



SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

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改进基于利益相关者方法的业务分析方法，考虑到第四经济部门的发展和公司商业模式的信息化

**IMPROVING THE METHODOLOGY OF BUSINESS ANALYSIS
BASED ON THE STAKEHOLDER APPROACH, TAKING INTO
ACCOUNT THE DEVELOPMENT OF THE QUATERNARY
SECTOR OF THE ECONOMY AND INFORMATIZATION OF THE
COMPANY'S BUSINESS MODEL**

Tretyakov Oleg Vladimirovich

*Candidate of Economic Sciences, Head of Department
Perm National Research Polytechnic University*

抽象的。 本文提出了改进公司生态系统研究领域、分析商业模式的信息组成部分、评估增长机会的建议。 已经开发了一种分析公司生态系统的方法，其中包括五个阶段。 值得注意的是，所开发的方法可以根据利益相关者的方法评估公司的活动，同时考虑到公司所属的经济部门。

关键词: 生态系统, 利益相关者, 经济部门, 商业模式信息化, 商业分析。

Abstract. *The article presents proposals for improving the research areas of the company's ecosystem, analyzing the information component of the business model, assessing growth opportunities. A methodology for analyzing the company's ecosystem has been developed, which includes five stages. It is noted that the developed methodology makes it possible to assess the company's activities based on the stakeholder approach, taking into account the economic sector to which the company belongs.*

Keywords: *ecosystem, stakeholders, economic sectors, business model informatization, business analysis.*

At the current stage of economic development, changes are taking place in the business environment associated with the digitalization of technologies, the accelerating growth of the Quaternary sector of the economy and, in general, with the transition to a digital economy, in which digital data is a key factor of production in all spheres of socio-economic activity. A feature of modern business is also the fact that it is to a much greater extent than before, associated with the external environment. Researchers believe that a modern company must constantly look outside - not least in order to timely identify rapidly approaching threats from new

technologies and competitors [1].

In modern analytics, companies should be viewed as complex adaptive systems that evolve constantly and in a difficultly predictable manner [2], which complicates forecasting cash flows and assessing the future state of the company.

All this necessitates the development of business analysis, namely, the formulation and solution of the following tasks during the analysis: study of the company's ecosystem, its business environment, stakeholders, the types of capital supplied by them and the risks associated with them; assessment of the transformation of the company's business model towards the inclusion of information resources and technologies; study of business development opportunities [3, p. 1879].

The modern direction in business analytics combines the features of a stakeholder approach in terms of identifying the interests and capabilities of business-related persons, elements of a resource approach and analysis of integrated reporting in terms of researching types of capital supplied by stakeholders, as well as elements of value-based management in terms of modeling the future state. the company, including its cash flows to assess the value created and value for all stakeholders.

The changes in the analysis are associated with changes in the goal setting of the business. Thus, the maximization of short-term profits and the efficiency of using material resources was replaced by the maximization of business value within the framework of value-oriented management. In modern conditions, the key goals of business are to create intangible types of capital, maximize value for all stakeholders and ensure "long-term viability", business survival in an unpredictable information environment [4].

In addition to assessing survivability, the modern concept of analysis should include the study of business opportunities in creating value for stakeholders, in the development of the entire business ecosystem, that is, the aggregate wealth of all persons involved in the company, and not just maximizing the wealth of shareholders. This approach significantly changes the concept of analysis: the emphasis is shifting in the direction of moving away from the proprietary concept to identifying significant stakeholders, their needs, opportunities and risks associated with them.

The development of the concept of stakeholders is the concept of common values [5, 6], which substantiates the need to increase the competitiveness of an individual company simultaneously with an increase in its contribution to organizational wealth, with an improvement in the economic and social conditions for the existence of those specific communities in which it operates [7]. Researchers emphasize the role of this concept for the development of the world economy, considering the efforts of business to make a profit, helping society to solve its problems, as a factor of such growth [8]. Within the framework of this concept,

companies strive to be a source of value not only for shareholders, but also for society as a whole.

The implementation of the updated concept of analysis is carried out in the course of the following stages [3, p. 1880]:

1) establishment of the economic sector to which the company belongs, in order to identify the ecosystem and business environment of the company, identification of key stakeholders, types of capital supplied by them and associated risks;

2) analysis of the types of capital that a company needs regardless of the sector of the economy, namely, organizational, financial and social and reputation capital, including its market and social components. Analysis of those types of capital and that group of stakeholders that are key for each individual company belonging to a specific sector of the economy;

3) analysis of the company's viability, risks associated with the types of capital used and the stakeholders that supply them. Analysis of the balance of interests of different groups of stakeholders, identification of those stakeholders whose interests are priority for the company;

4) analysis of the information component of the business model, identification of signs of the company using new approaches to doing business, attributes of exponential organizations [1], which can dramatically increase efficiency and survival, regardless of the sector to which it belongs;

5) a comprehensive assessment of indicators of the company's value for stakeholders.

Key aspects of the analysis are presented in fig. 1.

During the first stage, the company's ecosystem is identified, relationships with stakeholders are investigated. The composition of stakeholders is determined taking into account the sector of the economy to which the company belongs.

In accordance with the theory of the sectoral structure of the economy [9, 10], three sectors were initially identified in the economy: primary (extraction and processing of raw materials into semi-finished products, agriculture), secondary (industrial production, construction) and tertiary (production services and human services). Further, the "knowledge economy" was identified (the term was introduced into scientific circulation by Fritz Machlup in 1962) [11] and the quaternary sector was identified, which includes industries related to information, computer and other new technologies, that is, information economy companies [12].

Currently, the development of the Quaternary sector is characterized by such attributes as cloud computing, Big Data, predictive analytics, the Internet of Things, cyber-physical systems in production, etc. [13]. Experts note a noticeable increase in the share of the tertiary and quaternary sectors in total production [14].

The second stage analyzes the types of capital that a company needs regardless of the sector of the economy, as well as those types of capital that are key for each

individual company belonging to a particular sector of the economy. Also at this stage, the financial condition of the company and indicators of its development are assessed.

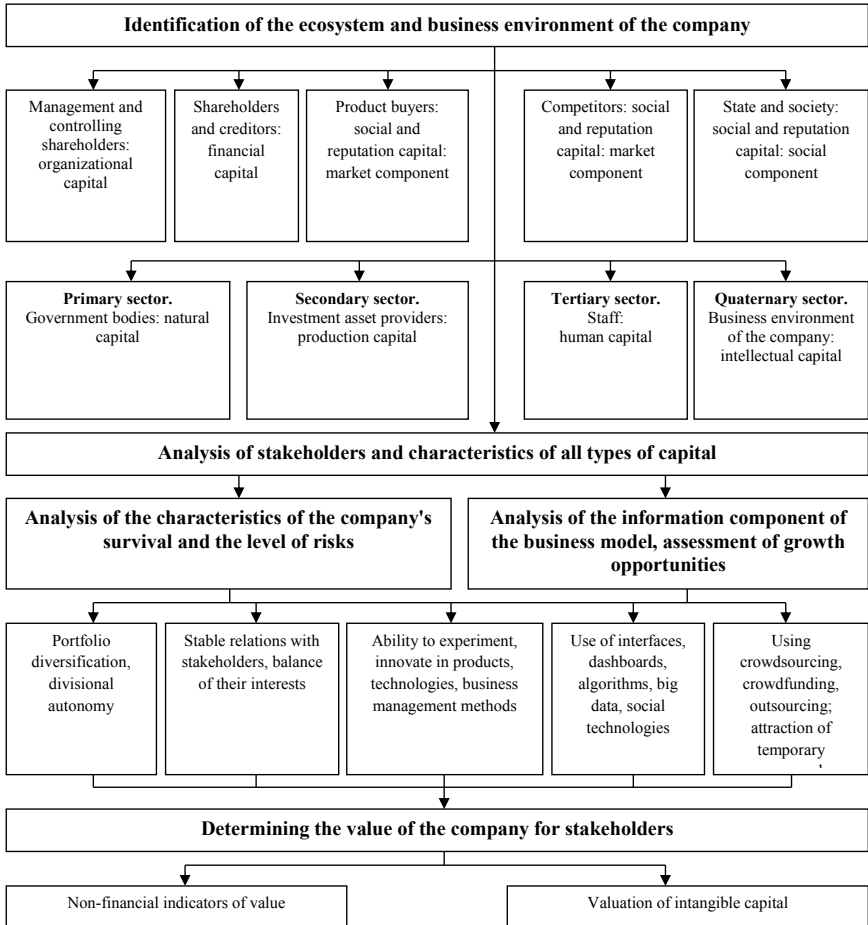


Fig. 1. Block diagram of the analysis of the company's ecosystem (Author's development)

It should be noted that the importance of information and digital technologies for all sectors of the economy leads to the fact that data are beginning to be perceived as a new factor of production [15], therefore experts distinguish another

type of capital - digital capital (intangible digital assets) [16], which is information-based intangible assets, including big data and how it is processed and applied. At this stage, this type of capital is considered as part of the intellectual capital, but in the future, it is likely to be transformed into a separate type, especially since it has fundamental properties of capital, in particular, the ability to generate income in the form of information and innovation rent [17].

The analysis of companies in the Quaternary sector of the economy has not been sufficiently developed, since the need for development appeared not so long ago and intensifies as such companies emerge and develop. The complexity of the analysis is associated with the need to assess the ability of a company to generate, process and effectively use information based on knowledge, since this is what their productivity and competitiveness depend on [18]. Therefore, the key algorithm for analyzing companies in the Quaternary sector of the economy is the analysis of product, technological, marketing, organizational innovations, that is, the analysis of the renewability of the business model.

Thus, it is necessary to formulate the concept of analysis, taking into account the types of capital that are significant for the analyzed company and critical stakeholders, whose interests determine the development trajectory and strategy of the company, as well as analyze those types of capital that are significant for each individual company. In the course of the analysis, the financial condition of the company should be assessed (in the analysis of financial capital), as well as indicators of the development of all types of capital provided by stakeholders, in particular [3, p. 1883]:

- availability of capital in quantitative and value terms;
- capital movement, assessed by indicators of inflow, outflow;
- the condition of the capital, its qualitative characteristics;
- productivity, capital efficiency;
- risks arising from the use of capital;
- the value of capital for a company, which consists in the ability to provide sustainable competitive advantages at the expense of capital;
- the value (attractiveness) of the company for the stakeholders supplying capital.

At the third stage, the signs of the company's survival are investigated, the risks associated with stakeholders are assessed. The balance of interests of different groups of stakeholders is analyzed, stakeholders are identified, whose interests are priority for the company.

Tab. 1 [3, p. 1890] presents the relationship between the sectors of the economy, key types of capital for them, stakeholders - suppliers of the corresponding types of capital, and those risks that arise when interacting with stakeholders. In the process of analyzing the level of riskiness of a company, it should be borne in

mind that the optimal strategy is not to avoid risks, but to accept them, actively and effectively manage them.

The most important trend in the analysis is the study of how adequately the company adapts to the external environment and manages risks; what is the margin of its strength; how ready she is for change.

Table 1

Interrelation of economic sectors, types of capital, stakeholders and risks

Sector of the economy to which the company belongs	Key type of capital	Stakeholders	Company risks in relations with stakeholders
<i>Types of capital for companies in all sectors of the economy</i>			
All sectors of the economy	Organizational capital (as part of intellectual capital)	Controlling owners, management	Strategic risk associated with errors in defining the company's goal and strategy. The risk of abuse associated with abuse of office
All sectors of the economy	Financial capital	Investors, lenders	Liquidity risk associated with debt burden. Market currency risk associated with unfavorable changes in the exchange rate of the borrowed capital. Market interest rate risk associated with unfavorable changes in interest rates for which borrowed capital is attracted
All sectors of the economy	Social and reputation capital (market component)	Consumers	Reputational risk associated with a decrease in the number of buyers. Market risk associated with adverse changes in product prices. Credit risk associated with default by buyers
All sectors of the economy	Social and reputation capital (market component)	Competitors	Market risk associated with unfavorable changes in product prices due to the actions of competitors. Reputational risk associated with a decrease in the number of buyers due to the actions of competitors. Risk of obsolescence of products, technologies and loss of the market due to the emergence of innovations from competitors

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All sectors of the economy	Social and reputation capital (social component)	State. Society	Country and regional risks associated with the political and economic situation, geographical features in the country and the region. Legal risks associated with changes in currency and customs regulations, tax legislation, etc. Social risk associated with the attitude of society towards the company
<i>Types of capital for a company in certain sectors of the economy</i>			
Primary sector	Natural capital, land	State; bodies granting the rights to use natural capital, land	Legal risks associated with changes in regulation, tax legislation in relation to the use of natural resources, environmental protection, etc. Market risk associated with unfavorable changes in prices for extracted natural resources. Environmental risks associated with environmental pollution
Secondary sector	Production capital	Producer capital suppliers	Market risk associated with unfavorable changes in prices for acquired assets of production capital. Technological risk associated with obsolescence of production capital facilities
Tertiary sector	Human capital	Staff	Social risk associated with the availability, qualifications and remuneration of personnel, actions of personnel, social conflicts. The risk of abuse associated with exceeding official authority by personnel
Quaternary sector	Intellectual, including informational, social and reputation capital	Business environment of the company: consumers, suppliers, competitors, government agencies, personnel, management, investors, creditors, society	Technological risk associated with the rapid obsolescence of intellectual property

At the fourth stage, the signs of informatization of the business model are assessed, which ensure business development, including the digitalization of technologies, crowdsourcing of information, the renewability of products, technologies, and business management methods.

In the course of the analysis, it is necessary to assess the company's effectiveness in using new technologies and information capital. For objective reasons, not all sectors of the economy and not all companies are equally capable of development and subject to exponential growth due to the presence of digitized assets that open up access to new user scenarios, partners, ecosystems and business models [1]. Although such opportunities are more available to companies in the Quaternary sector of the economy, companies in the traditional economy (the first three sectors of the economy) should also take advantage of these opportunities.

Information itself, including data on markets, demand, customers, the state of production facilities, competitors, their products and technologies, becomes a source of innovation and new services [15]. Therefore, in the process of analysis, it is necessary to identify signs of the use of information capital, since it not only increases the company's survival, but also its efficiency. According to experts in the field of big data, data is becoming an important corporate asset, a vital economic contribution and the basis of new business models [15]. In the course of the analysis, it is necessary to specifically investigate the attributes of exponential organization, which is understood as the structure that best suits the requirements of the accelerating, non-linear, Internet-connected new world [15]. Such companies, mainly related to the Quaternary sector of the economy, are characterized by explosive growth and high efficiency, based on the use of a new business model, rapidly developing information technologies, crowdsourcing, etc.

