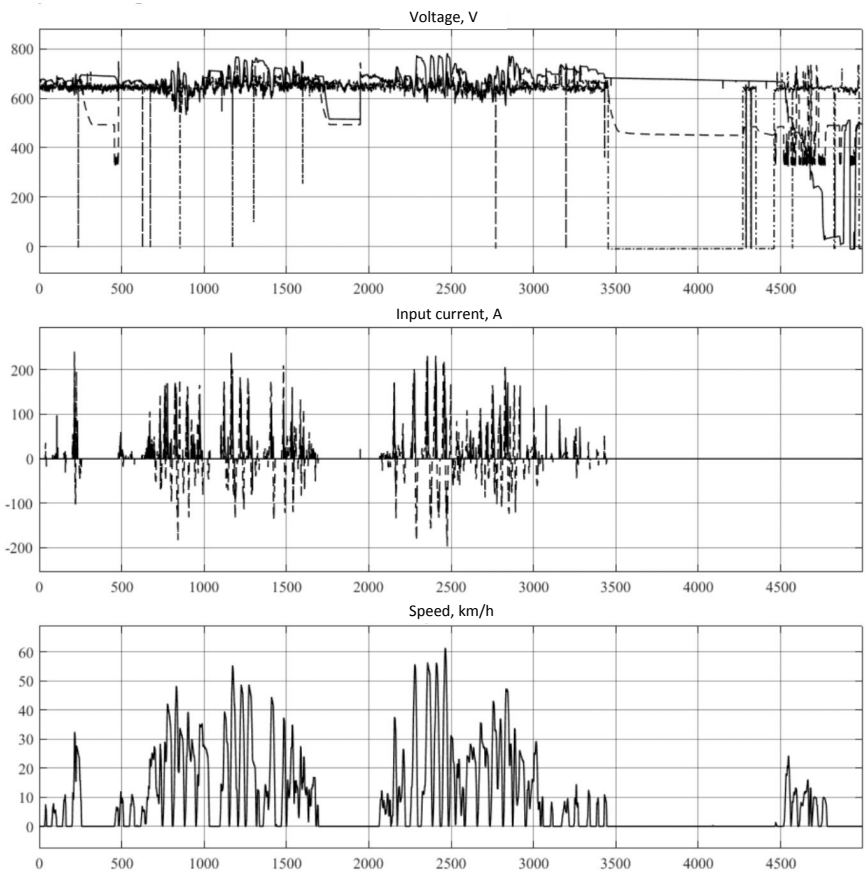


Figure 2. *Graphs of the change in voltage, current and speed over time during movement, where:*

_____ – voltage at the filter and current of the catenary system of the first bogie's traction drive;

--------- – voltage at the filter and current of the catenary system of the second bogie's traction drive;

-.-.-.-.-. – voltage in the catenary system.

Fig. 3 shows graphic fragments of the change in voltage, current and speed over time during movement.

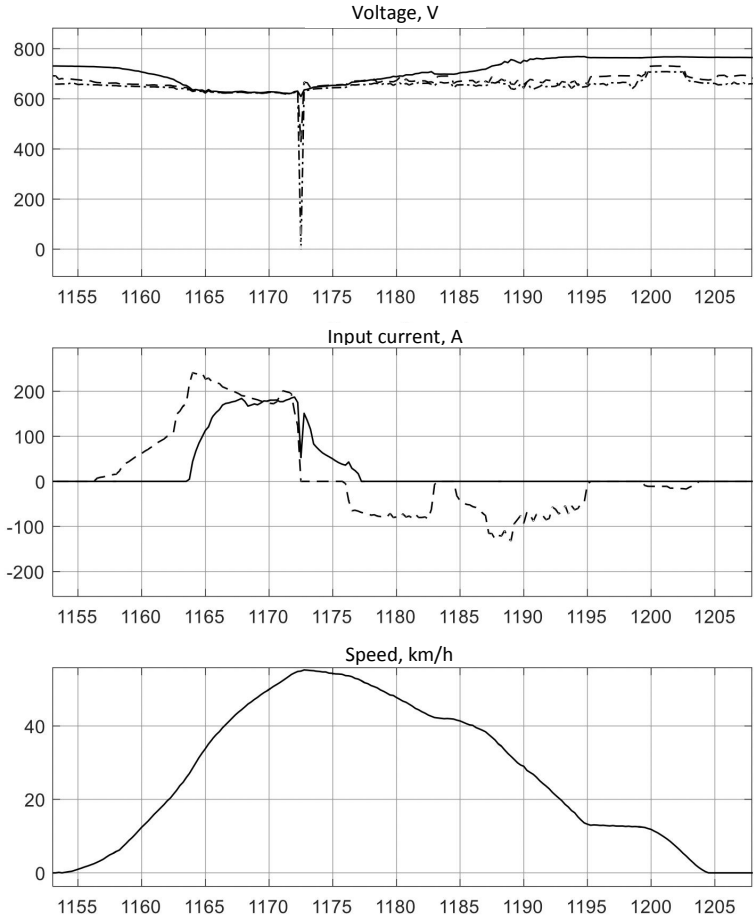


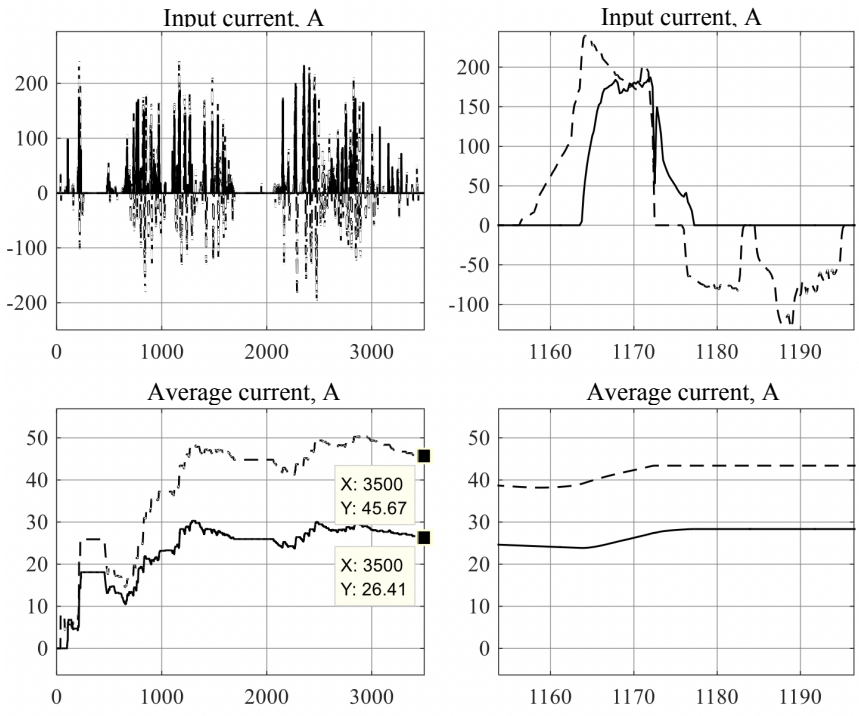
Figure 3. *Graphic fragments of the change in voltage, current and speed over time during movement, where:*

_____ – voltage at the filter and current of the catenary system of the first bogie's traction drive;

--------- – voltage at the filter and current of the catenary system of the second bogie's traction drive;

-.-.-.-.-. – voltage in the catenary system.

Measurements and calculations were taken of the average value of consumed current for traction during movement of the first and second bogies, respectively. **Fig. 4** shows the yielded values.



a) Whole route b) Fragment

Figure 4. *Graph of input currents and their average values during movement, where:*

_____ – current consumed by the traction drive of the first bogie with the EEA;

- - - - - - - - – current consumed by the traction drive of the second bogie.

As is evident from the graphs, the average value of the current consumed by the traction of the first traction converter is 26 A, and that of the second – 45 A.

A comparison of energy indicators leads to the conclusion that the use of EEA as part of rail transport yields a 40 % reduction in the average value of the current consumed from the catenary system and eliminates reverse-current injection into the catenary system during braking.

The total travel time of the route from the Babushkina St. stop to the Pribrezhnaya St. stop is 30 minutes. The number of stops on the one-way route is 10. During passage of this route, EEA operational data was recorded for both the intake of electricity and for its return.

Based on the results of analysis of the log files, it was found that during all the decelerations of the EEA, 10.363 MJ or 2.88 kW*h were accumulated. At the same time, in the process of all accelerations, 10.606 MJ or 2.95 kW*h were spent from the EEA.

The use of EEA as part of rail transport makes it possible to utilize the energy generated by the traction drive during braking. Energy in the amount of 0.288 kW*h is accumulated per braking. It should be noted that in the absence of EEA, the entire generated volume of energy is released into heat through dissipation onto the resistor modules and contact wire.

Based on the data received, graphs were formed depicting the change in energy spent on traction from the catenary system (**Fig. 5**).

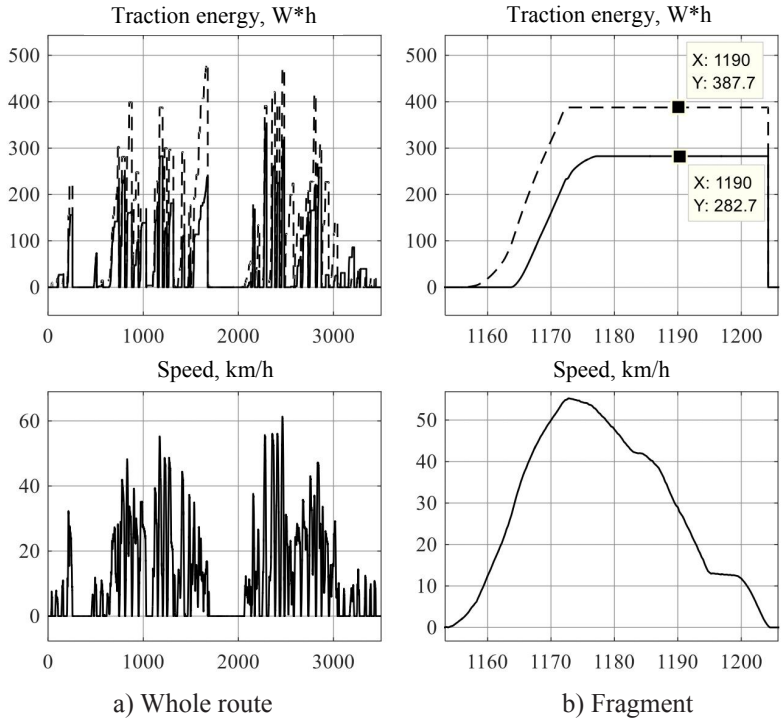


Figure 5. *Graphs of the change in energy spent on traction from the catenary system, where:*

_____ – current consumed by the traction drive of the first bogie with the EEA;

- - - - - - - - – current consumed by the traction drive of the second bogie.

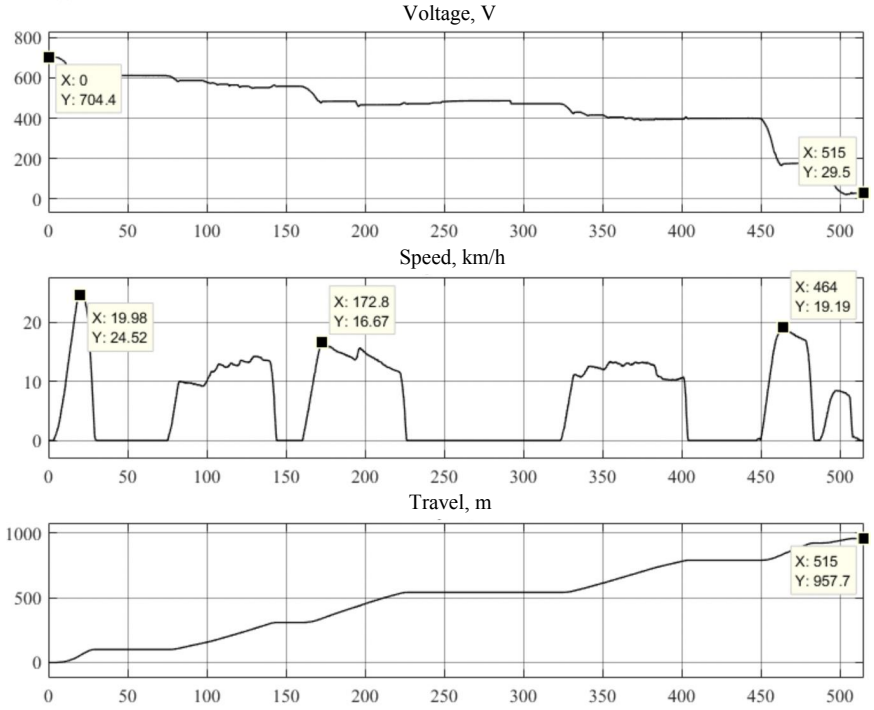
On the given fragment of the section, the value of the energy spent by the traction drive with the EEA is 282.7 W*h, and by the traction drive without the EEA – 387.7 W*h. The reduction in consumption from the catenary system, as well as energy savings, is 37 %.

The use of EEA as part of rail transport makes it possible to generate up to 40 % of the energy spent on its movement.

As part of the tests, an assessment was made of the possibility of a tram running autonomously on the energy of a supercapacitor accumulator.

The tests were conducted with a charged EEA and a lowered pantograph (no power supply from the catenary system), with only one bogie operating.

Fig. 6. illustrates graphs of the change in voltage, speed and distance traveled over time in "autonomous" mode.



According to the results, the tram, without limiting its dynamic properties, **traveled a distance of 957 meters in "autonomous" mode.** At the same time, the decrease in the EEA's voltage was 674 V – from 704 V to 30 V.

The use of EEA as part of rail transport supports “autonomous” running in case of a power failure in the catenary system, thereby allowing rail transport to exit a crossing or reach the catenary system’s next section.

Conclusion

The unique property of electric machines – the conversion reversibility of electrical energy (from electrical to mechanical and vice versa) – is not being fully utilized. **Only the first conversion is being used**, while the energy generated during the second conversion is not being collected but discharged into the atmosphere through the heating of resistors and other system elements. It is precisely the use of the two transitions that will make electric transport a truly efficient means of moving people and goods – and the cleanest.

The tests showed that supercapacitor batteries are the most efficient tool for the full utilization of the second transformation for the purposes of the generation of electrical energy and its subsequent use either at the generation location or with its subsequent transmission to the grid, making it possible to boost recovery rate from the existing 5-10 % to 40 %.

References

1. K.G. Marquardt. Power Supply of Electrified Railways: Textbook for Higher Educational Institutions of Railway Transport / K.G. Marquardt. – M.: Transport, 1982. – 528 p.

2. A.S. Maznev. Electrical Devices and Circuits of Rolling Stock: Textbook for Students of Secondary Vocational Education Institutions / A.S. Maznev, O.I. Shatnev. – M.: Akademiya, 2008. – 272 p.

3. V.G. Shcherbakov. Traction Electric Machines: Textbook / V.G. Shcherbakov, A.D. Petrushin, B.I. Khomchenko, V.I. Sedov, S.A. Pakhomin, A.S. Maznev, P.G. Kolpahchyan; edited by V.G. Shcherbakov, A.D. Petrushin. – M.: FSBEI “Training and Methodological Center of Education on Railway Transport”, 2016. – 641 p.

4. E.V. Ter-Oganov. Power Supply of Railways: Textbook for Students of the Ural State University of Railway Transport / E. V. Ter-Oganov, A.A. Pyshkin. – Yekaterinburg Publishing House of USURT, 2014. – 432 p.

5. A.A. Bogdanov. Structure and Repair of Electric Trains of the Subway: Textbook for Vocational Schools / A. A. Bogdanov, V.S. Gusev, Yu.Ya. Mogilner, E.A. Sementovskiy; edited by E.A. Sementovskiy.– M.: Transport, 1991. – 335 p.

6. STF “Energoprogress” JSC, “Electric Energy Chronicles” (http://vesti.energy-journals.ru/yenergeticheskie-otkhody-novyy-isto/) – “Energy Waste” – New Source of Green Energy.

DOI 10.34660/INF.2022.13.29.022

悬浮液运动粘度的研究
STUDY OF THE KINEMATIC VISCOSITY OF THE SUSPENSION

Vasyukova A.T.[1], Krivoshonok K.V. [1], Tokareva T.Yu.[1]
Talbi Mounir[2], Popov V.[2]
[1]MSUPP, Russia, Moscow
[2] MSUTU named after K.G. Razumovsky (PKU), Russia, Moscow

Particular attention of Russian and foreign developers was directed to the stability and viscosity of the suspension with maximum filling and minimum consumption of expensive surfactants. [1].

Experiments with bimodal suspensions are very effective. For example, two suspensions with equal content of powders of the same composition, but of different dispersion, are mixed. The viscosity of each of the mixed suspensions is very large (they are almost pastes). The viscosity of their mechanical mixture (with the same filling of 63.5 wt.%), prepared without the addition of surfactants or mechanical effects (except mixing), in the ratio of 45:55 is 0.2 Па • с — more than 20 times less than the viscosity of each of the original. Equally effective are experiments with bimodal suspensions, in which the dispersion of one of the fractions was consistently increased. As the dispersion of one of the fractions increases, the viscosity of the suspension first decreases sharply, and then equally sharply increases [1-5].