Examination of the attributes of exponential organizations shows that some of them are identical to the rules of business survival. This means that companies using information capital have a higher survival rate.

Based on the study of the attributes of the exponential organization and the rules of business survival, the author substantiates the distinctive characteristics of the traditional, linear and exponential organization (tab. 2). In the course of the analysis, the company should be assigned to one of these types.

Table 2

Comparative characteristics of linear and exponential organization

Characteristic	Linear organization	Exponential organization
The purpose of the organization	Narrow goals within activities	Large-scale, ambitious transformative goals that gravitate towards stakeholders, the entire business ecosystem
Organization tasks	Maximizing financial results, value for shareholders	Survival, development, stakeholder value maximization, social and environmental goals
Development	Consistent, stable, linear development, inflexibility in activities due to large material assets and permanent staff	Non-linear development: exponential growth, highly adaptable, mobility, flexibility through innovation, intangible capital and crowdsourcing
Key types of capital	Natural, industrial, human	Intellectual, including informational, social and reputational, human
Resource usage	Own resources, mainly material	External resources, crowdsourcing, minimal ownership of material resources, their use on a temporary basis. Key Resources - Intangible
Source of innovation	Internal sources	Business environment, stakeholders
Power	Centralized power and control	Distributed power and control
Organizational structure	Linear-functional, hierarchical, matrix, capable of controlling tangible assets and managing personnel, top-down management principle	Flat, the control principle is based on maximum autonomy; flexible structure capable of motivating stakeholders to innovate, accumulate and transform external information in the interests of stakeholders
Risk attitude	Risk aversion	Risk taking
Sectors of the economy	Primary, secondary, tertiary	Quaternary, selected companies in the primary, secondary, tertiary sectors
Staff	Stable staff	Focus on temporary staff recruited based on changing business needs
Marginal cost	Substantial	Strive for zero
Principle of operation	The law of diminishing returns	The law of accelerating returns
Contacts with stakeholders	Formal contacts	Close contacts, especially with consumers, crowdsourcing of information and ideas

Source: author's development

At the fifth stage of the analysis, the indicators of the company's value for all stakeholders included in the company's ecosystem are investigated, and the value of the company's intangible capital is estimated.

The most important stage of business analysis is the study of the company's value for stakeholders. The value should be sufficient to develop stakeholders and improve the capital supplied to the business, as well as to ensure that they do not have an incentive to withdraw capital and channel it to another business. To fulfill this condition, the value provided by the company to its stakeholders must exceed the possibility of alternative use of resources. Therefore, a successful company must channel part of the economic profit to stakeholders.

To analyze the value of a company for various groups of stakeholders, identify dominant stakeholders, as well as determine the most significant types of capital, a resource-based approach to analysis is used [19], according to which the company's resources and capabilities are the source of its sustainable competitive advantages. The high value of resources for a company should stimulate their adequate payment, therefore, to determine the most valuable and significant resources, resource intensity indicators are studied, calculated on the basis of company payments directed to pay for the types of capital raised.

The value of intangible capital is the capitalized deviation of net income before interest from the level determined based on the average market return. A positive value of the indicator indicates the effectiveness and value of intangible capital; negative - about negative organizational capital, that is, about ineffective business management. A high value of value is possessed by those companies that are characterized by effective organizational capital provided by management and controlling shareholders, have valuable social and reputation capital due to a high level of stakeholder trust, own intellectual property, and use information capital in their activities that ensures high efficiency and stimulates growth.

Thus, in modern economic conditions, the concept of business analysis must constantly transform. This implies a study in the course of analyzing the entire ecosystem of the company and its business environment, including both the types of capital and stakeholders that supply them that are common for companies in all sectors of the economy, and the types of capital that are critical for individual sectors of the economy, as well as the stakeholders supplying them. In a modern economy, analysis is impossible without assessing the prospects for business survival and risks associated with certain types of capital, researching trends in business digitalization and the effects that accompany these processes. Also, the analysis should investigate the value generated by the company for all stakeholders, which leads to multi-criteria in assessing the company's performance. The study of all these aspects provides an understanding of not only the current state of the business, but also the prospects for its survival and development.

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亚洲国家创新潜力发展特点
**FEATURES OF THE DEVELOPMENT OF INNOVATION
POTENTIAL OF ASIAN COUNTRIES**

Savina Natalia Pavlovna

*Candidate of Economic Sciences, Associate Professor
Plekhanov Russian University of Economics*

注解。对于许多处于发展阶段的国家来说,创新和技术已经成为工业化的基础。新加坡、香港、韩国等发展速度很快,在短时间内与发达国家展开了激烈的竞争。虽然高收入国家在 1996 年占全球研发 (R&D) 支出的 87%,但在 2017 年它们仅占研发总投资的 64%——这是 30 年来的最低数字。相比之下,中上收入国家,尤其是中国的研发投入份额从 1996 年占全球研发支出的 10% 持续上升到 2017 年的 31%。

关键词: 创新、数字技术、全球创新指数、数字化转型、研发投入、中国、韩国、日本。

***Annotation.** For many countries that are at the stage of development, innovation and technology have become the basis of industrialization. Singapore, Hong Kong, South Korea, etc., showing high rates of development, in a short time made a significant competition for developed countries. While high-income countries accounted for 87% of global research and development (R&D) spending in 1996, in 2017 they accounted for only 64% of total R&D investment – the lowest figure recorded in 30 years. In contrast, the share of R&D investment in upper-middle-income countries, particularly China, has consistently increased from 10% of global R&D spending in 1996 to 31% in 2017.*

***Keywords:** innovation, digital technologies, global innovation index, digital transformation, R&D investment, China, South Korea, Japan.*

Asian R&D centers – China, Japan, the Republic of Korea, and India – increased their share of global R&D from 22% in 1996 to 40% in 2017, of which 24% of global R&D spending is accounted for by China, up from 2.6% in 1996 [6].

The Global Innovation Index (GII) is a ranking of 129 countries and economies in terms of innovation performance. Historically, only a few countries have managed to join the battle of the leading innovation powers-especially Japan and

the Republic of Korea in the 1980s and 1990s. While the countries of North America and Europe continue to lead in the Global Innovation Ranking, Singapore leads in Asia. Recently, only China – an economy with an above-average income and an exception among other high-income economies-has entered the top 20 of the GII (Table 1).

Table 1
Ranking of selected countries in the Global Innovation Index (GII), 2019

Country	Index	Place in the overall ranking	Income level	Place in the region
Switzerland	67,24	1	high	1
Sweden	63,65	2	high	2
USA	61,73	3	high	1
Netherlands	61,44	4	high	3
Singapore	58,37	8	high	1
Germany	58,19	9	high	7
Israel	57,43	10	high	1
Republic of Korea	56,55	11	high	2
Ireland	56,10	12	high	8
Hong Kong	55,54	13	high	3
China	54,82	14	upper-middle	4
Japan	54,68	15	high	5

Источник: составлено автором на основе данных WIPO. The Global Innovation Index (GII) 2019: Creating Healthy Lives – The Future of Medical Innovation. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2019-intro4.pdf

South Korea, ranked 12th in 2018, moved up a line and took 11th place in 2019 with an index of 56.55, but in the Southeast Asian region, the country ranks 2nd after the innovation giant-Singapore. It is worth noting that China is ahead of Japan and ranks 14th in the Global Innovation Index (GII) in 2019. (Hong Kong, a special administrative region of the People's Republic of China, is one line higher) and has been increasing its position in this rating for several years. All of the first 15 GII countries (with the exception of China) have a high income per capita.

Decades of rapid economic growth have allowed China to invest in key areas that spur innovation, such as research and development, and the creation of new intellectual property. These investments improved China's GII ranking and allowed it to compete with advanced economies such as the United States and Sweden.

Research and development (R&D) is the foundation of innovation, supporting the development of new products and services that can drive growth and productivity. In recent decades, China has increasingly prioritized R&D, with spending as a percentage of GDP rising from 0.6% in 1996 to 2.19% in 2018. Although this is less than the OECD average (2.37%), the huge size of China's economy means that its R&D spending was 526.06 billion US dollars in 2018 and is currently second after the United States [3].

Achievements in R&D have helped improve China's position in the GII, where it ranks 9th in the world in terms of business development, just behind the USA and ahead of Ireland. Enterprises in developed countries tend to finance a significant portion of R&D initiatives. For example, enterprises in OECD countries on average finance about 60% of R&D in 2018, but in countries such as Japan and South Korea, this figure exceeds 75% [4]. This trend is also reflected in China, where enterprises financed 76.5 percent (338.8 billion US dollars) of the country's gross R&D spending in 2017 [1].

Assessing the role of business in R&D financing in China is complicated by the importance of state-owned enterprises (SOEs). Many SOE leaders hold positions in the government and the Communist Party of China, which means that SOE-funded R&D initiatives often overlap with those funded by the government. State-owned enterprises also have preferential access to bank loans from state-owned banks, which reduces the cost of borrowing and provides state-owned enterprises with stronger financial support compared to private companies.

Most of the use of R&D in China is focused on commercial applications, which has led to higher education performing a smaller portion of R&D in China than anywhere else. Between 2008 and 2017, China's universities and academies performed an average of only 7.5% of R&D. This is well below the level of leading innovation leaders such as the Netherlands (33.9%), Sweden (26.2%) and the United Kingdom (26.0%), and significantly less than the OECD average (17.9%) [5].

Intellectual property (IP) protection, such as patents, is also crucial for innovation. They provide legal guarantees for innovators and serve as a useful indicator of a country's innovation potential. For decades, China has relied on foreign IP. In 2012, a World Bank study found that 18 percent of Chinese firms reported using foreign companies' technology, higher than the global average (14.8%) and almost twice as high as the OECD average (9.3%) [7].

Beijing has implemented a number of measures to improve China's patent system. In 2008, the Chinese Government launched a national IP strategy and amended existing patent laws. The National Patent Development Strategy was published in 2010. The plan provides incentives to increase the number of patents filed domestically, but it has resulted in patents being awarded for small design tweaks and incremental changes, rather than for entirely new inventions. New amendments to the patent law were proposed in January 2019. The Government's

efforts have had their effect. China has quickly become a world leader in patent applications. According to the World Intellectual Property Organization, China filed about 161,000 patent applications in 2007, representing just 8.5% of the global total. Ten years later, China filed more than 1.3 million patent applications, accounting for 44% of all applications in 2017 [8]. This high volume of production has put China in the top five in terms of GII knowledge and technological results.

In other aspects of innovation, the country is also making progress, but China is still lagging behind the developed economies. Government initiatives, backed by significant funding, have enabled China to achieve near-universal primary and secondary education coverage and literacy levels. Inequality still exists in poor regions of China, but notable improvements in education have increased its ability to innovate. Improved primary and secondary education and increased funding for start-ups have helped drive Chinese innovation, but problems with higher education, the business environment, and the work culture persist. Startups are attracting more venture capital than ever before, but business regulatory issues are hampering innovation. Cities such as Beijing, Shanghai, and Hangzhou have begun to challenge Silicon Valley's dominance in startup development, accounting for more than 30 percent global growth in venture capital investment in 2010-2012 and 2015-2017. They are also home to 75% of China's "unicorns" (startups worth at least 1 billion US dollars) [1].

However, Chinese companies face significant obstacles that hinder their operations and innovation. Although government measures have helped to deal with red tape, reducing the average business start time from 22.9 days in 2017 to 8.6 days in 2019, China ranks 31st out of 190 economies in terms of ease of doing business due to existing legal obstacles and problems with the credit system [2].

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新型冠状病毒感染COVID-19引起的大流行对中国经济重点的影响
**ON THE IMPACT OF THE PANDEMIC CAUSED BY THE NEW
CORONAVIRUS INFECTION COVID-19 ON CHINA'S ECONOMIC
PRIORITIES**

Chaplygina Svetlana Borisovna

Student

Saint Petersburg State University

Rondyrev-Ilinsky Vladimir Borisovich

Candidate of Pedagogical Sciences

Nizhnevartovsk State University

抽象的。由于经济复苏加速,中国领导人已采取行动加强国家的经济优先事项。该论文考察了新型冠状病毒感染 COVID-19 对中华人民共和国经济形势的影响。对短期和长期粮食和能源安全的新重视给予了特别关注。还讨论了中国的技术改造和现代化、中国在全球供应链中的地位以及深化医药发展的必要性等问题。

关键词: 经济优先事项、COVID-19 大流行、粮食安全、能源安全、医疗保健全球化、数字经济。

Abstract. *Thanks to the accelerated economic recovery, the Chinese leadership has moved to strengthen the country's economic priorities. The paper examines the consequences of the new coronavirus infection COVID-19, which affected the economic situation of the People's Republic of China. Special attention is paid to the new emphasis on food and energy security, both in the short and long term. The issues of China's technological transformation and modernization, China's position in the global supply chain, and the need to deepen the development of medicine are also discussed.*

Keywords: *economic priorities, COVID-19 pandemic, food security, energy security, healthcare globalization, digital economy.*

Despite the fairly successful overcoming of the consequences of the pandemic, the costs of fighting the epidemic, medical equipment, unemployment insurance, tax incentives and investments have led to an increase in China's budget deficit (Figure 1). It is planned that in 2021 the state budget deficit will amount to 3.2% of the country's GDP, since the rehabilitation of the economy so far requires budget

funds, mainly aimed at supporting small and medium-sized businesses [7].

Nevertheless, despite the pandemic, China has maintained its strategic plans. However, the importance of food, technological, energy and medical security has increased.

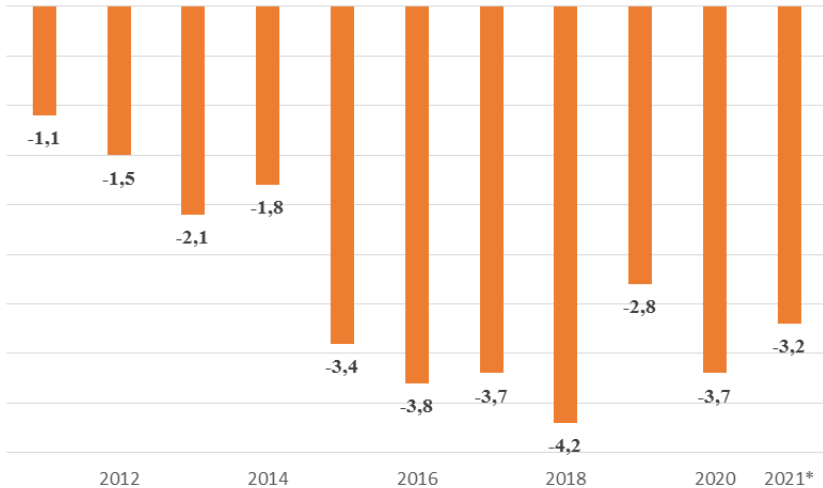


Figure 1. China Government Budget (% of GDP) from 2011 to 2020 with a forecast for 2021 [12].

China's stability depends on food security. During the pandemic, supply chains were disrupted, so the government decided to increase stocks of agricultural products. In addition, China does not rule out a repeat of the isolation, but already in connection with the aggravation of the geopolitical situation [3]. In order to be self-sufficient with grain, its production in 2021 should be at least 650 million tons. To implement the plan, it will be necessary to diversify the imported agricultural products more competently, increase the yield by introducing breeding biotechnologies, without reducing the acreage. For a more rational use of food in the long term, the law on the control of food waste [1] has been adopted, as a result of which a significant amount of food will be saved. This is also necessary because of the growing population of the People's Republic of China. In the mind of every person, a negative attitude towards those who neglect food should be developed. The main trends that determine the development of food security in the near future, according to experts, will be digitalization and improving the quality of products [2]. Thus, the PRC is building up its domestic capacity to implement the plan to ensure food security.

The recovery of the economy occurred during the same period as the maximum fall in oil prices. Since China ranks first in the world in terms of oil imports, this has had a positive impact on the recovery of production, especially for refineries. As a result, China has filled the storage facilities with cheap oil. According to the Customs Administration of the People's Republic of China, oil imports increased in March 2020 by 4.5% compared to March 2019. However, its own oil industry has become unprofitable. A similar situation occurred with the gas industry. Due to the reduction in the price, the active filling of storage capacities has begun. In the event of an external threat, the PRC can use these reserves [5]. Imported oil and gas must be transported along safe strategic routes, one of which is the "Power of Siberia". In the current circumstances, China is seeking to actively promote energy payments in national currencies.

Also, the emphasis is on the construction of nuclear power plants. By 2050, Chinese nuclear power plants should exceed the capacity of all the world's nuclear power plants [8]. However, it takes time for training and construction.

The coal industry, the main supplier of fuel to the industry, has been hit in large part by the COVID-19 coronavirus epidemic. The problem was complicated not only by the shutdown of the mines due to the self-isolation of the collectives, but also by the lack of demand from the steel and chemical industries that were stopped during the quarantine. The demand for electricity from industrial enterprises has decreased, so the consumption of coal has decreased. It was decided not to increase the price of coal, but to make exports free. In the short term, the coal industry is of great importance for China's manufacturing activities, as it is still dominant. In early 2020, the government eased restrictions on the construction of new coal-fired power plants, which were introduced in 2016, to curb the surge in construction. [10] In this regard, the policy towards the Chinese energy sector does not have a pronounced green hue. Amid concerns about economic growth and energy security among Chinese leaders, the role of coal in China's energy consumption is increasing, which could have a long-term negative impact on global carbon emissions and the prospects for developing renewable energy sources in China. Currently, it is possible that emissions will continue to increase until 2025. This will delay the important progress needed in decarbonization until the second half of the decade. Thus, the country's leadership aims to more effectively use the domestic resources of coal, oil and gas to improve national energy security.

As a result of the epidemic, the country's leadership decided to focus more on the development of pharmaceuticals and biotechnologies. It is expected that more and more pharmaceutical companies will strengthen the research, development and production of innovative medicines and medical devices. By 2025, it is planned to achieve the performance of major global companies in the field of medical technological innovations. China has moved to use the globalization of

healthcare: online interaction with different regions and countries, remote consultations. Online hospitals, online diagnostics and treatment, as well as various online pharmacies have received an unprecedented boost to development [11]. The number of startups in the field of artificial intelligence in medicine has also increased. This will contribute to the further development of telemedicine and "smart" medical care, as well as solve the problem of shortage of medical personnel. Manufacturing companies that provide related products and ideas will get new opportunities for development. The role of technology in empowering medicine and the healthcare industry is becoming more and more apparent. By 2030, digital medicine revenues should account for up to 45% of all healthcare revenues in China [4]. As a result of the coronavirus, it was revealed that primary medical care has insufficient capabilities. Following the epidemic, public investment in primary health capacity is expected to increase and strengthen the establishment of a hierarchical diagnostic and treatment system so that it can play a more active role in ensuring universal health security. The state already supports both public and private hospitals: a pilot program of medical centers, their comprehensive reform. Since March 2020, exports have increased significantly due to the supply of medical equipment and medicines to various countries, which contributed to the thematic segmentation within the framework of the "Belt and Road" initiative, namely the development of the Silk Road of Health.

China's economic priority in technology has not changed, but the pandemic has highlighted the need to ramp up the pace of digital growth. It is worth considering the fact that this industry is the least affected by the effects of the coronavirus. The pandemic has accelerated the development of markets for new technologies and the implementation of new business models, such as remote offices, online education, unmanned automated services, and e-commerce [9]. Even before the pandemic, the population had been making online purchases for several years, so it turned out to be psychologically ready to shift sales to the online sphere. Online shopping rates have increased significantly. Thus, the pandemic has further increased the number of customers with mainly long-term purchases in the online store. The effects of the pandemic are already ingrained in the consumer landscape, as Chinese consumers are moving much faster and deeper into the digital economy, and people are taking a greater interest in issues related to health and sustainable development. At the same time, "online" offices that are not limited by geographical space, especially office software that can implement individual collaboration, have become a trend of future development [6].

Despite the fact that the epidemic has affected China's key position in the global supply chain, the active development of high technologies has had a positive impact on exports in this industry. Revenue for high-tech products produced in China has increased significantly: equipment and components for automatic data

processing, mobile phones, integrated circuits (Figure 2). In this regard, the "One Belt, One Road" initiative, which is a priority and important strategic rear for China's foreign economic development, has become even more important for the PRC. China aims to strengthen its influence and leadership in East Asia. A feature of China is considered to be a fast and flexible restructuring of production, so during the pandemic, China was able not only to maintain the priority of technology development, but also to increase it. Faced with the impact of the epidemic, traditional industries have also accelerated their transformation and modernization to improve the quality and efficiency of their production. Thus, with the development of new technologies and industries, such as artificial intelligence, big data, 5G and blockchain, the operational efficiency of enterprises and the entire society will be significantly improved, and the pace of technological change in the country will be even faster.

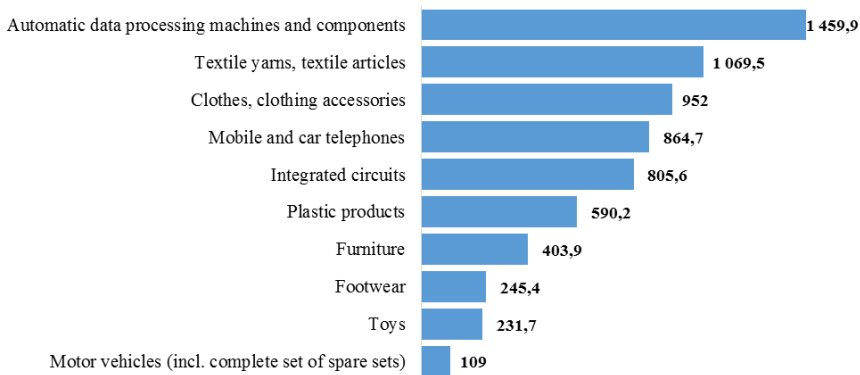


Figure 2 Main export goods from China 2020 (in billion yuan) [12].

The epidemic has also drawn public attention to insurance services. The uncertainty of future risks made life insurance claimed [6]. During the epidemic, insurance agents expanded online insurance, which partially offset the negative impact of the inability to attract customers offline. China's insurance market has huge opportunities for future development. The acceleration of health and pension insurance will also contribute to the development of the industry.

Thus, thanks to the flexible and firm policy of the state, China was able to quickly begin to recover from the COVID-19 epidemic. Against the background of the pandemic, the need to strengthen China's economic priorities has emerged, and the leadership has moved quite actively from response to planning. Projects aimed at eliminating bottlenecks in energy, food, technology, medicine, and sup-

ply chain security are being considered. Therefore, the main investments on the part of the state are aimed at the development of the sectors of long-term economic goals and the national strategy, creating new conditions for further development. Chinese enterprises, supported by the government, are confidently coping with the tasks set. The PRC aims to maintain a balance between stabilizing economic growth and preventing risks, despite a temporary increase in debt to support the economy affected by the coronavirus.

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博列茨卡娅在“节日宝箱”上的绘画制作技术
**MANUFACTURING TECHNOLOGY OF BORETSKAYA PAINTING
ON THE «FESTIVE CHEST»**

Zakharova Svetlana Sergeevna
Graduate student
Omsk State Pedagogical University

抽象的。 文章的目的是描述制作Boretskaya绘画的技术并突出最重要的事情。 此外，谈论博列茨卡娅绘画的特点以及构图技巧、技术、主题和方式。

关键词：北德文斯克绘画、技术、民间艺术、boretskaya。

Abstract. *The purpose of the article is to describe the technology of making Boretskaya painting and highlight the most important thing. In addition, talk about the peculiarities of the Boretskaya painting and about compositional techniques, technology, themes and manner.*

Keywords: *Severodvinsk painting, technology, folk art, boretskaya.*



Fig. 1 *"Festive chest" in the "Boretskaya" painting*

Introduction

Boretskaya painting is colorful, it is impossible not to notice and look away. The painting got its name from the village, where it originated. Her beauty inspired her to study motives, event plots, created by masters of folk painting, revealing for herself the characteristic features and techniques, technology. The set of technical and visual means of artists corresponds to the rules of icon painting. The images did not have a play of light and shadow, there was no implied light source. Images are always two-dimensional, and all persons are either equally enlarged or equal in size in terms of their importance in a particular plot. A characteristic feature is the minimum of details, due to which all scenes acquire special expressiveness. The characters are facing the beholder. The painting was done over the ground. The plot was arranged in a vegetable framed frame. Recognizable element: vegetation, berries, leaves, tree, animals, birds. Gold is added to the composition, making it festive and elegant. The images are distinguished by the grace of lines and the whiteness or naturalness of the background, the floral pattern is highlighted in color, gilding with gold leaf created a festive look and an elegant, expressive mood. [3] Compositional features and themes: For the painting, the "Festive Chest" Bench "was chosen. The composition is characterized by a rosette with a very rich tulip (Fig. 1). In the uppermost compositional circle there is a dove, possibly an image of a flower. The traditional composition reflects the everyday scenes of the people. There are vegetation - bushes with buds and curls, petal rosettes, solar symbols, wedding themes, a carriage a guy and a girl in themed exposure. The tulip element is characteristic, the heroes are dressed in beautiful laconic outfits.

The symbolic "Tree of Life" with the image of birds - a symbol of the power of nature, the well-being of a happy life is depicted by a strong and at the same time graceful tree with roots - the "Tree of Life". [5] The composition of the gift chest depicts a scene with a village sleigh, transport that is relevant at any time of the year and in any weather, for any holiday and fair, for a wedding - this object is present in all characteristic scenes. To depict geometric details, which are rich in painting, it is necessary to use a compass and a ruler so that the painting is clear and accurate. Before starting work on the product, you need to study the history of painting and develop a suitable shape for the chest and take into account the functional use in the interior.

The shape of the "Bench" chest is selected (Fig. 2.).



Fig. 2. Sketches of chests

For the painting, we take the wooden parts of the bench chest. Materials and tools: wood base, gouache, tempera, ink, brushes, feather, varnish, sandpaper for surface treatment and primer. Traditionally, gouache and tempera are used in painting. For painting, they use round columnar brushes and synthetics with a sharp end No. 2, 3, 4, 5. [4] A quality approach is important, you need to select good quality tools, as well as materials, everything affects the quality and appearance of the object. It is necessary to use pencils of all types of hardness, you will need coarse and fine sandpaper, sketch paper and varnish (acrylic matt or pf unique super matte).

Sketching.

The basis for the development of sketches was used to study photos of products from the Bork Museum of Folk Artists, a book on color science. In compositions, everything depends on the shape of the object, the plot is selected based on this rule. In the composition, there is a symbiosis of nature and man is inherently present in every plot. The main symbol is a tree - a sign of human happiness.

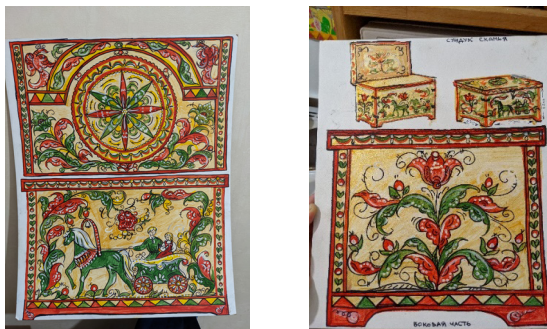


Fig.3 Compositions of borets painting "Rosette" "Tree" and "holiday skating"

Painting assumes a graphic character using geometric elements; when transferring a sketch to a product, you need to use tools (a ruler and a compass). Ornament border, or column (Fig. 3). assumes - the use of two parallel straight lines dividing into segments, connecting with vertical strokes. It depends on the compositional idea that triangles, rhombuses, flowers, berries can be depicted. The ornament of a snake, grains, circles and curls are used to create a floral image. Everything is subject to a certain sequence and the plant elements are arranged based on this. In the rosette composition, the middle is assigned, the centering, then the circle is drawn out with a compass. The circle is divided into several even segments for further elaboration of the details in the circle. It remains to work out and outline the rest of the compositional elements. The main compositions of the product. Includes - symbolizing a tree, and in the lower part - a festive sleigh ride, birds, vegetation - the whole plane is decorated with climbing vegetation.

A characteristic element of the trefoil has a more rounded, bent to the stem, the upper and lower parts of the leaf, passing into the berry. It is necessary to adhere to the compositional laws, the characteristic style of painting, rhythm. Having determined the color palette: scarlet, green, sand, white and gold, [2] an ornamental sketch and a key central drawing (skating and the tree of life) are created.

Подготовка :



Fig. 4 Grinding

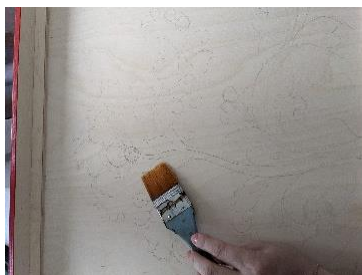


Fig. 5 Primer

- Grinding. Prepare sandpaper, sand the wooden part along the grain. Remove dusty residues with a brush. (Fig. 4) -The primer is pva glue. It is shaded with a flute brush and dried. (Fig. 5) –

Tinting. If required by the composition, then a light levkas or color collar can be applied. - Drawing a picture. Graphic elements are strictly drawn using a ruler or tracing paper, possibly a compass.