The viscosity of suspensions determines the hydration process, when, over time of storage, the hygroscopic absorption of water becomes larger and their viscosity increases. Reducing viscosity is not the only purpose of introducing chemical additives. The second task of this technological technique is to ensure high stability. [1,2,6].

Viscosity is the inverse of the fluid flow of a liquid, which depends on the nature of the liquid and decreases with increasing temperature. Viscosity directly depends on the concentration of dissolved substances, as a result of which the property of the mixture also changes. The viscosity of milk mixtures can be affected by the substances present in them - thickeners. Thickening agents are needed in milk formulas for better absorption of nutrients [7].

When creating new types of culinary products, one of the most important crite-

ria is the organoleptic properties of food products. In the formation of organoleptic properties of products, the number of components, heat treatment of raw materials, technological modes are also crucial. One of the indicators of semi-finished liquid dough that we develop is consistency, and its formation is influenced by flour raw materials and its heat treatment, as well as various components included in the recipe. Taking this into account, in our research papers we studied the optimal temperature indicators and the influence of raw materials, the type and amount of liquid included in the dispersed system. The quality of the liquid itself included in the suspension is also important. This is water treatment, fluid temperature and ambient temperature. In the binary system liquid: the dense part of the main component is a powdered product (different types of flour from cereals and oilseeds are selected).

Nut (almond) flour is rich in vitamins E, group B, A, PP, as well as useful minerals: potassium, calcium, magnesium, zinc, manganese, iron, phosphorus and sodium. In addition, it contains Omega-3 acids, without which the normal functioning of the body is impossible It also contains about 20% protein and 55% fat [8], and this, in turn, means that products and semi-finished products prepared on its basis will have a pleasant texture and taste properties (Skurikhin, 2002, c. 1-236) [9].

Corn flour contains a small amount of amino acids, but is high in carbohydrates, contributing to the normalization and stabilization of blood sugar levels, vitamin B_1, it also contains calcium, magnesium, iron, phosphorus and copper. It is often used in the production of confectionery, which makes cakes, cookies and cakes the most crumbly and pleasant to the taste. [10].

Rice, buckwheat, flaxseed and amaranth flour are gluten-free. As a rule, the content of gliadins in gluten is at the level of 50%, so 20 mg / kg of gluten (0.002%) corresponds to the limit concentration of gliadin of 10 mg / kg (0,001%) [11].

According to the ideas adopted in the analyzed period of time, and established ideas, the rheology of consistent media is considered as the result of the contact interaction of their constituent particles, spontaneous, caused by physicochemical factors or caused by the action of external forces, the formation and destruction of conglomerate structures of various types, depending on the factors of the internal and external environment. However, the studies conducted do not provide exhaustive answers to the rheology of organic binary systems. In this regard, search work in this direction is relevant.

Materials and methods

The purpose of the work is to study the kinematic viscosity of the suspension during the manufacture of liquid unleavened dough.

The object of the study was suspensions of liquid dough based on liquid media (water, milk, water: milk - 1:1) and various powdered products: wheat flour, rice,

buckwheat, amaranth, mineral, corn and flax. The kinematic viscosity of the suspension under study was determined by viscometry using a viscometer-2.

The methodology of this work is based on the theoretical and practical aspects of modern nutrition related to the development of the consistency of the liquid dough for industrial technologies. When solving the tasks, generally accepted standard research methods were used: organoleptic, physicochemical, microbiological, statistical.

Organoleptic parameters were determined according to GOST 27558-87[12].

Research results and discussion

The study of the kinematic viscosity of the suspension included the creation of a liquid dough structure, which should have strength characteristics that allow in a limited period of time to be evenly distributed over the frying surface, create an elastic structure that retains its shape well when baking and dispensing finished products to consumers.

One of the components of the suspension is a liquid medium. In this study, the following were used: water, milk, water: milk - 1:1. The viscosity of liquids was determined at 20 ° C on a viscometer VPJ-2. The properties of these media are shown in Fig.1.

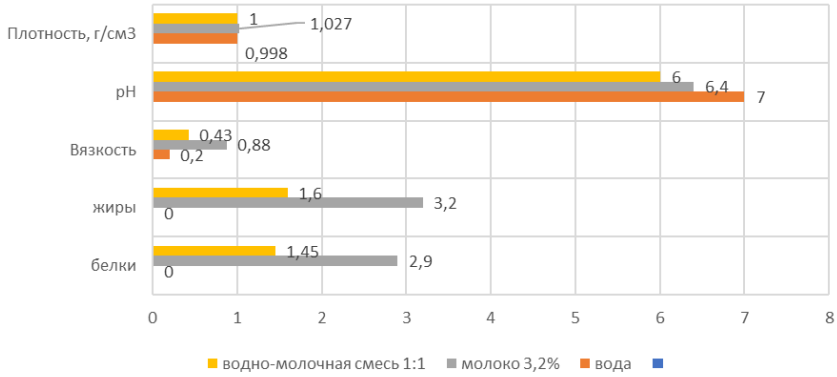


Figure 1. *Properties of liquid components of the suspension*

The mass fraction of moisture depends on the water-absorbing capacity of the flour, and its water absorption capacity, in turn, is affected by gluten and starch grains damaged during grinding. From the above data it follows that when replacing wheat flour with a mixture of corn, buckwheat, amaranth, linseed and almond flour in the ratio of 50:50, the humidity indicators are closest to the control sample. It is obtained that the viscosity and density of the studied liquid media depends on the type of liquid and the constituent components of the mixture.

Based on the results of our study, generalized equations for the viscosity of suspensions were obtained, which for dilute suspensions coincide with Einstein's formula and adequately describe the experimentally investigated features of the rheology of suspensions in the entire range of their consistency.

The viscosity of suspensions of non-interacting spherical particles, but higher concentration than necessary to fulfill Einstein's equation, is described by empirical polynomial equations of a higher order for samples with milk and water (Fig. 2-9):

- for suspension of wheat flour with water – $y = 0{,}0373x^2-0{,}0688x+0{,}3118$;
- for suspension of wheat flour with milk – $y = 0{,}0373x^2-0{,}0688x+0{,}3118$;
- for suspension of buckwheat flour with water – $y = 0{,}122x^2-0{,}348x+0{,}8485$;
- for suspension of buckwheat flour with milk – $y = 0{,}239x^2-0{,}7568x+1{,}4565$;
- for suspension of corn flour with water – $y = 0{,}0172x^2-0{,}0569x+0{,}6003$;
- for suspension of corn flour with milk – $y = -0{,}01x^2-0{,}088x+0{,}695$;
- for suspension of almond flour with water – $y = 0{,}0415x+0{,}4435$;
- for suspension of almond flour with milk – $y = -0{,}007x^2+0{,}077x+0{,}761$.