Painting.



Fig 6. Application of painting

You need to fix the hand and completely relax the hand. Smooth strokes are applied with a bold slide of the hand, holding the brush with the little finger on the hand. (Fig. 6)

Initially, apply all light colors, then darker ones, be sure to start reviving with whitewash (Fig. 7), finish the composition with contouring (Fig. 8), thin lines, circles, dashes, etc. black tempera. Select the brushes № 4, for the stroke -№ 1. [4]



Fig. 7 Execution of the living



Fig. 8 execution of the Contouring

Varnishing

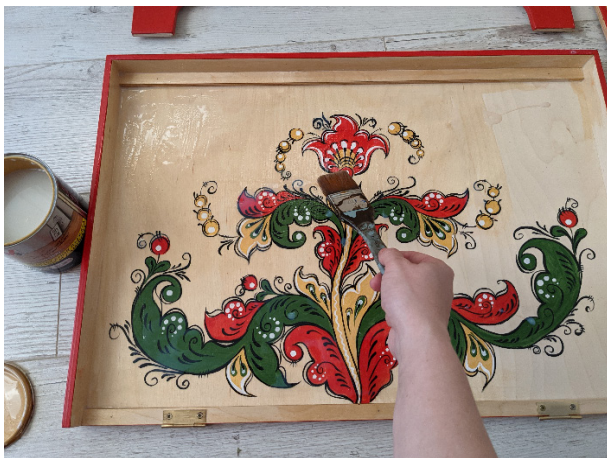


Fig. 9 Varnishing

Protects the product from moisture and scratches. A colorless matt varnish is used. (Fig. 9) The widest possible flute brush over the wood pattern without stopping. The coating is applied in layers, each layer must be dried about three times. After drying, the product is assembled. (Fig. 10).



Fig. 10 Elements, chest walls



Fig. 11 Finished product

The product is ready and will become a real functional decoration of any interior. (Fig. 11)

The painted chest is relevant in a modern interior, finds its place, thereby preserving the traditions of the craft.

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重型颅脑外伤合并急性期温度反应的年龄相关特征
**AGE-RELATED FEATURES OF TEMPERATURE REACTION IN
THE ACUTE PERIOD OF COMBINED SEVERE TRAUMATIC
BRAIN INJURY**

Muhitdinova Hura Nuritdinovna

Doctor of Medical Sciences, Full Professor

*Center for the Development of Professional Qualifications of Medical
Workers*

Tashkent, Uzbekistan

抽象的。第 1 组患者 (19–40 岁) 的体温昼夜节律中值指标的区别不仅在于没有体温过高的趋势, 而且还在于研究指标趋于正常化的趋势。第 30 天。在受伤组 2 (41–60 岁) 中观察到在强化治疗的第 18 天和随后的天数中体温昼夜节律的中间水平逐渐升高的趋势。在第 3 组 (61–88 岁) 患者的 CSTBI 急性期, 昼夜节律 $T^{\circ}C$ 的中波波动水平相对较低。抗炎治疗效果的缺失, 最有可能表明热疗具有中心源性的可能性, 不排除所有患者的完全继发感染, 特别是在合并严重创伤性脑损伤的晚期 (第 25 天) 在第 3 组患者中。

关键词: 体温, 合并重型颅脑损伤。

Abstract. *The indicator of the mesor of the circadian rhythm of body temperature of the 1st group of patients (19-40 years old) was distinguished not only by the absence of a tendency to hyperthermia, but also by the tendency to normalize the studied indicator by the 30th day. A tendency to a gradual increase in the level of the mesor of the circadian rhythm of temperature on the 18th and subsequent days of intensive therapy was observed in the injured group 2 (41-60 years old). A comparatively lower level of fluctuations in the mesor of the circadian rhythm $T^{\circ}C$ was revealed in the acute period of CSTBI in patients of group 3 (61-88 years old). The absence of the effect of anti-inflammatory therapy, most likely, indicates the likelihood of a centrogenic nature of hyperthermia, not excluding completely secondary infection in all patients, especially in the late periods (on the 25th day) of combined severe traumatic brain injury in patients of group 3.*

Keywords: *temperature, combined severe traumatic brain injury.*

Relevance. *The increase in injuries increases not only the frequency, but also*

the severity of traumatic brain injury (TBI), which is 50–70% associated with extracranial injuries. Mortality from concomitant traumatic brain injury (CTBI) ranges from 12 to 69%. In the general structure of peacetime injuries, the proportion of combined and multiple injuries ranges from 5 to 12%, and among the most severe - up to 40%. An almost constant component of severe associated injuries is TBI, which occurs in such cases with a frequency of 50-72 to 80-82%. The limbs are injured in 22.9% of cases, the chest - in 31%, the abdomen - in 25-29%. Multiple extracranial injuries in combination with TBI occur in 15% of cases. There is strong evidence that hyperthermic response increases the likelihood of death in patients with brain damage [1,2,3,4]. It has been shown that mortality is increased in patients with TBI, stroke, if they have an elevated body temperature in the first 24 hours after admission to the critical care unit. There are several possible explanations for why hyperthermic conditions increase mortality in patients with brain damage. It is known that the temperature of the brain is not only slightly higher than the internal temperature of the body, but the difference between them also increases as the latter increases. Hyperthermia increases metabolic requirements (an increase in temperature by 1°C leads to an increase in metabolic rate by 13%), which is detrimental to ischemic neurons. An increase in brain temperature is accompanied by an increase in intracranial pressure. Hyperthermia increases edema, inflammation in damaged brain tissue. Other possible mechanisms of brain damage: violation of the integrity of the blood-brain barrier, violation of the stability of protein structures and their functional activity.

Given the effect of elevated temperature on the damaged brain, it is very important to quickly and accurately determine the etiology of the hyperthermic state and begin the correct treatment. Of course, if indicated, the appropriate antibacterial drugs are life-saving agents. However, early and accurate diagnosis of centrogenic hyperthermia can prevent patients from prescribing unnecessary antibiotics and their associated complications.

According to Badjatia N. (2009), 70% of patients with brain damage have an elevated body temperature during their stay in intensive care, and, for example, among patients of general intensive care, only 30–45%. Moreover, only half of the cases reported fever (infectious cause). Among patients of neurosurgical intensive care units (ICU), patients with subarachnoid hemorrhage (SAH) had the highest risk of developing a hyperthermic state, both of fever (infectious genesis) and centrogenic hyperthermic reaction (non-infectious genesis). The authors found that among ICU patients with a neurosurgical profile, only 50% of fever cases have an infectious cause. Other possible non-infectious causes of fever: drugs, venous thromboembolism, non-calculous cholecystitis. Almost any drug can cause fever, but among the most commonly used in ICU settings: antibiotics (especially β -lactams), anticonvulsants (phenytoin), barbiturates. Among

TBI patients, patients with diffuse axonal injury (DAI) and damage to the frontal lobes are at risk of developing centrogenic hyperthermia. It is likely that these types of TBI are accompanied by damage to the hypothalamus. For non-infectious fevers, it is typical for the patient to appear in the early stages of hospitalization at the ICU. Blood in the ventricles is a risk factor, since catheterization of the ventricles of the brain often occurs with intraventricular hemorrhage. Centrogenic hyperthermia may not be accompanied by tachycardia and sweating, as is usual with infectious fever, and may be resistant to antipyretics. Although it is desirable to avoid the use of antibiotics without indications due to the development of undesirable side effects, the rejection of antibiotic therapy in patients with sepsis can be fatal [1-5].

Despite the numerous results of studies on the study of the temperature response in brain damage due to the lack of information in the literature on the age-related characteristics of the dynamics of the mesor of the circadian rhythm of body temperature in the acute period of injuries associated with severe traumatic brain injury (STBI), we tried to identify on the basis of a retrospective analysis distinctive characteristics, features in different age groups. The division into groups was dictated by the well-known features inherent in each age group, described in detail in the literature.

Purpose of the work: to study and assess the age-related characteristics of the temperature reaction in the acute period of combined severe traumatic brain injury.

Material and research methods. The indicators of a comprehensive examination of 27 patients with concomitant severe craniocerebral trauma (CSTBI) who were admitted to the ICU of the neurosurgical department of the RSCRMA in the first hours after an accident - 25, catatrauma of 2 patients were studied. According to the indications, 26 patients on admission started invasive mechanical respiratory support (MRS), 1 patient, due to the lack of direct indications for (mechanical ventilation) MV, intensive therapy was carried out with spontaneous breathing. Monitoring was carried out by complex hourly registration of parameters of body temperature, hemodynamics, respiration. Mechanical respiratory support was initiated by mechanical ventilation (LV) for a short time followed by transfer to SIMV. On admission, impaired consciousness in 26 injured patients was assessed on the Coma Glasgow Scale (GS) 8 points and below. Patients were considered in three age groups: group 1, 19-40 years old (13 patients), 2 - 41-60 years old (7), 3 - 61-84 years old (7 patients). After recovery from shock, anesthetic, anti-inflammatory, antibacterial, infusion therapy, correction of violations of protein, water-electrolyte balance, surgical early correction, as far as possible, syndromic, symptomatic therapy were carried out.

Results and its discussion.**Table 1**

Dynamics of the mesor of the circadian rhythm of body temperature in the acute period of combined severe traumatic brain injury

days	group 1	group 2	group 3
1	37.0±0.2	37.2±0.7	36.8±0.1
2	37.2±0.3	37.4±0.4	37.3±0.3*
3	37.7±0.6	37.3±0.4	37.1±0.2
4	37.4±0.3	37.4±0.4	37.5±0.4
5	37.5±0.4	37.7±0.4	37.3±0.3*
6	37.5±0.3	37.4±0.3	37.4±0.5
7	37.5±0.3	37.5±0.2	37.3±0.4
8	37.5±0.3	37.5±0.4	37.2±0.4
9	37.6±0.3*	37.6±0.1	37.2±0.3
10	37.7±0.4*	37.4±0.2	37.1±0.5
11	37.4±0.5	37.7±0.2	37.1±0.3
12	37.5±0.4	37.6±0.2	37.2±0.3
13	37.4±0.2	37.3±0.2	37.0±0.3
14	37.4±0.3	37.3±0.3	37.2±0.1
15	37.2±0.2	37.4±0.2	37.1±0.2
16	37.2±0.1	37.3±0.4	37.2±0.1
17	37.1±0.2	37.3±0.4	37.1±0.2
18	37.2±0.4	37.4±0.4	37.1±0.3
19	37.3±0.3	37.5±0.4	37.0±0.2
20	37.2±0.4	37.6±0.3	37.0±0.2
21	37.2±0.3	37.5±0.2	37.0±0.2
22	37.4±0.2	37.6±0.1	36.9±0.3
23	37.3±0.3	37.5±0.3	37.3±0.5
24	37.3±0.2	37.7±0.4	36.8±0.2
25	37.3±0.2	37.4±0.3	37.4±0.4*
26	37.3±0.3	37.8±0.2	37.3±0.3
27	37.3±0.2	37.6±0.1	37.0±0.3
28	37.3±0.1	37.8±0.2	37.2±0.4
29	37.3±0.1	37.9±0.03	37.0±0.1
30	36.9±0.4	37.5±0.1	37.2±0.3

*-reliably relative to the indicator in 1 day

As shown in table 1, on the day of admission to the clinic in the first hours after combined severe traumatic brain injury, the mesor of the circadian rhythm of body temperature in patients of groups 1 and 2 was within subfebrile numbers (from

36.8°C to 37.9°C), in group 3 - $36.8 \pm 0.1^\circ\text{C}$. During the acute period, in group 1 of the injured, a significantly significant increase in the mesor of the circadian rhythm of body temperature was revealed on days 9 and 10 to $37.6 \pm 0.3^\circ\text{C}$ and $37.7 \pm 0.4^\circ\text{C}$, respectively. In group 2, there was a tendency to an increase in the temperature reaction throughout the entire period of treatment in the ICU. In group 3, a significantly significant increase in body temperature was detected on days 2, 5, 25 to $37.3 \pm 0.3^\circ\text{C}$, $37.3 \pm 0.3^\circ\text{C}$ and $37.4 \pm 0.4^\circ\text{C}$, respectively. That is, despite the ongoing anti-inflammatory complex and antibacterial therapy, on days 9-10 in group 1, on days 2, 5, 25 in group 3, a hyperthermic reaction was revealed, which indicated the insufficient effectiveness of traditional complex therapy in all age groups, which is more likely in total, indicates the likelihood of a centrogenic nature of hyperthermia, especially in the late periods (on the 25th day) of combined severe traumatic brain injury in patients of group 3.

Thus, secondary brain damage remains a problem far from resolving secondary brain damage, there are no effective methods not only for prevention, but also for preserving the structural integrity and functional activity of initially intact brain areas. The existing recommendations are not effective enough in the correction of ischemia, edema, diffuse axonal injuries, cannot serve as methods of preventing an increase in the zone of irreversible changes in the medulla.

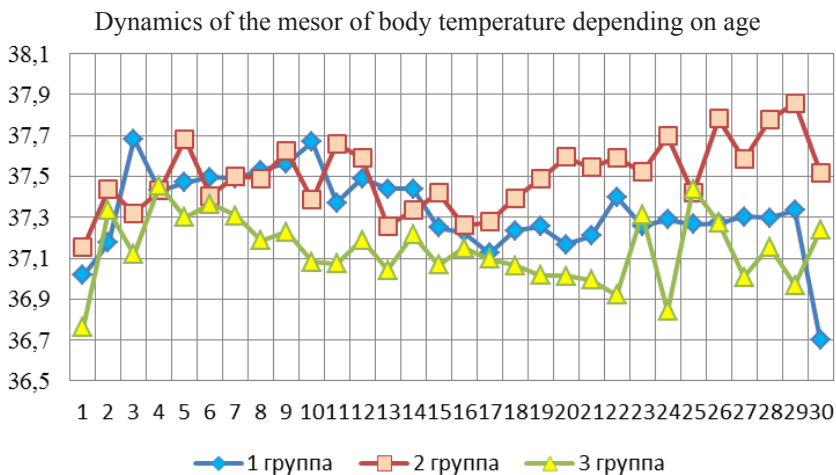


Fig.1

As can be seen from fig. 1, draws attention to the relatively lower level of changes in the mesor of the circadian rhythm $T^{\circ}C$ with an increase to $37.4^{\circ}C$; $37.3^{\circ}C$ and $37.4^{\circ}C$ on day 4.23.25 of the acute period in patients of group 3. A tendency to a gradual increase in the level of the mesor of the circadian rhythm of temperature on the 18th and subsequent days of intensive therapy was observed in the injured group 2 (up to $37.9^{\circ}C$ on the 29th day). The mesor temperature index of the 1st group of patients differed not only by the absence of a tendency to hyperthermia, but also by the tendency to normalize the studied parameter by the 30th day.

Correlations between the dynamics of the temperature response and hemodynamic parameters in age groups are shown in fig. 2.

Correlation relations of $T^{\circ}C$ with parameters of hemodynamics and respiration

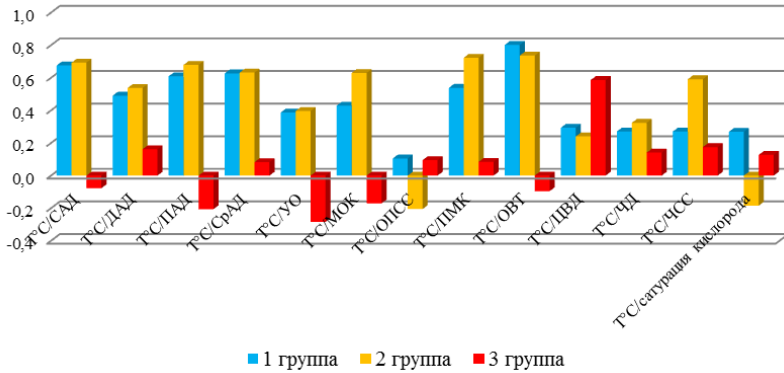


Fig.2

A direct correlation was found between changes in $T^{\circ}C$ and the dynamics of the mesoor SBP (0.63), PBP (0.62), avBP (0.6), CO (0.6), MVP (0.64), AVT (0, 7) in patients of groups 1 and 2. That is, the systemic inflammatory response to severe trauma was accompanied by a compensatory increase in the functional activity of hemodynamics, which indicated a preserved regulatory mechanism of the central nervous system, despite STBI in patients under 60 years of age. Draws attention to the fact that these compensatory reactions completely disappeared in patients over 61 years of age. Direct correlation between $T^{\circ}C$ and CVP level (0.58) confirms the likelihood of developing acute heart failure in conditions of an intact systemic inflammatory reaction, the objective indicator of which is hyperthermic syndrome.

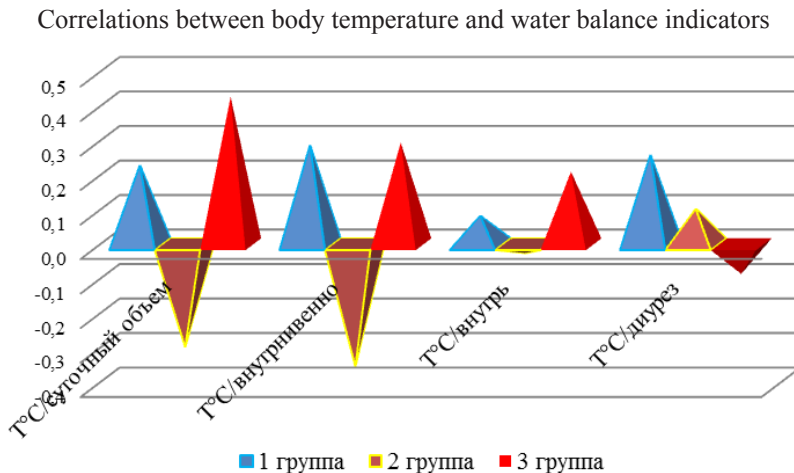


Fig.3

A moderately pronounced direct correlation was found between the dynamics of the mesor of the circadian rhythm of temperature and the total daily volume of the injected fluid (0.38). An insignificant trend towards a decrease in temperature with an increase in the volume of intravenous administration (0.35) was revealed in patients of group 2 (fig. 3).

Conclusion. The mesor temperature index of the 1st group of patients differed not only by the absence of a tendency to hyperthermia, but also by the tendency to normalize the studied parameter by the 30th day. A tendency to a gradual increase in the level of the mesor of the circadian rhythm of temperature on the 18th and subsequent days of intensive therapy was observed in the injured group 2. A comparatively lower level of fluctuations in the mesor of the circadian rhythm $T^{\circ}C$ was revealed in the acute period of CSTBI in patients of group 3. The absence of the effect of anti-inflammatory therapy, most likely, indicates the likelihood of a centrogenic nature of hyperthermia, not excluding completely secondary infection in all patients, especially in the late periods (on the 25th day) of combined severe traumatic brain injury in patients of group 3.

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重型颅脑外伤合并收缩压昼夜节律适应性变化的相位分析
**PHASE ANALYSIS OF ADAPTIVE CHANGES IN THE CIRCADIAN
RHYTHM OF SYSTOLIC BLOOD PRESSURE IN CONCOMITANT
SEVERE TRAUMATIC BRAIN INJURY**

Muhitdinova Hura Nuritdinovna

Doctor of Medical Sciences, Full Professor

*Center for the Development of Professional Qualifications of Medical
Workers*

抽象的。第1组患者损伤最严重(50.2±5.6分),合并重型颅脑外伤后第一天的病情严重程度和意识障碍与第2组和第3组无显著差异。收缩压的昼夜节律表明40岁以下的血液动力学代偿性防御机制处于更好的状态。

关键词: 昼夜节律, 收缩压, 重型颅脑外伤

Abstract. *With the most severe injuries in patients of group 1 (50.2±5.6 points), the severity of the condition and impaired consciousness on the first day after combined severe traumatic brain injury did not differ significantly from those in groups 2 and 3. Changes in the circadian rhythm of systolic blood pressure indicated a better state of compensatory defense mechanisms of hemodynamics at the age of up to 40 years.*

Keywords: *circadian rhythm, systolic blood pressure, combined severe traumatic brain injury*

Relevance. The factors aggravating combined TBI from bone fractures are their shockogenicity, blood loss, increased systemic inflammatory response and coagulopathy, which leads to secondary damage to the brain and lungs, increases the incidence of embolic, pulmonary complications and multiple organ failure. Bone fractures and soft tissue injuries in polytrauma become significant sources of factors of systemic inflammatory response and oxidative stress, which penetrate the blood-brain barrier, modulate immune responses and have a cytotoxic effect in the brain, exacerbating the severity of TBI. Early operations of osteosynthesis, being an operational trauma, can provoke the progression of the inflammatory reaction, the development of systemic complications and multiple organ failure, that is, cause the effect of the "second blow". In polytrauma with TBI, early osteosynthesis for fractures of the femur, unstable fractures of the pelvic bones can

reduce the incidence of complications (ARDS, pneumonia, pulmonary embolism, fat embolism syndrome, sepsis and multiple organ failure), reduce mortality and improve anatomical and functional results of treatment. But, being an operational trauma, osteosynthesis can, on the contrary, provoke the development of dangerous systemic complications, that is, cause a "second shock", and excessive intra-operative infusion therapy can induce neuronal apoptosis, ischemic stroke and cerebral edema in patients with TBI concomitant. aggravate cardiorespiratory disorders and worsen neurological outcome (6). The danger of hypertension for predicting a person's life in a relatively stable state has nothing to do with the significance of the increase in BP in the acute period of severe TBI. In the latter case, the increase in BP is aimed at increasing the perfusion of the affected brain. The authors believe that it is not necessary and unsafe, from the point of view of providing cerebral perfusion, to administer antihypertensive drugs with an increase in BP, no matter what values it reaches. A decrease in systemic BP under the influence of antihypertensive drugs led to a decrease in cerebral perfusion pressure with unchanged ICP values. The decrease in CPP created the risk of hypoperfusion and cerebral ischemia. The researchers did not observe a decrease in ICP with a decrease in blood pressure. This fact makes it possible to exclude such a hypothetical mechanism as a decrease in vasogenic cerebral edema with a decrease in elevated BP (Lund-concept). Cerebral edema with a decrease in BP not only does not decrease, but increases (1-5.7). The ambiguous attitude to changes in blood pressure in STBI stimulated us to study the circadian rhythm of SBP in the acute period of concomitant severe traumatic brain injury (CSTBI).

Purpose of the work: to study and assess the adaptive changes in the phase structures of the circadian rhythm of systolic blood pressure in combined severe craniocerebral trauma.

Material and research methods. The indicators of a comprehensive examination of 30 patients with concomitant severe craniocerebral trauma (STBI) who were admitted to the ICU of the RSCEMA neurosurgical department in the first hours after an accident - 28, catatrauma of 2 patients were studied. In all patients, head injury was accompanied by various associated injuries. In particular, the victims had fractures of the limbs and pelvis, damage to the bones of the facial skeleton, damage to the chest, spine and spinal cord, damage to the abdominal cavity and retroperitoneal organs (ruptures of the spleen, liver, kidney capsules, etc.). According to the testimony of 29 patients, on admission, invasive mechanical respiratory support (MRS) was started. Monitoring was carried out by complex hourly registration of parameters of body temperature, hemodynamics, respiration. Mechanical respiratory support began with mechanical ventilation (ALV) for a short time, followed by transfer to SIMV (tab. 2). The severity of the condition was assessed by scoring methods according to the scales for assessing the severity

of combined injuries - the CRAMS scale, the assessment of the severity of injuries according to the ISS scale. On admission, impaired consciousness in 29 injured patients was assessed on the Glasgow coma scale (GS) 8 points or less (tab. 1). Patients were considered in three age groups: group 1, 19-40 years old (13), group 2 - 41-60 years old (9), 3 - 61-84 years old (8 patients). Complex intensive care consisted in identifying and timely correction of deviations: MRS, after removing from shock pain-relieving, anti-inflammatory, antibacterial, infusion therapy, correction of protein and water-electrolyte balance disorders, surgical, to the extent possible, early correction, syndromic, symptomatic therapy.

Results and discussion

Table 1.

Assessment of the severity of the condition by age

Parameters	Group 1	Group 2	Group 3
age in years	29.5±4.3	51.6±4.8	72.3±9.1
CRAMS, points	4.5±0.6	4.4±0.8	4.8±0.6
ISS, points	50.2±5.6	43.3±7.1	46.2±9.1
GS, points	7.3±0.5	7.9±1.3	7.8±1.5

It was found that with the most severe injuries in patients of group 1 (50.2±5.6 points), the severity of the condition and impaired consciousness did not differ significantly from those in groups 2 and 3.

Table 2.

Respiratory support depending on the severity of the condition

Parameters	Group 1	Group 2	Group 3
age in years	29.5±4.3	51.6±4.8	72.3±9.1
CRAMS, points	4.5±0.6	3.6±1.0	4.8±0.6
ISS, points	50.2±5.6	27.8±20.4	46.2±9.1
GS, points	7.3±0.5	7.3±3.3	7.8±1.5
SIMV, number of days	8.6±3.9	11.8±5.5	17.8±16.9
BIPAP, number of days	4.5±5.3	3.2±1.7	1.4±1.7
CPAP, number of days	5.8±7.1	7.0±0.6	7.6±7.5
Number of mode switching	3.5±2.5	2.5±0.8	3.0±0.8
MRS, duration of respiratory support in days	14.7±8.2	16.5±5.1	26.8±16.5
Number of days in ICU	21.3±11.8	23.0±6.5	36.0±23.0
Total number of days in hospital	25.4±13.1	26.7±9.9	46.5±21.8

The longest duration of intensive care in ICU, prolonged MRS in SIMV mode, the duration of inpatient treatment was observed in group 3 (tab. 2).

Table 3.
Dynamics of the mesor of the circadian rhythm of systolic blood pressure in the acute period of combined severe trauma

days	Group 1	Group 2	Group 3
1	128.2±4.0	119.8±11.9	134.7±9.1
2	125.0±2.4	129.3±7.0	125.9±4.4
3	128.0±2.7	126.0±5.6	126.7±3.4
4	131.5±2.5	134.1±5.6	127.7±3.3
5	124.6±2.6	133.9±5.3	133.4±4.9
6	129.4±2.9	133.4±3.7	133.4±2.9
7	130.7±2.2	134.9±3.2	128.7±2.7
8	127.8±2.6	129.5±4.3	128.6±6.5
9	127.2±2.6	126.6±3.9	128.4±4.7
10	130.2±3.3	124.9±3.4	129.0±5.4
11	124.1±2.1	126.7±3.5	128.2±4.5
12	124.5±2.6	124.4±4.6	129.0±4.3
13	123.6±4.2	121.2±4.6	116.2±4.2*
14	122.5±3.6	117.8±4.0	125.2±4.9
15	121.0±2.4	125.7±4.1	129.2±4.1
16	121.8±3.7	122.6±5.2	126.4±4.3
17	119.8±3.5*	130.5±6.2	131.6±3.4
18	121.0±4.0	130.8±5.3	119.4±4.2*
19	114.1±4.1*	127.4±3.2	121.1±4.4
20	116.5±2.8*	134.7±8.8	123.7±3.6
21	125.6±3.5	139.9±9.0	127.6±5.5
22	127.8±4.7	139.9±9.0	128.5±7.0
23	123.3±5.4	133.8±5.3	123.0±7.8
24	123.7±5.4	137.4±6.1	130.4±6.9
25	117.5±3.9*	134.5±5.5	130.2±6.1

*-deviations are reliable relative to the indicator in 1 day

As presented in tab. 3, on the first day of the combined STBI, age-specific features of the mesor of the circadian rhythm SBP were not revealed. On the fol-

lowing days, in group 1, there was a decrease in the indicator by 19 (6%), 20 (11%), 25 days (8%). In group 2, there were no significant differences due to the large scatter of data on day 1. In group 3, the mesors of the circadian rhythm SBP decreased by 13 (5%), 18 days (11%).

Dynamics of the mesor of the circadian rhythm of systolic blood pressure in the acute period of combined severe trauma (mmHg)

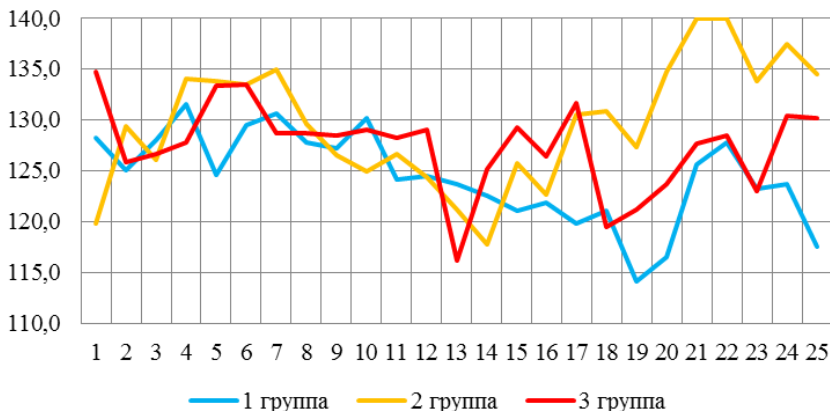


Fig.1

As shown in fig. 1, changes in the SBP circadian rhythm mesor in the acute period of CSTBI occurred in waves with periods of fluctuations in group 1 of 4 days, when the detected decrease in SBP mesor on days 19 and 25 represented the SBP value in the bathyphase of four-day biorhythms. In group 2, the wavelike changes in the SBP mesor fell into two: 14- and 11-day periods of fluctuations with the acrophase peak on days 7 and 21, which in turn consisted of several four-day phases. In group 3, wave-like fluctuations fit into 5 day periods with a comparatively smaller amplitude of each wave. The minimum values of SBP mesor in bathyphase in group 3 were detected on days 13 and 18, amounting to (116.2±4.2 mmHg and 119.4±4.2 mmHg, respectively).