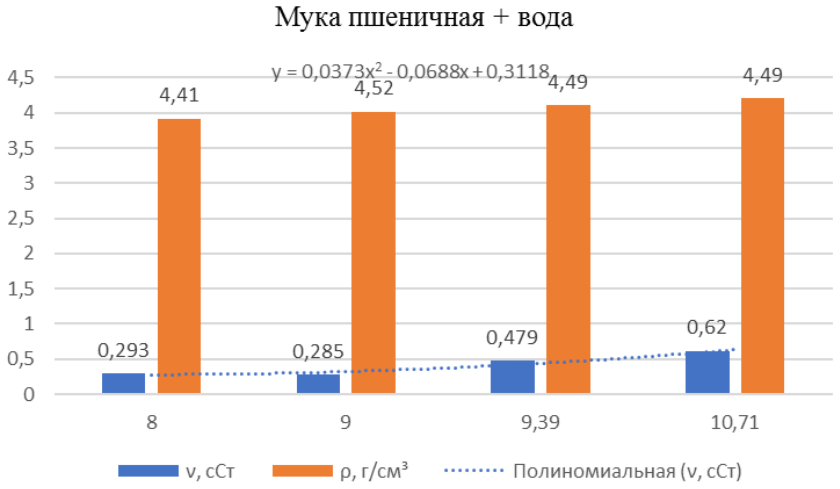


Figure 2. *Change in the viscosity of wheat suspension from flour density*

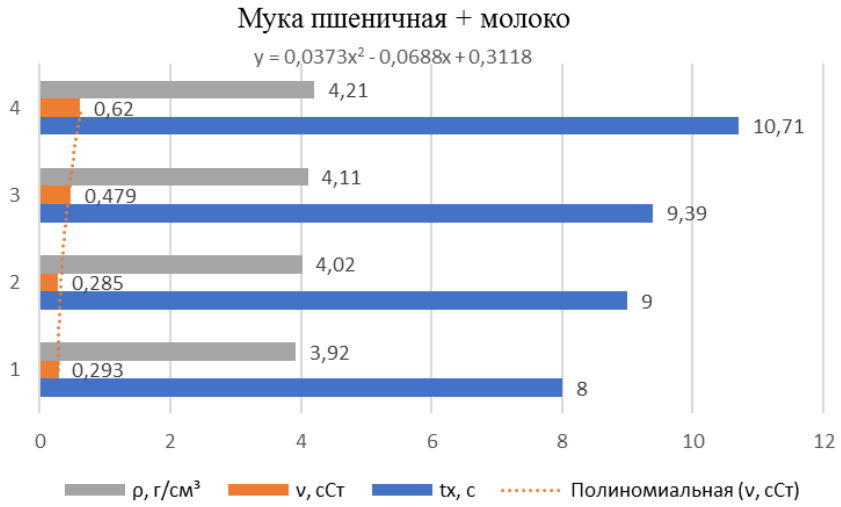


Figure 3. *Dependence of the viscosity of the water-milk solution on the density of wheat flour*

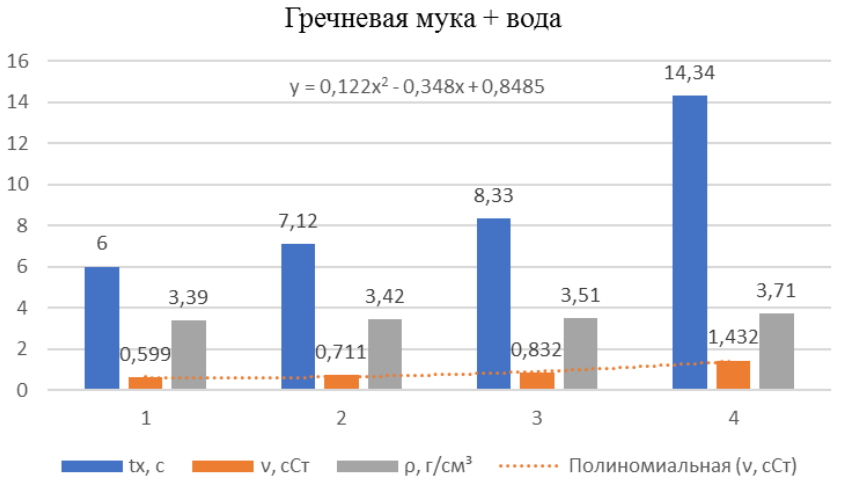


Figure 4. *Change in the viscosity of buckwheat suspension from flour density*

Figure 5. *Dependence of the viscosity of the water-milk solution on the density of buckwheat flour*

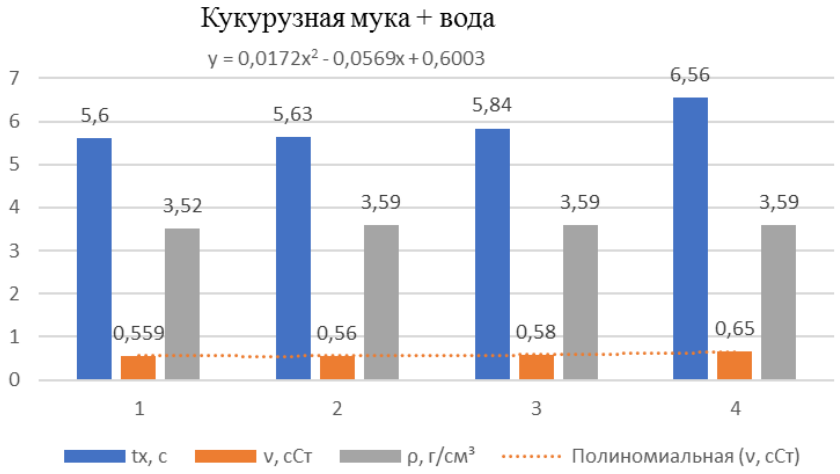


Figure 6. *Change in the viscosity of the corn slurry from the flour density*

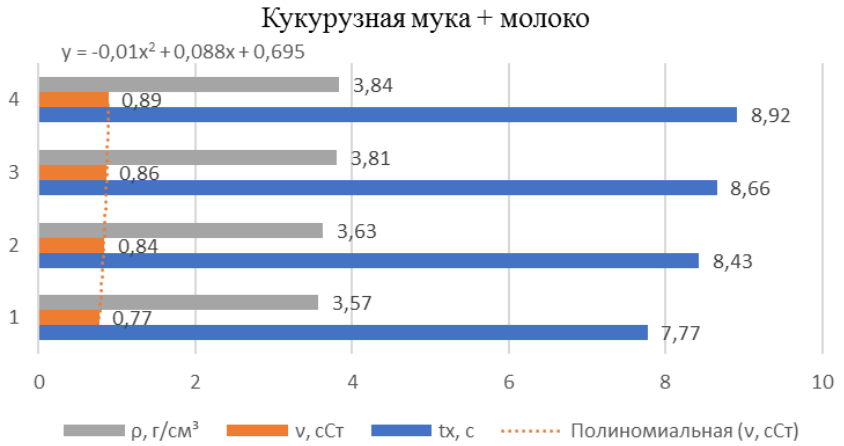


Figure 7. *Dependence of the viscosity of the water-milk solution on the density of corn flour*

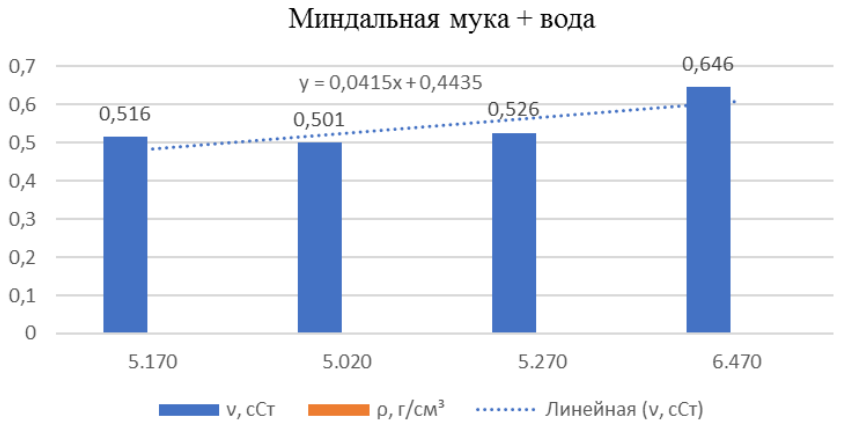


Figure 8. *Change in the viscosity of the almond suspension from the flour density*

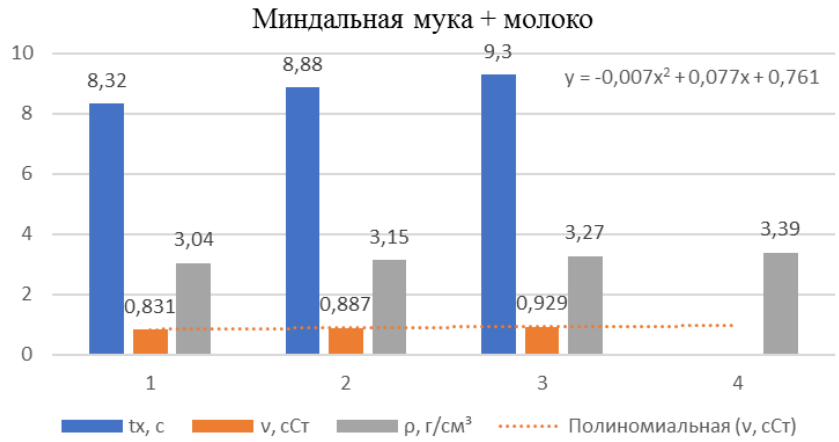


Figure 9. *Dependence of the viscosity of the water-milk solution on the density of almond flour*

Studies show that suspensions in rheological models should be considered as two-phase (irreducible to single-phase) systems in which the dispersion medium actually determines their viscosity. Of course, only the part of it that is not enclosed inside the particle aggregates is not attached in any way to the particles and is "free" on this basis.

In the theory of viscosity of suspensions with a low solid phase content, Einstein considered particles as inclusions in the dispersion medium, and the viscosity of suspensions as a consequence of the perturbations they introduced. If we consider highly filled suspensions from the same position, i.e. to assume that the viscosity of suspensions determines the viscosity of the dispersion medium, and the particles of the solid phase introduce a consolidated perturbation into it, then the proportionality of the viscosity of the suspensions of the viscosity of the dispersion medium seems quite logical. This concept means the transition from the macroreology of suspensions to phase rheology - the representation of suspensions as a dispersion in the composition of two phases, from which the dispersion medium determines their rheological properties, and the dispersed phase - the state of the dispersion medium [2, 3,6,7].

Studies of the mutual influence of the physicochemical properties of liquids and various types of flour made it possible to find the dependence of the components of the dispersed system. These studies are based on the theory of stability of lyophobic colloids, suggesting that in a thixotropic finely dispersed aqueous suspension, the total energy of the interaction of two spherical particles consists of ionic-electrostatic and molecular dispersion components.

Since amaranth flour contains lecithin, which provides an improvement in the structural and mechanical properties of the dough, it is advisable to use it in a mixture with other types of flour that do not contain gluten, which are characterized by low water absorption capacity, such as rice (62.8%) and corn flour (64.9%), flaxseed (47.0%) and almond flour. (20,0%).

The liquid fraction of the suspension (water: milk – 1: 1) made it possible to obtain a viscosity that occupies an intermediate position between water and milk. Also, the mass fraction of moisture depends on the water-absorbing capacity of the flour, and its water absorption capacity, in turn, is affected by gluten and starch grains damaged by grinding. Our results are consistent with studies the influence of various additives and heat treatment on the degree of swelling of rice, wheat, pea flour, which is part of the semi-finished vegetable sauces [10].

Thus, the studies carried out on the creation of stable suspensions for the manufacture of pancakes made it possible to obtain the dependencies of the mutual participation of the components of the dispersed system in the simulated process.

The results of the determination of kinematic viscosity show that a suspension of rice and amaranth flour has a lower viscosity, which leads to the need to increase the proportion of these types of flour in the formulation. Therefore, in order to obtain the specified properties of the dough, it is advisable to mix flour with increased kinematic viscosity (corn) with other types with weaker kinematic viscosity, which is reflected in the work of Tiunov V.M. in the formation of the quality of flour culinary products from flour that does not contain gluten. [13].

This result makes it possible to use the kinematic viscosity of suspensions obtained from various types of liquid at a temperature^{of}20° C in a dispersed medium with powdered plant substances [14].

Conclusion

The study of the kinematic viscosity of the suspension revealed the dependencies described by empirical polynomial equations of a higher order for samples with milk and water. The liquid fraction of the water-milk suspension made it possible to obtain a viscosity that occupies an intermediate position between suspensions with water and milk. All these data make it possible to calculate the recipe for a liquid dough that has the required strength characteristics.

References

1. Redkina, N.I. Rheology of water-coal suspensions /N.I. Redkina, G.S. Khodakov, E.G. Gorlov // Chemistry of solid fuel, 2009, No 6, p. 15-24. https:// naukarus.com/reologiya-vodougolnyh-suspenziy

2. Khodakov, G.S. Rheology of suspensions. The theory of phase flow and its experimental substantiation /G. S. Khodakov. - Done. chem. zh. (J. Ros. khim. ob-va im. D.I. Mendeleev), 2003, t. XLVII, № 2. – P 33-44.

3. Vasyukova A T, Alekseev A A, Slavyansky A, Moshkin A B 2019. The use of natural plant supplements in flour culinary products III International Scientific and Practical Conference "Science and Education in the Modern World: Challenges of the Twentieth Century" 289-293

4. Vasilenko V.N., Frolova L.N., Derkanosova A.A., Mikhailova N.A., Shhepkina A.A., Davydov A.M. Software of the extrusion process abnormally viscous fluids methods of experiment planning. Proceedings of the Voronezh State University of Engineering Technologies. 2018;80(3):37-42. (In Russ.) https://doi.org/10.20914/2310-1202-2018-3-37-42

5. Kolomnikova Y.P., Derkanosova A.A., Manukovskaya M.V., Litvinova E.V. Effect of non-traditional vegetable raw materials on the properties and biotechnological structure pastry. Proceedings of the Voronezh State University of Engineering Technologies. 2015; (3):157-160. (In Russ.) https://doi.org/10.20914/2310-1202-2015-3-157-160

6. Vasyukova A T, Ganina V I, Egorova S V 2020. The dietary supplement: Composition, control and functional properties Journal of Advanced Research in Dynamical and Control Systems **12(4** *Special Issue) 903-906.*

7. Naronova, N.A. Estimation of osmomolality and viscosity of milk mixtures in different types of water / N.A. Naronova, E.A. Surnina, Yu.A. Cheraneva. // International Journal of Medicine and Psychology / International Journal of Medicine and Psychology, 2019, Volume 2, №4. – C. 43-45.

8. Shchetinin, M.P. Expansion of the range of biscuit gluten-free semi-finished products. /M.P. Shchetinin, Z.R. Khodyreva // Confectionery. Technology. http://www.candytech.ru/okompanii/rasshirenieassortimentabiskvitnyhbezglyutenovymhpolufabrikatovm.html

9. Tables of chemical composition of Russian food products. /Ed. by I.M. Skurikhin, V.A. Tutelyan. – M.: DeLi Plus, 2002. – 283 c.

10. Atakhanov, Sh.N. Study of the influence of various additives and heat treatment on the degree of swelling of rice, wheat, pea flour, which is part of the semi-finished vegetable sauces / Sh.N. Atakhanov, K.O. Dodaev, L. Mamadzhanov, D.O. Rakhmonov // Technology of food products, 2021, 4(85) 14.

11. MUK 4.1.2880-11 Methods for determining gluten.

12. GOST 27558-87 Flour and bran. Methods for determining color, smell, taste and crunch. Introduction. 1989 – 01-01. - M.: Standartinform, 2007. – 4 c.

13. Tiunov V.M. Formation of the quality of flour culinary products from gluten-free flour and a diet based on them. Abstract of the diss... Ph.D., Yekaterinburg, 2019. – 23 p.

14. Vasyukova, A.T. Enrichment of yeast dough with additives of wild plants / Vasyukova A.T., Adzhyan E.A., Strokova A.S. /In the collection: Development of engineering education and its role in the technical modernization of the agro-industrial complex. Materials of the International Scientific and Practical Conference dedicated to the 65th anniversary of the training of mechanical engineers by the Izhevsk State Agricultural Academy. Izhevsk, 2021. C. 273-279.

DOI 10.34660/INF.2022.43.18.023

确定海岸边缘时的回波信号海面波动建模

MODELING OF FLUCTUATIONS OF SEA SURFACE ECHO SIGNALS WHEN DETERMINING THE COASTAL EDGE

Wattimena Gysberth Maurits
State Polytechnic Institute Ambon, Indonesia
Bozhenko Victoria Vyacheslavovna
Assistant
Saint-Petersburg State University of Aerospace Instrumentation
Tyurinova Violetta Alexandrovna
Master's degree student
Saint-Petersburg State University of Aerospace Instrumentation

抽象的。 除了中值滤波之外，还通过使用模拟方法研究了确定沿海边缘的算法。 这些算法包含在距离坐标中移动一个分辨率元素的回波信号的序列减法运算。 这相当于对随机过程进行微分的操作。 因此，有必要使用微分过程的数学模型来正确确定用于确定海岸边缘的算法的质量特征。 该论文提出了一种可微过程模型，该模型描述了海面回波信号的波动，同时考虑了回波信号的空间相关性。

关键词：数学建模，回波信号，海面，海岸边缘，可微过程，机载设备。

Abstract. *Algorithms for determining the coastal edge are studied by using simulation methods, while in addition to median filtering. These algorithms contain sequence subtraction operations of echo signals shifted by one resolution element in the range coordinate. This is equivalent to the operation of differentiating a random process. Therefore, it is necessary to use mathematical models of differentiated processes to determine correctly the quality characteristics of algorithms for determining the coastal edge. The paper proposes a model of a differentiable process that describes fluctuations of echo signals of the sea surface, taking into account the spatial correlation of echo signals.*

Keywords: *mathematical modeling, echo signal, sea surface, coastal edge, differentiable process, onboard equipment.*

Introduction

Changes in sea level, as well as all kinds of natural disasters, such as volcanic eruptions, tsunamis, landslides, etc., lead to a change in the coastline. These

changes must be promptly tracked, therefore, algorithms for determining coastlines are important [1,2].

The assessment of the quality of algorithms for determining the land-sea edge due to the nonlinearity of the algorithms is carried out using simulation methods, for the implementation of which mathematical models of fluctuations of location signals reflected both from the sea surface and from the land are required.