Thus, the adaptive reaction of hemodynamics in the acute period of CSTBI occurred by changing not only the structure of the circadian rhythm, but also by restructuring the circadian biorhythm in about four to five days with a slightly reduced amplitude of fluctuations in group 3 of patients.

Age features of the SBP circadian rhythm response to CSTBI in the first 8 days (mmHg)

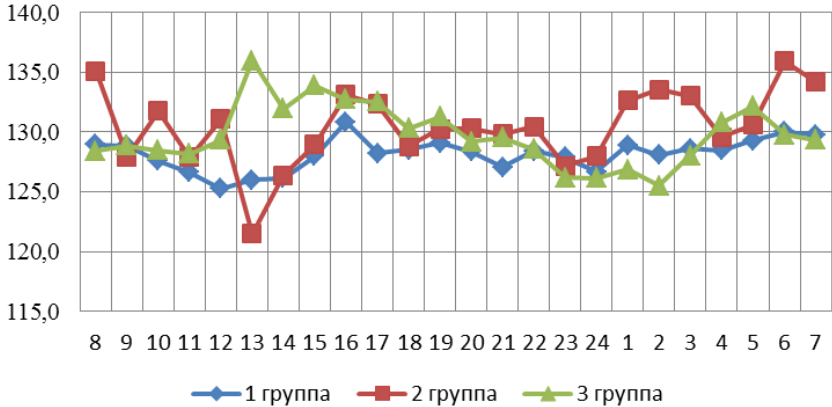


Fig.2

An attempt to identify the distinctive features depending on the time elapsed after the injury made it possible to differentiate the changes in the SBP indicators in the circadian rhythm inherent in each subsequent week after the injury. So, in patients of group 1 in the first 8 days (Fig. 2) during the day, the SBP indicator fluctuated within 125 mmHg at 12 o'clock with a rise to 132 mmHg. at 16 o'clock. On the next day from 9 to 17 (fig. 3), daily changes in SBP were low-amplitude waves within 123 - 127 mmHg. In the third week of observation (from 18 to 25 days), the amplitude of daily fluctuations increased (from 118 mmHg at 14 o'clock to 125 mmHg at 18 o'clock). Thus, the average value of the amplitude of the circadian rhythm SBP in the first 8 days was 6, on days 9-17 - 4, 18-25 days 6 mmHg. In group 2, the mean value of the amplitude of daily SBP changes in the first 8 days was 15 mmHg (121 mmHg at 13 o'clock, 136 mmHg at 6 a.m.). The bathiphase projection at 13 o'clock characterizes the inversion of the circadian rhythm of SBP in group 2 in the first 8 days of treatment. From 9 to 17 days in patients of group 2, daily fluctuations were characterized by low-amplitude wave-like SBP changes with an amplitude of 5 mmHg. In fig. 4, draws attention to the increase in the amplitude (up to 18 mmHg) of daily changes in the SBP index with bathiphase at 11 o'clock and the maximum SBP value at 17 o'clock on the 18-25 day. The revealed changes in the circadian rhythm correspond to the inversion of the circadian rhythm of SBP in age 2 patients at the third week of observation.

Age features of the SBP circadian rhythm response to CSTBI from 9 to 17 days (mmHg)

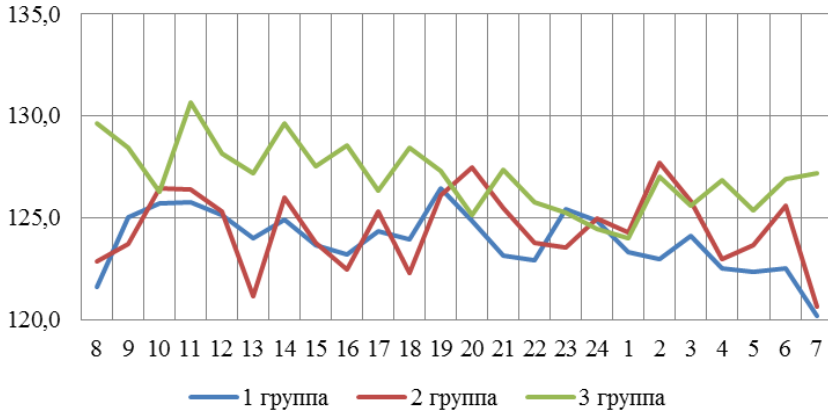


Fig.3

Fluctuations of SBP in group 3 from 1 to 8 days of the acute period of CSTBI were manifested by the projection of acrophase 137 mmHg at 13 o'clock, while the amplitude of daily fluctuations in SBP was 12 mmHg. From 9 to 17 days, the daily fluctuations of patients over 61 years old also differed in low amplitude (4 mmHg), on the next 18-25 days the amplitude of fluctuations increased to 8 mmHg, the acrophase projection was detected at 24 hours, indicating an inversion of the daily rhythm of fluctuations of SBP in group 3 (fig. 4). Thus, the circadian rhythm of SBP in the process of hemodynamic adaptation under conditions of severe stress caused by CSTBI took an active part, being rearranged by a moderate displacement of the acrophase projection in groups 2 and 3 (in the first 8 days and 18-25 days), bathyphase in group 2 on 9- 17 days, decreasing (in all three groups on days 9-17) and increasing the amplitude of daily fluctuations in group 2 on days 17-25 after combined STBI.

Age features of the SBP circadian rhythm response to CSTBI from 18 to 25 days (mmHg)

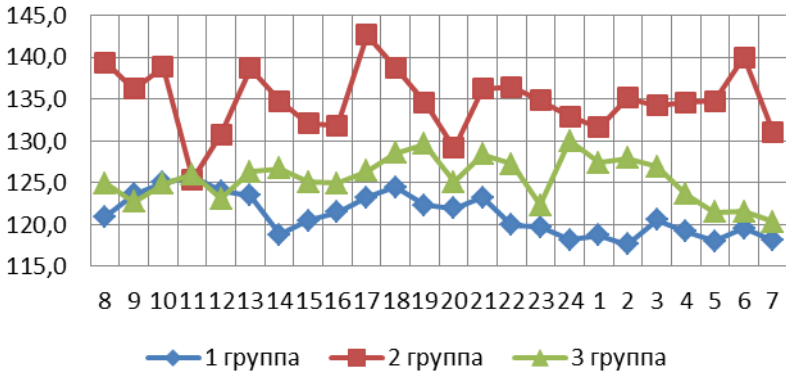


Fig.4

Dynamics of the amplitude of the circadian rhythm of systolic pressure, mmHg

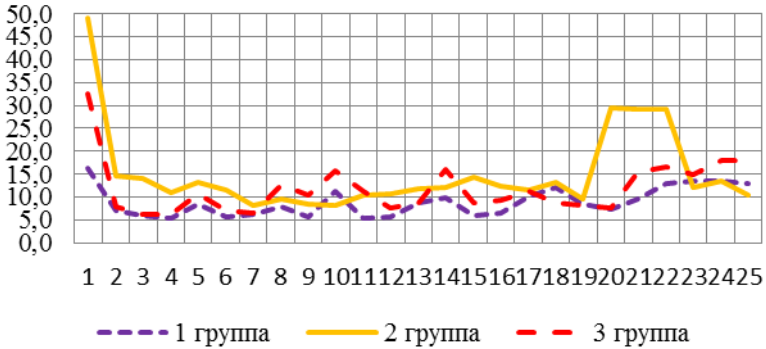


Fig.5

A characteristic common feature was the highest value of the amplitude of the circadian rhythm SBP on day 1, amounting to 16 mmHg in group 1, 50 mmHg in 2, 32 mmHg in group 3. The stress reaction of hemodynamics to CSTBI was manifested by an increase in SBP drops within 1 day, characterizing the instability of myocardial contractility caused not only by stress response to trauma, but primarily by damage to brain structures, an inflammatory reaction not only of brain tissue, but also bone fractures and soft tissue injuries. in polytrauma - sources of factors of systemic inflammatory response and oxidative stress, which penetrated the blood-brain barrier, modulating immune responses and exerting a cytotoxic

effect in the brain, aggravating the severity of TBI. The most pronounced changes in cardiac output were found in the 2nd age group (fig. 5). Almost synchronous changes in the dynamics of the amplitude of the daily fluctuation of the circadian rhythm SBP (50 mmHg) with the maximum drop in the indicator in 1 day were revealed in patients of group 2 (85 mmHg) (fig. 6). Attention is drawn to the second wave of increased daily SBP drops on days 20-22 in group 2 of patients. The repeated SBP stress response may have had a compensatory significance in response to hypoxia caused by repeated attempts to transfer patients to spontaneous breathing. The smallest indicators of the daily SBP fluctuations in 1 day in patients of group 1 with the most pronounced trauma injuries indicate a better state of anti-stress protective mechanisms (in particular, the parasympathetic autonomic system, inhibitory activity of CNS neurotransmitters, and others) at the age of up to 40 years.

Rahmach of daily fluctuations in systolic pressure in the acute period of combined severe traumatic brain injury, mmHg.

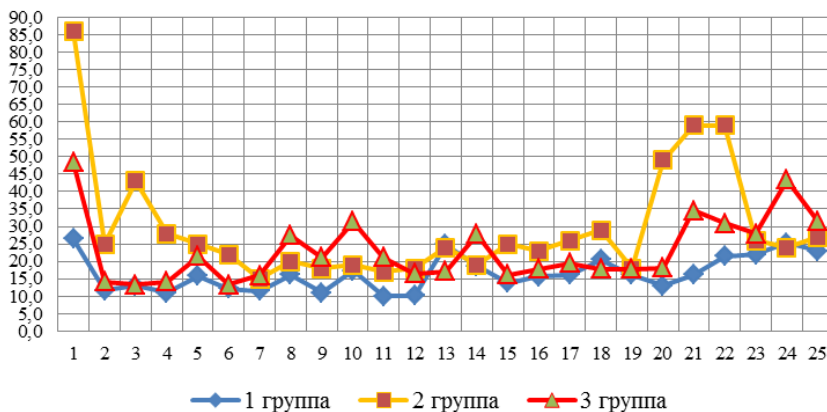


Fig.6

Conclusion. With the most pronounced CSTBI lesions in patients of group 1 relative to age groups 2 and 3, changes in the circadian rhythm of systolic blood pressure indicated a better state of compensatory defense mechanisms of hemodynamics at the age of up to 40 years.

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儿童和孕产妇发病率, 作为俄罗斯滨海边疆区公共卫生的基本因素
**CHILDREN'S AND MATERNAL MORBIDITY, AS A BASIC
FACTOR IN PUBLIC HEALTH IN THE PRIMORSKY KRAI OF
RUSSIA**

Dmitry S. Osmolovsky

Neurologist, Neurophysiologist

Head of the Center for Restorative Medicine and Rehabilitation

Krai Clinical Center for Specialized Types of Medical Care

Tatyana A. Gvozdenko

Doctor of Medical Sciences, Professor of the RAS

Director of the Vladivostok branch

Far Eastern Scientific Center of Respiratory Physiology and Pathology

Sergej L. Kolpakov

Candidate of Medical Sciences, Associate Professor

Pacific State Medical University

Sergey V. Osmolovsky

Candidate of Medical Sciences, Rehabilitation Physician

Center for Restorative Medicine and Rehabilitation

Krai Clinical Center for Specialized Types of Medical Care

抽象的。文章介绍了滨海边疆区2009年至2019年新生儿和儿童发病率和死亡率的研究数据。分析了同期孕妇的发病率、孕期状态以及分娩并发症和产后活动。已经根据长期数据和滨海边疆区行政-领土结构的统计指标进行了计算。死产风险的主要领土焦点是位于汉卡湖西部和南部的滨海边疆区地区。在Khanka 地区, 预测死产率为每 1,000 名新生儿 15.2 例。儿童死产和早产与高血压疾病有中等强的统计关系 ($r=0.46$; 0.31)。它们最常见于生态不利地区的孕妇。儿童神经系统疾病是我们检查的唯一病理类别, 其中与孕妇泌尿生殖系统疾病存在统计关系 ($r = 0.31$)。发现患有精神障碍 ($r=0.38$)、神经系统疾病 ($r=0.40$)、儿童先天性异常 ($r=0.45$) 的孕妇循环系统疾病存在显着的统计关系。

关键词: 死产、新生儿死亡率、儿童、神经系统疾病、先天性异常、精神障碍。

Abstract. *The article presents data on the study of morbidity and mortality in newborns and children in Primorsky Krai from 2009 to 2019. The morbidity of pregnant women, the state during pregnancy and complications of childbirth and postpartum activity in the same time period were analyzed. The calculation*

of statistical indicators based on long-term data and in the spatial aspect for the administrative-territorial formations of Primorsky Krai has been made. The leading territorial focus of stillbirth risk was the Primorskiy Krai districts located to the west and south of Lake Khanka. In the Khanka region, the forecast for the still-birth rate was 15.2 per 1,000 births. Stillbirth and prematurity in children had a moderately strong statistical relationship with hypertensive disorders ($r=0.46$; 0.31). They were most often formed in pregnant women in ecologically unfavorable areas. Nervous diseases of children were the only category of pathology that we examined, in which there is a statistical relationship with diseases of the genitourinary system of pregnant women ($r=0.31$). A significant statistical relationship was revealed between the presence of diseases of the circulatory system in pregnant women with mental disorders ($r=0.38$), nervous diseases ($r=0.40$), congenital anomalies in children ($r=0.45$).

Keywords: stillbirth, newborn mortality, children, diseases of the nervous system, congenital anomalies, mental disorders.

Introduction. A difficult demographic situation remains a medical and social health problem in the Russian Federation [1]. This is especially true of the Far Eastern region, in particular the Primorsky Krai [2]. In its solution, priority is given to aspects that shape the health of children: the prevention of stillbirth, prematurity, newborn mortality, morbidity with socially significant classes of pathology in children, the health of women of childbearing age, the provision of medical care to pregnant women, childbirth.