The work [3] presents a mathematical model of the reflection of location signals from the edge - the resolution element of the onboard radar, into which both the elements of the land and the sea surface fall. Simulation models of these reflections of location signals from land and sea surface are presented in the work [4], but the authors did not take into account possible correlations, since it was enough for them to use traditional models.

The work [5] presents the results of mathematical modeling of determining the coastal edge, taking into account the correlations of the echo signals of the sea surface. However, the authors limited themselves to the simplest Markov process, since the purpose of the work was to obtain comparative characteristics of different algorithms for determining the edge. The model of a non-differentiable Markov process was used in the work [4]. This paper presents a fluctuation model described by a differentiable second-order Markov process, which makes it possible to determine more accurately the characteristics of edge detection algorithms.

Mathematical model of sea surface echo fluctuations

By the mathematical model of fluctuations of echo signals of the sea surface, we mean the probability distribution density of the amplitudes of the sounding signals reflected from the resolution elements of the onboard radar. In this work, as well as in works [3,4], we will restrict ourselves to the consideration of one range track.

Suppose the on-board locator "illuminate" M range tracks, then, considering only one sounding period, we obtain a vector of amplitudes of the location signals reflected from the corresponding resolution elements $\mathbf{A}_M = \left(A_1, A_2, \ldots A_M\right)^T$. Suppose the width of the direction pattern of the onboard radar antenna system be such that only one element in the vector $\mathbf{A}_M$ only one corresponds to the resolution element, which includes both the land and the sea surface. This resolution element is the land-sea edge. Let assign index m to this element and assume that $1 \le m \le M$, that is, edge elements can also be the most extreme elements of the selection.

As the distribution of the amplitudes of the vector elements, we take the logarithmic normal distribution [6], which is most often used when approximating fluctuations of echo signals of the sea surface

$$w(\mathbf{A}_M)=\frac{1}{\sqrt{(2\pi)^M D_M}\sigma^M\prod_{p=1}^{M}A_p}\exp\left\{-\frac{1}{2D_M}\sum_{p=1}^{M}\sum_{q=1}^{M}\frac{D_{p,q}}{\sigma^2}\ln\frac{A_p}{\overline{A}_p}\ln\frac{A_q}{\overline{A}_q}\right\}, \quad (1)$$

where $\overline{A}_p$ and σ are distribution parameters associated with the average power of reflections, calculated using the well-known radar formula [7] and the coefficient of variation of amplitudes K_A by the relations given in [6], in particular, $\sigma^2=1+K_A^2$ and for sea waves, we can put $K_A\approx 0.52$ [8], D_M is the determinant of the correlation matrix $\mathbf{r}_M=\|r_{pq}\|$

$$\mathbf{r}_M=\begin{Vmatrix} r_{1,1} & r_{1,2} & r_{1,3} & \dots & r_{1,M} \\ r_{2,1} & r_{2,2} & r_{2,3} & \dots & r_{2,M} \\ r_{3,1} & r_{3,2} & r_{3,3} & \dots & r_{3,M} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ r_{M,1} & r_{M,2} & r_{M,3} & \dots & r_{M,M} \end{Vmatrix}, \quad (2)$$

whose elements are the correlation coefficients of random variables $\ln\left(A_p/\overline{A}_p\right)$ and $\ln\left(A_q/\overline{A}_q\right)$, and $D_{p,q}$ - algebraic complements of elements $r_{p,q}$ in the determinant D_M, $p,q=1,2,\dots M$.

Elements of the correlation matrix $\mathbf{R}_M=\|R_{pq}\|$ amplitude vectors

$$\mathbf{R}_M=\begin{Vmatrix} R_{1,1} & R_{1,2} & R_{1,3} & \dots & R_{1,M} \\ R_{2,1} & R_{2,2} & R_{2,3} & \dots & R_{2,M} \\ R_{3,1} & R_{3,2} & R_{3,3} & \dots & R_{3,M} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ R_{M,1} & R_{M,2} & R_{M,3} & \dots & R_{M,M} \end{Vmatrix}, \quad (3)$$

are defined by formulas

$$R_{pq}=\frac{1}{K_{pq}^2}\left[\left(1+K_{pq}^2\right)^{r_{pq}}-1\right],\ p,q=1,2,\dots M. \quad (4)$$

The presented expressions define a mathematical model of fluctuations of echo signals of the sea surface in the form of a random vector $\mathbf{A}_M$ with given statistical characteristics: a vector of means, a vector of variances and a correlation matrix $\mathbf{R}_M$. Let's define the correlation matrix $\mathbf{R}_M$.

Correlation-spectral characteristics of fluctuations of echo signals

In this case, it is necessary to specify the elements of the correlation matrix $\mathbf{R}_M$. There is no strict general theory of reflections of electromagnetic waves from the sea surface. There are separate mathematical models that allow one to describe particular cases of reflection of electromagnetic waves from the sea surface, which introduce some restrictions. In addition, there are experimental data and empirical expressions that make it possible to determine the parameters of the laws of distribution of echo signals fluctuations.

The work uses an empirical approach that determines the parameters of the distribution laws for fairly wide conditions for observing the sea surface. In particular, there are expressions for the width of the spectrum of reflected echo signals and the width of the correlation function of echo signals at a level of 0.5 [8]. In our case, the correlation function should be used, but since only the width of the correlation function is known, it is necessary to use only those approximations that depend on only one parameter.

Considering a vector $\mathbf{A}_M$, as a sample of a Markov process and limiting ourselves to first-order Markov processes and a differentiable Markov process of no higher than second order, for which the correlation function contains only one parameter, we can offer only two types of approximation of the correlation function:

- for a first order Markov process

$$R_1(\tau) = \frac{1}{K^2}\left[\left(1+K^2\right)^{r_1(\tau)} - 1\right],\ r_1(\tau) = e^{-\alpha_1|\tau|}, \tag{5}$$

this process is not differentiable;

- for a second order Markov process

$$R_2(\tau) = \frac{1}{K^2}\left[\left(1+K^2\right)^{r_2(\tau)} - 1\right],\ r_2(\tau) = \left(1+\alpha_2|\tau|\right)e^{-\alpha_2|\tau|}; \tag{6}$$

this process is differentiable.

These two approximations of the correlation functions determine the elements of the correlation matrices of the logarithms of the amplitudes (2) and the amplitudes themselves (3). It should be noted that in this work we consider only the spatial correlation of signals, since the temporal correlation can be "eliminated" by using the fast tuning of the carrier frequency of the probing pulses [9], and spatial correlation is always present. Therefore, although the sequence of readings of the envelope of the sea surface echoes are consistently received in time at the input of the onboard radar receivers, the coefficients of the correlation matrices are calculated as the correlation coefficients between the amplitudes of the echo signals of the range resolution elements.

Echo Fluctuation Simulation Algorithms

Now it is necessary for two types of correlation dependences represented by expressions (5) and (6) to synthesize algorithms for vector modeling $\mathbf{A}_M$. Actually, these algorithms are known as algorithms for vector modeling with a given correlation matrix. However, we can model a segment of a random discrete process considering the case $M \to \infty$, instead of modeling a vector with a given correlation matrix, [10].

When modeling a vector with a correlation matrix defined by formulas (5), it does not matter which approach should be used - modeling a vector with a given correlation matrix or modeling a segment of a random process of the form. In both cases, the same algorithm is obtained, which was used in [5]

$$\begin{cases} U_k = a_1 \cdot U_{k-1} + b_0 \cdot \eta_k, \\ A_k = \exp\left(m_1 + \sigma_1 \cdot U_k\right), \end{cases} \tag{7}$$

where m_1 and σ_1 – parameters determined through the average power of reflections from the resolution elements of the sea surface and the coefficient of variation, which are calculated by the method described in [3], and η_k is a sequence of normally distributed random variables with zero mean and unit variance, and, $a_1 = r$ and $b_0 = \sqrt{1-r^2}$, where r – the correlation coefficient of logarithms of echo amplitudes of neighboring elements of range resolution.

Modeling a vector with a correlation matrix defined by formulas (6) differs in that here the two approaches indicated above lead to different modeling algorithms. The modeling algorithm using the modeling of a segment of a random discrete process turns out to be much simpler and more efficient. This algorithm can be written as

$$\begin{cases} U_k = a_1 \cdot U_{k-1} + a_2 \cdot U_{k-2} + b_0 \cdot \eta_k + b_1 \cdot \eta_{k-1}, \\ A_k = \exp\left(m_1 + \sigma_1 \cdot U_k\right), \end{cases} \tag{8}$$

where the parameters of the algorithm are determined by the formulas [10]

$$\begin{cases} a_1 = 2\exp\left(-\mu T\right), \\ a_2 = -\exp\left(-2\mu T\right), \\ r_0 = 1 - 4\mu T \cdot \exp\left(-2\mu T\right) - \exp\left(-4\mu T\right), \\ r_1 = -\left(1-\mu T\right)\cdot\exp\left(-\mu T\right) + \left(1+\mu T\right)\cdot\exp\left(-3\mu T\right), \\ b_0 = 0.5\left(\sqrt{r_0 + 2r_1} + \sqrt{r_0 - 2r_1}\right), \\ b_1 = 0.5\left(\sqrt{r_0 + 2r_1} - \sqrt{r_0 - 2r_1}\right). \end{cases} \tag{9}$$

where μT is determined through the correlation coefficient of neighboring elements R_1^* from the expression

$$R_1^* = \frac{1}{K^2}\left[\left(1+K^2\right)^{r_2(\mu T)} - 1\right],\ r_2(\tau) = (1+\mu T)e^{-\mu T} \qquad (10)$$

which is solved by numerical methods. Here the designations taken from the source [10] are preserved.

Conclusion

The paper presents two algorithms for modeling the fluctuations of echo signals used in the simulation of the determination of the land-sea edge. The first algorithm makes it possible to investigate the characteristics of edge detection systems, provided that there is no differentiation operation of the input signal in these systems. The second algorithm, less efficient in the sense of speed, is used in those systems in which there is a differentiation operation. Both algorithms use correlation functions of fluctuations, in which there is only one unknown parameter, which makes it possible to use empirical formulas obtained in experimental studies to estimate this parameter.

Reference

1. M.L. Irvine Monitoring Coastal Change in Newfoundland and Labrador: 2014 UPDATE. Current Research (2015) Newfoundland and Labrador Department of Natural Resources Geological Survey, Report 15-1, pages 263-276, Geochemistry, Geophysics and Terrain Sciences Section.

2. Y. Wan, X. Zhang. X. Shi Research on a Method for Simulating Multiview Ocean Wave Synchronization Data by Networked SAR Satellites. College of Information and Control Engineering, China University of Petroleum, No. 66, Changjiangxi Road, Huangdao District, Qingdao 266580, China. Journal of Marine Science and Engineering. J. Mar. Sci. Eng. 2019, 7(6), 180.

3. Isakov V. I., Shepeta D. A. Modeling of location signals reflected from the land-sea edge // Information and control systems. 2017. No. 5 (90). P. 89-94.

4. V.I. Isakov, D.A. Shepeta Simulation of location signals when determining a coastal edge," 2021 Wave Electronics and its Application in Information and Telecommunication Systems (WECONF), 2021, pp. 1-5, (June 2021 г.) Вышло – июнь 2021.

5. Wattimena, Gysberth Maurits, Shepeta, Dmitry, Isakov,Victor Gysberth Maurits Wattimena, Dmitry Shepeta, Victor Isakov, "Determination ofthe coastal edge using on-board radar," Proc. SPIE 11914, SPIE FutureSensing Technologies 2021, 119140D (14 November 2021); doi:10.1117/12.2603944.

6. Isakov V. I. D. A. Shepeta Density of power distribution of the envelope of location signals reflected from the land-sea edge // Processing, transmission and protection of information in computer systems: 21: International scientific. conf. (St. Petersburg, April 14-22, 2021): book of reports – SPb.: SSUAI, 2021. -- 245 p; pp. 25-28.

7. Blaunstein N. Sh., Sergeyev M. B., Shepeta A. P. Applied aspects of electrodynamics. - SPb: Agraf +, 2016. - 272 p., Ill.

8. Shepeta A. P., Bazhin S. A., Davidchuk A. G. Experimental characteristics of ship echo-signals observed by the radars of onboard information processing systems // Information and control systems. 2005. No. 2 (15). P. 7-12.

9. Shepeta A. P., Podoplekin Yu. F. Decorrelation of ship echo-signals during restructuring of the carrier frequency of the onboard radar // Marine Radioelectronics. 2020. No. 4 (74). P. 18-23.

10. Shepeta A. P. Synthesis of nonlinear shaping filters for modeling input signals of location systems // Modern Radiolocation. 1994. P. 81-85.

DOI 10.34660/INF.2022.62.29.024

液压缸孔组合加工时张力对零件尺寸变化的影响

THE EFFECTS OF TENSION ON THE CHANGE IN THE SIZE OF THE PART WHEN COMBINED PROCESSING OF HYDRAULIC CYLINDER HOLES

Berikbayeva Meruyert Amirkhanovna
Master student, Senior Lecturer
Manash Kozybayev North Kazakhstan university
Tanirbergenova Anar Amirkhanovna
Candidate of Technical Sciences, Assistant to the Professor
Satbayev university

抽象的。 本文介绍了在液压缸孔组合加工过程中干涉对零件尺寸变化影响的研究结果。 为了对组合刀具的设计参数对加工表面质量的影响的理论研究结果进行实验验证，使用了零件的分割图案。 研究结果使我们能够推荐组合孔加工，结合切削和塑性变形。 工作取得的成果将改进液压缸深孔的加工，具有实践和理论科学意义。

关键词：光塑性，中等剂量，显微硬度，宏观几何，组合加工。

Abstract. *The article presents the results of a study of the influence of interference on the change in the size of the part during combined processing of hydraulic cylinder holes. For experimental verification of the results of a theoretical study of the effect of the design parameters of the combined tool on the quality of the machined surface, a split pattern of the part was used. The research results allow us to recommend a combined hole processing, combining cutting and plastic deformation. The results obtained in the work will improve the processing of deep holes of hydraulic cylinders, which has practical and theoretical scientific significance.*

Keywords: *photoplasticity, mesdose, microhardness, macrogeometry, combined processing.*

Processing the inner surfaces of the cylinder holes has always been a more complex process than the outer surfaces of the hydraulic cylinders. This is due to the closure of the holes, thereby associated with these difficulties in orienting the tool relative to the machined surface, using a more complex tool design, observing the process of measuring and controlling microgeometry and dimensions, cutting

fluid feed, observing the process, and other features.

The main and most widespread in industry methods of finishing work of the cylinder bore by cutting are not only insufficiently productive, but also technologically imperfect, because, to ensure high processing accuracy at the proper level of macrogeometry, the shape and size of the holes, they do not create the corresponding high characteristics at the level of microgeometry. Thus, in the technological process of processing the sleeves, after fine boring, a fine-tuning operation was introduced, creating the necessary quality of the surface layer [2].

These parts are made mainly of plastic materials, and it is more rational to achieve the required surface quality by surface plastic deformation.

In the case of processing cylinder liners and pipes with D0 / d0 = 1.7, the surface roughness reaches the required size under the most suitable processing modes. Increasing the rigidity of the part reduces deformation before flaking occurs. Combined processing creates a strengthening and an increase in the mechanical characteristics of the material of the part, which has a positive effect on its use. The deformation along the wall thickness of the part is distributed unevenly as a result of the friction process creating a texture layer on the machined surface with a very high level of deformation and high hardening compared to the rest of the metal.

The thickness of the layer with increased hardness depends on the type of lubricant, the material of the part, the amount of interference, and the wall thickness.

In the theory of plastic deformation, experimental and experimental and calculation methods for determining stresses in the plastic region have been developed: the method of slide lines, the method of photo plasticity, the method of dividing grids; method of optically active coatings; method of mesdoses;.

For experimental verification of the results of a theoretical study of the effect of the design parameters of the combined tool on the quality of the machined surface, a split pattern of the part was used [3]. The processing was carried out on a vertical drilling machine. The determination of the size of the deformations was carried out using a digital strain gauge bridge DSGB - 5. To reconstruct the units of relative strain ($1\ URS = 10^{-6}\frac{\Delta l}{l}$) into a change in the outer diameter, the measuring device was calibrated. To determine the quality of the surface layer, the microhardness was measured with a MHD-3 device and the height of irregularities with an MII-4 microinterferometer.

DSGB-5 is designed to determine the size of deformations in parts and assemblies of machines, structures, etc. with the help of resistance strain gauges, included on a half-bridge circuit. The measurement range is from 0000 to 3999x5 URS - units of relative strain, the price of one unit of discreteness of the readings of the device is 5 URS. The time of one measurement is not more than 1.2 s,

power supply from an alternating current voltage of 220^{+22}_{-33} V, frequency 50±1 Hz resistance of the applied strain gauges from 50 to 200 Ohm, the basic error of the instrument readings is no more than 20 URS.

In the study of the influence of the interference on the deformation of the part during the combined machining of the hydraulic cylinder bore, parts with different wall thicknesses were used. The experimental results are shown in Fig. 1

Experimental studies of the influence of interference on an increase in the outer diameter with combined processing of the hydraulic cylinder bore are shown in Table 1.