Research on the identification of risk factors for the pathology of pregnant women, newborns and children plays an important role in the strategy of maintaining and strengthening the health of the country's population. Success has been achieved in the study of individual risks: biological, genetic, clinical factors [3; 4; 5; 6]. Residents of large and small cities have established the role of nutrition, physical activity, body weight, smoking, hypertension, hypercholesterolemia and other diseases [4]. Similar studies were carried out in rural areas [5]. Risk factors are also studied in the social sphere: in education, family and social status, interpersonal relationships, and living conditions [3]. The effectiveness of obstetric care institutions as a factor in children's health has been analyzed [1]. The role of non-term maturity in the formation of nervous and mental diseases in children has been established [7; 8]. However, with all the redundancy of information about individual risk factors, the question of the mechanisms of their implementation remains open. Does the prevalence of risk factors in the population correlate with the spatio-temporal characteristics of the pathology? With the same stillbirth, prematurity, morbidity in children and pregnant women. In systems theory, the position is well known that at a higher level of organization (population level relative

to the individual level), the phenomenon is characterized by both quantitative and qualitative originality [9]. For prevention, planning of treatment measures and organization of medical care, it is important to know the mechanisms of interaction between individual and population risk factors.

Purpose of the study: to establish population risk factors for stillbirth, prematurity, newborn mortality, morbidity with socially significant pathology in Primorsky Krai. To achieve the goal, the following tasks were set: to study the territorial and temporal characteristics of pathology in newborns and children, pathological conditions in pregnant women and their impact on the health of children during pregnancy and complications of labor.

Materials and methods. The study used statistical data on the pathological conditions of newborns: stillbirth, prematurity, and newborn mortality in Primorsky Krai for the period from 2009 to 2018. We studied statistical data on socially significant classes of neonatal diseases: congenital anomalies of newborns. As well as diseases of children: congenital anomalies of children, nervous diseases, mental illnesses from 2009 to 2018. We used statistical data on diseases of pregnant women by classes: diseases of the endocrine and genitourinary systems, circulatory systems, anemia, hypertensive disorders, venous complications. According to these classes of diseases, statistical indicators of "detectability" were calculated in women (per 1000) from among those who completed pregnancy in childbirth.

Statistical data on the state of women during pregnancy were used: the threat of premature birth and termination of pregnancy, the pathological state of the fetus, Rh immunization. For complications of labor and postpartum activities: detachment of the placenta, eclampsia, premature rupture of the membranes. The choice of the states of women during pregnancy and complications of childbirth and the postpartum period was determined by the possibility of statistical processing and analysis (frequency of events, completeness of data on objects). The study was carried out in the administrative-territorial formations of Primorsky Krai (31 objects).

Data on primary and general childhood morbidity were obtained from the statistical reports "Basic indicators of medical services for the population of Primorsky Krai", reporting form No. 12. Analyzed the statistical indicators for administrative-territorial entities from the annual information and statistical reference books of the information and analytical center of the Department of Health of Primorsky Krai "Health of the population and healthcare of Primorsky Krai". The article presents the average and prognostic indicators of the period under consideration. Stillbirth statistics were calculated in ppm per 1,000 births (‰). Newborn mortality - per 100 observations (%). Prematurity rates per 1,000 births (‰). Incidence (newly diagnosed cases) and prevalence (overall incidence, prevalence) were calculated per 100,000 child population (‰₀₀). Statistical indicators of the

detection of pathology in pregnant women, pathological conditions during pregnancy, complications of childbirth and the postpartum period are calculated for 1,000 observations (%).

To analyze statistical data, assess the epidemiological situation, study the territorial distribution of statistical indicators, and correlation analysis, prognostic values were used. They have an advantage over average indicators in that they take into account the long-term trend and reflect the epidemiological situation at the current time [10]. Based on the regression equation, predictive values of all studied statistical variables were obtained.

To establish a statistical relationship, a correlation was made between the prognostic indicators of the state of newborns and the incidence of children with socially significant classes of diseases with the prognosis of the detection of diseases by the main classes in pregnant women in the administrative-territorial entities of Primorsky Krai. And also with forecasts of pathological conditions during pregnancy and complications of childbirth and postpartum activities. Statistical analysis was carried out on the basis of Microsoft Office Excel.

Results. The formation of the state of health of children can be represented in a chain of cause-and-effect relationships: born alive - stillborn; newborn alive - newborn deceased; healthy newborns - sick newborns; healthy children are sick children. In this sequence, the first level (live birth) is characterized by statistical indicators of stillbirth. We are considering the population factors of this phenomenon on the model of the territorial distribution of stillbirth in the administrative-territorial formations of Primorsky Krai. To level out random factors, as well as to take into account the patterns (long-term trend) as much as possible, the forecasts of stillbirth and infant mortality were calculated.

The leading territorial focus of stillbirth risk was the Primorskiy Krai areas located to the west and south of Lake Khanka, bordering the PRC. This is the Khanka region, the forecast for the stillbirth rate is 15.2 per 1,000 births. Border region - 11.2 per 1,000 births. Oktyabrsky district - 9.5 per 1,000 births. Ussuriysk and Ussuriysk district - 7.4 per 1,000 births. The mosaic nature of the risk areas is associated with the increased rates of Luchegorsk, Lesozavodsk and Partizansk, small towns of Primorsky Krai with industrial city-forming enterprises.

The territorial distribution of forecasts for infant mortality had a completely different character. First, the rates were significantly higher. The average stillbirth rate in one area is 4.8 per 1,000 births, and the average newborn death rate is 3.3 per 100 live births. Secondly, the territories at risk for the death of a newborn were remote areas of Primorsky Krai. The mortality forecast in the Kavalеровsky district was 6.2 per 100 live births; Pozharsky district - 4.7%; Dalnerechensk and Dalnerechensk region - 4.4%. In the rest of the territories, there is a tendency towards a decrease in infant mortality rates and the forecast values are below average.

The territorial distribution of prematurity prediction indicators in Primorsky Krai by risk areas was mosaic. With an average statistical indicator of prematurity of 19.7 per 1,000 births, the maximum values were in the city of Spassk-Dalny and Spassky districts (47.4 per 1,000 births); Terneisky district (43.8.); Artem (35.2 %); Krasnoarmeisky district (33.8 %); Border area (32.5 %). The distribution patterns of prematurity differed from stillbirth and neonatal mortality.

To establish the general nature of the formation of pathology, a correlation analysis was carried out. It does not reveal a statistical relationship between stillbirth and neonatal mortality ($r=-0.17$); prematurity and neonatal mortality ($r=-0.02$). However, between prematurity and stillbirth, there is a positive statistical relationship of average strength ($r=0.39$), which allows us to speak about the general population and pathogenetic mechanism of the formation of prematurity and stillbirth. At the same time, differences in the territorial nature of pathology and a low statistical relationship suggest that environmental factors have a greater influence on stillbirth, and individual factors of parents (mothers) have a greater effect on prematurity.

Table 1
The statistical relationship between pediatric pathology and the condition of pregnant women

Conditions and diseases of children	Diseases of pregnant women					
	endo-crine system	genito-urinary system	circulatory system	anemia	Hyper-tensive disorders	venous compli-cations
stillbirth	0.16	-0.05	0.21	-0.10	0.46	0
infant mortality	0.02	-0.08	-0.03	-0.02	-0.20	-0.17
prematurity	0	-0.24	0.26	-0.11	0.31	0
congenital anomalies of children	0.18	0.14	0.45	-0.07	-0.11	0.60
congenital anomalies of newborns	0.21	0.01	-0.09	0.14	0.14	0.28
nervous diseases	0.13	0.31	0.40	0.13	-0.07	0.26
mental disorders	-0.13	0.03	0.38	-0.15	0.10	0.33

The study of statistical relationships between stillbirth, infant mortality and prematurity with diseases of pregnant women, possibly, shows the presence of causal relationships and risk factors (tab. 1). Thus, diseases of pregnant women did not have a statistically significant effect on the mortality of newborns. However, they had a statistically significant effect on prematurity and stillbirth. First of all, we

are talking about hypertensive disorders. The statistical relationship between still-birth and the presence of hypertensive disorders during pregnancy was moderately strong, positive ($r=0.46$). A similar statistical relationship, at the border of moderate and weak strength, was found between hypertensive disorders and prematurity ($r=0.31$). The risk areas for the detection of hypertensive disorders in pregnant women were Khankaisky district (20.3 per 1,000 women who completed pregnancy with childbirth), Khasansky district (19.5 %) and Pogranichny district (15.1 %). These are the southern regions of Primorsky Krai, bordering the PRC. The main occupation of the population is agricultural plant growing (rice, soybeans, corn ...). Increased rates of detection of hypertensive disorders were observed in pregnant women in the remote, northern territories of Primorsky Krai. These are Krasnoarmeisky District (13.0 %), Dalnegorsk and Dalnegorsk District (12.7 %), Luchegorsk City and Pozharsky District (8.8 %). These are territories with a harsh climate and developed industrial production. In general, the nature of the territorial distribution of hypertensive disorders (the presence of risk zones) suggests the predominance of climatic and environmental risk factors over the individual risk factors of pregnant women.

As the main socially significant pathology of children, we studied the incidence of congenital anomalies, the incidence of nervous and mental diseases. The presence of statistical links between these classes of diseases in children and the incidence of diseases in pregnant women (detection of diseases) has been analyzed. The presence of an average strength of the statistical relationship between venous complications in pregnant women and the incidence of congenital anomalies in children ($r=0.60$) was established. At the same time, the statistical relationship with the incidence of congenital anomalies in newborns was significantly lower ($r=0.28$). Venous complications in pregnant women were also statistically associated with the incidence of mental illness in children ($r=0.33$). To a lesser extent - with nervous diseases of children ($r=0.26$). In this regard, it should be noted that the nervous diseases of children are the only category of pathology that we have considered, in which there is a statistical connection with diseases of the genitourinary system of pregnant women ($r=0.31$). Probably, there may be a direct etiological and pathogenetic role of infectious pathology.

The presence of a significant statistical relationship between the detection of diseases of the circulatory system in pregnant women with socially significant pathology of children was revealed. With mental disorders ($r=0.38$), nervous diseases ($r=0.40$), congenital anomalies in children ($r=0.45$). At the same time, there was no statistical relationship with congenital anomalies of newborns ($r=-0.09$). This is probably due to the fact that predominantly congenital anomalies of a hereditary nature are detected in the maternity hospital. And in children, congenital anomalies are detected, acquired in the process of intrauterine development.

The features of the territorial distribution of the prognosis of diseases of the circulatory system in pregnant women, at first glance, do not have a natural character. Territories at risk are Oktyabrsky District (20.2 per 1,000 pregnant women), Artem (14.4 ‰), Nakhodka (13.6 ‰), Krasnoarmeisky District (10.1 ‰). Therefore, in identifying risk factors for diseases of the circulatory system, one should look for a pathogenetic mechanism that explains the territorial distribution of indicators.

The presence of statistical relationships between the states and diseases of newborns and children and the state of women during pregnancy was studied (tab. 2). There were no significant statistical associations with stillbirth, neonatal mortality and prematurity. In general, this indicates the effectiveness of treatment measures and the provision of medical care to pregnant women. In the formation of socially significant pathology, a statistical relationship was established on the border of weak and medium strength with the pathological state of the fetus. With mental disorders ($r=0.31$), nervous diseases ($r=0.29$) and congenital anomalies of children ($r=0.15$).

The presence of a negative statistical relationship between medical care for pregnant women with a pathological state of the fetus and prematurity of newborns ($r=-0.36$) was established. In other words, there is a therapeutic and prophylactic effect. Negative statistical relationship between stillbirth and the threat of termination of pregnancy ($r=-0.12$), pathological state of the fetus ($r=-0.11$) and Rh immunization ($r=-0.11$). The statistical feedback is weak, but there is a general tendency for the presence of a preventive effect of stillbirth in women in labor receiving medical care in the presence of pregnancy pathology.

Table 2
Statistical relationship of diseases of newborns and children with the condition of pregnant women

Conditions and diseases of children	Conditions during pregnancy			
	Threat of premature birth	The threat of termination of pregnancy	Pathological condition of the fetus	Rh immunization
stillbirth	0.27	-0.12	-0.11	-0.11
infant mortality	0.18	0.22	0.14	-0.07
prematurity	0.13	0.16	-0.36	0.07
congenital anomalies of children	0.02	-0.23	0.15	0.10
nervous diseases	0.16	-0.07	0.29	-0.01
mental disorders	-0.04	-0.21	0.31	0.18

In a number of cases, the presence of statistical links between complications of childbirth and postpartum activity with the conditions and pathology of children was revealed (tab. 3). A statistical relationship of moderate strength was established between eclampsia and the presence of congenital anomalies ($r=0.32$). Between placental abruption and prematurity ($r=0.36$). Labor complications did not affect neonatal mortality. On the contrary, in all types of complications of childbirth had a weak positive statistical relationship with stillbirth. In general, the data obtained can be regarded as a reflection of effective medical care in the conditions of acutely emerging complications of childbirth and postpartum activity.

Table 3

Statistical relationship of conditions and diseases of newborns and children with complications childbirth and postpartum activities

Conditions and diseases of children	Complications of childbirth and postpartum activities		
	detachment of the placenta	eclampsia	premature rupture of fruit membranes
stillbirth	0.27	0.16	0.28
infant mortality	0.02	0.02	-0.11
prematurity	0.36	0.09	0.23
congenital anomalies	0.03	0.32	0.02
nervous diseases	0.19	0.18	0.15
mental disorders	0.00	0.00	-0.19

Thus, the study of the patterns and features of the territorial distribution of the detection of pathology in pregnant women shows the presence of statistical and causal relationships with stillbirth, prematurity and socially significant diseases of children. At the same time, there is no reason to believe that the distribution of individual behavioral risk factors (smoking, nutrition, education ...) can have similar spatial and temporal characteristics. Rather, a normal distribution pattern in the population with a predominance of mean levels should be expected. Since the frequency of occurrence of individual risk factors in the population of working adults is very high (smoking - 35%; overweight - 64%; hypercholesterolemia - 35% ...) [4], the incidence rates are formed in association with them. But at the same time enough, regardless of their prevalence. Population mechanisms based on individual risk factors are regulators of the incidence rates of women of child-bearing age and children, stillbirth and prematurity.

Stillbirth and prematurity in children were statistically associated with hypertensive disorders ($r=0.46$; 0.31). They, in turn, were formed in pregnant women in ecologically unfavorable areas with less quality medical care. Therefore, as a

population mechanism, one can consider the ecological dependence of the incidence (through water, food, occupational factors). Territories of risk for infant mortality were extremely remote areas where it is difficult to receive timely qualified medical care. This corresponds to the model of WHO experts on the factors that determine health: medical provision accounts for 8-12%, and the environment - 15-20% [10].