In the course of the experiment, a number of properties were obtained. The performed linearization has a deviation from the average parameter of 1 ... 2%, which makes it possible to enter the coefficient a, let's call it the coefficient of resizing. $tg\, a = \frac{\Delta H}{i}$

Probably, the change in the outer diameter on the interference has a direct relationship. The coefficient, *a*, is the thickness value, so our task was to relate this coefficient to the wall thickness of the part. For this, it was necessary to obtain an analytical dependence of the wall thickness on the coefficient of resizing.

Table 1

Influence of the interference on the increase in the outer diameter

i, mm	**Δn, mm**			
	t = 7,5 mm	**t = 8 mm**	**t = 9 mm**	**t = 10 mm**
0,05	0,01	0,008	0,006	0,004
0,1	0,025	0,02	0,015	0,013
0,2	0,045	0,035	0,03	0,028
0,3	0,07	0,055	0,05	0,04
0,4	0,085	0,07	0,06	0,055

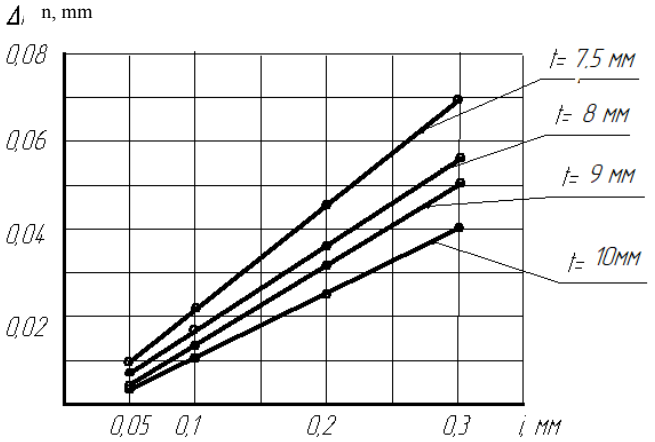


Figure 1. *Influence of interference on the processing characteristics*

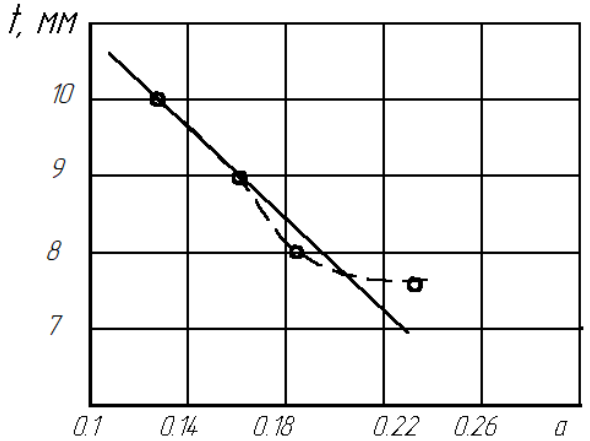


Figure 2. *Determination of the analytical dependence of the wall thickness on the coefficient of change in size*

The method of least squares, most often used in the processing of statistical data and based on variance minimizing, was used.

This method of mathematical statistics made it possible to obtain analytical dependencies:

$$t = 20.932 \cdot e^{-4,425a} \quad (1)$$

$$t = 3.655 \cdot a^{-0,536} \quad (2)$$

$$t = 5.655 + \frac{0,579}{a} \quad (3)$$

$$t = \frac{1}{0,422a + 0,036} \quad (4)$$

It is not difficult to calculate the thickness values for the resizing factor in the range from 0.1 to 0.3 by using Excel

Table 2.

Wall thickness calculation results

coef. a	0,1	0,12	0,14	0,16	0,18	0,2	0,22	0,24	0,26	0,28	0,3
f-la (1)	13, 488	12, 353	11, 313	10, 361	9, 489	8, 691	7, 959	7,29	6,676	6, 114	5,6
f-la (2)	12, 079	10, 955	10, 086	9, 389	8, 815	8, 331	7, 916	7, 555	7, 238	6, 956	6, 704
f-la (3)	11, 445	10,48	9,79	9,27	8,87	8,55	8, 286	8, 067	7, 881	7, 722	7, 585
f-la (4)	12, 787	11, 542	10, 517	9, 659	8, 932	8, 305	7, 761	7, 284	6,82	6, 486	6,15

We will obtain the magnitude of the discrepancy between the results having selected the values of the coefficient from Table 2 for the control points.

Table 3.

The magnitude of the discrepancy

Wall thickness	Coefficient value a	F-la (1)	F-la (2)	F-la (3)	F-la (4)
7,5	1,4	8,136783	7,437565	7,670904	7,50743
8	0,1833	8,813756	8,82203	8,729589	9,35256
9	0,166	9,142952	9,429337	9,205999	10,09142
10	0,133	10,00838	10,8547	10,36727	11,66655
Aver. value of discrepancy		1,654413	1,847394	2,05169	0,381949

As can be seen from the table, formula (4) is more accurate.

Thus, the value of the wall thickness:

$$t = \frac{1}{0{,}422a + 0.036} \tag{5}$$

Under these conditions, it is possible to determine the amount of interference allowed by a change in the outer diameter

$$i = \frac{0{,}422 \cdot \Delta_и \cdot t}{1 - 0.036 \cdot t} \tag{6}$$

This dependence is applicable only for parts with a ratio $D_0/d_0 \leq 1.7$. Dependency testing took place at control points. The discrepancy did not exceed 3%.

The value of the actual random error in the combined processing of the hydraulic cylinder bore can be most influenced by the variability of the mechanical properties of the workpiece material. For example, fluctuations in the yield point in a batch of workpieces $T(\sigma_T) = 200$ MPa with a diameter d_0=40 mm, E=2·10^5 MPa lead to a random error in the operation $\frac{d_0}{E} T(\sigma_T) = 40$ μm. Thus, in order to increase the accuracy, it is possible to recommend a preliminary heat treatment, which ensures stable mechanical properties of the material.

Due to the unequal conditions of plastic deformation, the holes in the cylinders at a distance of 2-4 mm from the ends have a diameter that differs by 0.02-0.1 mm from the diameter on the rest of the cylinder length (for thick-walled parts, the diameter increases, for thin-walled parts, it decreases). Accordingly, to carry out the manufacture of long blanks in this way and then cut them into individual parts.

When thin-walled cylinders are deformed, the outer diameter increases, the length of the cylinder and the thickness of its wall decrease. A practically confirmed fact, which is based on the experiment of other collections [1, 4, 5] on other types of pressure treatment, that the limiting value of hole deformation before the appearance of microcracks is 25%.

When it is necessary to check the dimensions of the tool experimentally for a newly designed process. Taking into account the actual values of the hole sizes and the properties of the processed material, the tension value of the deforming element of the reamer can be corrected.

Conclusion

The adequacy of the mathematical model of the tightness allowed by the limit of deformation during combined processing has been experimentally confirmed. In this case, the magnitude of the interference is a function of the wall thickness of the product, which makes it possible to use this dependence to ensure the predicted quality characteristics of the surface layer.

References

1. The study of methods for combined processing of deep holes of hydraulic cylinders Berikbaeva M.A., Khairullin B.T., Mukhamadeyeva R.M. International Journal of Mechanics. 2020. V. 14. P. 177-184.

2. M.A. Berikbaeva, B.T. Khairullin, R.M. Mukhamadeyeva, "Combined hole processing for hydraulic cylinders," in LXVI Int. Sci.-Pract. Conf. "Int. Sci. Rev. Probl. Prospects Mod. Sci. Educ.", Boston, 2020, pp. 7–11.

3. V. F. Gubanov, V. V. Marfitsyn, V. N. Orlov, A. G. Skhirtladze. Surface quality control during finishing of parts by smoothing: Textbook. – Kurgan: KSU of Publishing House, 2007. – 84 p.

4. Гидроцилиндрдің ішкі беттерін заманауи әдіспен өңдеу

Хайруллин Б.Т., Берикбаева М.А. Bulletin of the Almaty University of Energy and Communication. 2019. No. 4 (47). P. 177-187.

5. Gubanov V. F. Innovative technology of finishing and hardening treatment by surface plastic deformation // Forging and stamping production. Material processing by pressure. – 2011. – No. 4. – P. 16-18.

科学出版物

上合组织国家的科学研究：协同和一体化

国际科学大会的材料

2021年12月30日。中国北京

编辑A.A.Siliverstova
校正A.I.尼古拉耶夫

2021年12月30日。中国北京
USL。沸点：98.7。 订单253.流通500份。

在编辑和出版中心印制
无限出版社