In the formation of socially significant pathology of children in Primorsky Krai, by the strength of statistical connections, the presence of heart and circulatory system diseases in pregnant women plays an important role. As well as the associated pathogenetic venous complications. It is difficult to explain the territorial features of the incidence of diseases of the circulatory system in pregnant women by climate, ecology, social factors, and the provision of medical care (fig. 5). Previously, we studied the mechanisms of the formation of the incidence of streptococcal group A infection, acute rheumatic fever and chronic rheumatic heart disease in Primorsky Krai. A territorial model of the epidemic process with areas of risk of morbidity was developed [11]. The spatial distribution of heart and circulatory system diseases in pregnant women is fully consistent with this model. Therefore, we formulated a hypothesis that the territories at risk for congenital anomalies detected in children are formed on the basis of the pathogenetic mechanisms of the incidence of rheumatism. And how indirectly, through the pathological conditions of the mother. So directly, as an autoimmune, post-streptococcal congenital disease of the newborn. In the sources available to us, such a mechanism and its possibility are not described.

In conclusion, we note the positive, preventive effect of providing medical care to women with pregnancy pathology. And also with complications during childbirth. Even with a high risk of stillbirth and pathology in newborns and children, there is no significant statistical relationship. And in some cases, feedback is noted as a positive effect of therapeutic measures.

Conclusions.

1. When studying the morbidity of pregnant women, stillbirth, infant mortality and morbidity in children with diseases of the nervous system, congenital anomalies and mental disorders, a regular pattern of spatial distribution over the territories of Primorsky Krai was revealed.

2. The coincidence of the patterns of the territorial distribution of pathology in pregnant women with stillbirth, mortality and morbidity in children was established.

3. The main classes of pathology in pregnant women that determine stillbirth, mortality and morbidity in children are diseases of the heart and circulatory system, hypertensive disorders, and venous complications.

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干扰疗法联合脊柱牵引在神经根性背痛患者中的应用效果
**EFFICIENCY OF APPLICATION OF INTERFERENCE THERAPY
IN COMPLEX WITH SPINE TRACTION
IN PATIENTS WITH RADICULAR BACK PAIN**

Akhundov Parviz Yashar

*Researcher in medical rehabilitation department,
Scientific Research Institute of Medical Rehabilitation, Baku, Azerbaijan*

Guseinova Sadagat Qanbar

*Doctor of Medical Sciences, Professor,
Head of the neurophysiology Laboratory
Scientific Research Institute of Medical Rehabilitation,
Baku, Azerbaijan*

注解。一项前瞻性研究评估干扰疗法在复合脊柱牵引治疗神经根性背痛患者中的应用效果。该研究对 64 名 20 至 69 岁的患者进行。患者分为两组。第一对照组包括 32 名接受脊柱牵引治疗的患者。第二个治疗组包括32例在同一天采用脊柱牵引和干扰电流疗法治疗的患者。疗程持续10-12天。治疗前后对患者进行评估。使用视觉模拟量表 (VAS) 评估疼痛,并使用简短的麦吉尔疼痛问卷 (SF-MPQ) 评估疼痛特征。由 Roland-Morris “残疾问卷”衡量的残疾水平。

我们的研究表明,脊柱牵引复合干扰疗法治疗根性背痛患者是一种有效的方法。这种治疗复合物对疾病临床过程的有益作用、更显著的镇痛作用和改善生活质量指标 ($p < 0,001$)。

关键词: 腰痛, 神经根病, 干扰疗法, 脊柱牵引

Annotation. *A prospective study evaluating efficiency of application of interference therapy in complex with spine traction in patients with radicular back pain. The study was conducted on 64 patients of age from 20 to 69. Patients were divided into two groups. The first—control group included 32 patients who were treated by using spine traction as a treatment. The second— treatment group included 32 patients who were treated by using the spine traction and interference current therapy on the same day. The course of treatment lasted 10-12 days. The patients were evaluated before and after the treatment. Pain was assessed using the Visual Analog Scale (VAS), and the short-form McGill Pain Questionnaire (SF-MPQ) were used to assess characteristics of pain. Disability level measured by the Roland-Morris “Disability Questionnaire”.*

Our study results show that interference therapy complex with spine traction in the treatment of patients with radicular back pain is an effective approach. The beneficial effect of this therapeutic complex on the clinical course of the disease, more pronounced analgesic effect, and improving the indicators of the quality of life ($p < 0,001$).

Keywords: low back pain, radiculopathy, interference therapy, spine traction

Introduction

Low back pain (LBP) is one of the most common musculoskeletal complaints encountered in clinical practice with a lifetime prevalence of 70% to 85%. It is the leading cause of disability in the developed world. Lumbosacral radiculopathy can also appear in the absence of actual lumbar pain [2,3]. Lumbosacral radiculopathy (LSR) is one of the most common disorders evaluated by neurologists. Its prevalence has been estimated to be 3% – 5% of the population, affecting both men and women. Symptoms typically begin in midlife [9,10]. Moreover, the condition constitutes a significant reason for patient referral to either neurologists, neurosurgeons, or orthopedic spine surgeons therefore treatment of LSR requires a multimodal and multispecialty team. Physiotherapy interventions for the management of LBP are wide and variable, but the efficacy of many is still questionable. There are a wide range of modalities that can serve many purposes including reducing inflammation, decreasing muscle spasm, and increasing local blood flow to improve the rate of tissue healing, and decreasing pain [1,5,7]. Interferential therapy (IFT) has been widely used for many years. Several reviews are indicating it is an overall supportive evidence base, especially for pain based management (e.g. Fuentes et al, 2010) [4]. The result of applying a higher frequency is that it will pass more easily through the skin, requiring less electrical energy input to reach the deeper tissues & giving rise to less discomfort. Lumbar traction is a traditional treatment modality. Several studies have investigated the effect of lumbar traction on lumbar disc herniation [11]. Traction has been prescribed to treat various spinal disorders, including radiculopathy, disk herniation, disk degeneration, and nonspecific low back pain. Research in this area has been confounded by the multiple types of traction techniques and treatment protocols and by methodological flaws. Axial distraction of the motion segment is thought to change the position of the nucleus pulposus relative to the posterior annulus fibrosus or change the disc-nerve interface, which could decrease mechanical pressure exerted on a nerve by a displaced disc [6,8].

The aim of the study

The purpose of this study is to determine the efficacy of complex application of IFT and spine traction (ST) in patients with radicular back pain.

Materials and methods

A prospective open controlled randomized study was conducted to assess the efficacy of complex application IFT and ST in patients with LSR.

Inclusion criteria: the age of patients older than 18 years, less than 70 years, one or more lumbar radiculopathy confirmed with clinical studies and MRI. Exclusion criteria: patients with corresponding contraindications for physical therapy, also pregnancy, diabetes.

Imaging plays a critical role in the diagnosis of low back pain. MRI has become a mainstay in the workup of low back pain due to its excellent soft tissue contrast, cross-sectional capability, and lack of ionizing radiation.

Participants were randomly assigned into treatment (n=32), and control group (n=32). The first control group included 32 patients were treated by using spine traction as a treatment. Traction was horizontal, 20% to 40% of the patient's body weight force used. Duration was 10-30 min. The treatment group included 32 patients who treated by using the spine traction and interference therapy on the same day. Frequencies of 30-100 Hz were used for IFT. IFT duration was 12-15 min. In both group lumbar exercises and medical massage therapy also was utilized for improving the efficiency. Course of treatment lasted 10-12 days. The patients were evaluated before and after the treatment. In this study, pain was assessed using the Visual Analog Scale (VAS).

The short-form McGill Pain Questionnaire (SF-MPQ) were used to assess characteristics of pain, particularly sensory and affective qualities. Disability level measured by the Roland-Morris "Disability Questionnaire" (RDQ). All the data collected from this study were analyzed using a statistical processing program (SPSS statistics 26)

Results and discussion

Among the examined patients, male patients prevailed the age ranged from 18 to 70 years, averaging 41.7 ± 1.4 years. The overwhelming majority (70.1 %) were patients of working age.

Patients studied on a 1.5 Tesla Magnetic Resonance Imaging machine. MRI findings like lumbar lordosis, Schmorl's nodes, decreased disk height, disc annular tear, disc bulge, disc protrusion, and disc herniation were observed (Fig 1). In part of patients ligamentum flavum thickening and facet arthropathy was also observed. Disc herniation & protrusion played a special role in compression of the nerve roots, however, in some cases also facet arthropathy takes a role. The L₄-L₅ & L₅-S₁ intervertebral discs were the most commonly involved.

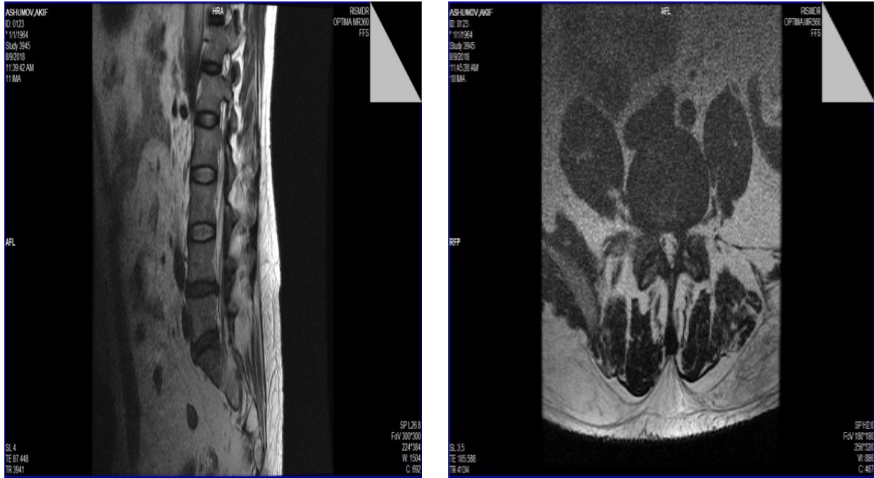


Figure 1.

Degenerative disc disease in a patient with LBP. Lateral paramedian lumbar disc herniation at L₄-L₅ intervertebral area (affects L₅ nerve roots). Asymmetric disc bulges in the L₅-S₁ intervertebral area.

Narrowing of the spinal canal. Osteo-degenerative changes in the lumbar spine

In the examined patients, the main symptom was LBP, in most cases radiating to the lower extremities. Clinically, infraction of the biomechanics of the spine was often noted - in most cases (76.3%) there was a restriction ROM lumbar spine, mainly bending forward. Sensory root involvement caused sensory impairment in a dermatomal distribution in 65 % of patients.

Results showed that the mean pain score (VAS), (SF)-MPQ and RMDQ) were similar at baseline: the mean for pain score (VAS) at the baseline period ranged from 6.31 to 6.53 cm, number of selected descriptors (NSD) on SF-MPQ from 2.21 to 2.3, Pain Rating Index (PRI) from 4.17 to 4.63, disability level on the RMQ from 51.7 % to 56.8 %. Before treatment RMQ total score was 9.57 ± 2.43 in control group, 10.23 ± 2.41 in treatment group. However, during 10-12 days treatment periods, the VAS mean values were decreased to 2.91 ± 1.53 cm (p<0.001), NSD on SF-MPQ 1.33 ± 0.71(p<0.01), PRI 1.63 ± 0.81 (p<0.005) for the treatment group, 3.88 ± 2,0 (p<0,001), 1.55 ± 0,69 and 1.92 ± 1.21(p<0.01) for the control group (table 1).

Table 1.
Dynamics of pain scores scale indicators

Indicators	Treatment Group			Control Group		
	Before treat. Mean±SD	After treat. Mean±SD	p value	Before treat. Mean±SD	After treat. Mean±SD	p value
Pain Score (VAS)	6,53 ± 0,95	2,91 ± 1,53	p<0,001	6,31 ± 1,31	3,88 ± 2,0	p<0,01
SF - MPQ (NSD)	2,3 ± 0,53	1,33 ± 0,71	p<0,01	2,21 ± 0,49	1,55 ± 0,69	p>0,05
SF- MPQ (PRI)	4,63 ± 1,38	1,63 ± 0,81	p<0,005	4,17 ± 1,23	1,92 ± 1,21	p<0,01

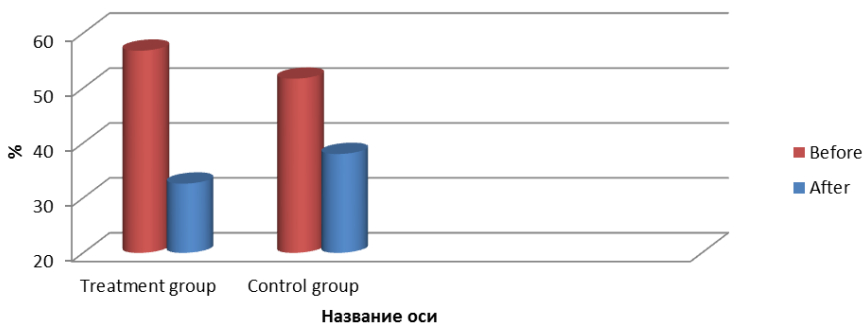
Due to the decreasing of pain, static-dynamic disturbances diminished, ROM in the lumbar spine increased, and the gait improved. It should be noted that such changes were most pronounced in the treatment group.

Daily functional activity were grouped into overarching themes of mobility (walking, stairs, sitting/standing, bending/kneeling, lifting, lying down), activities (chores/housework, dressing, washing, driving, work) and other (relationships/socializing, mood, sleep, appetite), which are consistent with those evaluated within the RMDQ. Regression of pain also take a role to improve the quality of life for patients. After treatment, disability level on the RMQ decreased from 56.8% to 32.6 % for the treatment group and from 51.7 % to 38 % in control group (diagram 1). RMQ total score decreased from 9.57 ± 2.43 to 6.86 ± 3.17 in control group, 10.23 ± 2.41 to 5.87 ± 2.22 in treatment group ($p < 0.001$).

Complications during and after IFT and ST were not observed.

Diagram 1.

Dynamics of disability level on RMQ



Conclusion

In this study, combination types of therapeutic interventions (IFT and ST in the complex, ST as monotherapy) were chosen for the management of LSR within the framework of these principles. The analysis highlighted no statistically significant differences found between the two study groups in pre-treatment assessments. This indicates that the patients in the two groups were homogenous.

Overall improvement rate in experimental group was 62,5%, in treatment group 84,4 %. Analyzing the results of our study, it can be noted that the treatment of ST as a monotherapy or with combination IFT had a positive effect in patients. However, the use of ST in combination with IF showed more statistical significance and efficiency in reducing back pain and disability. The beneficial effect of this therapeutic complex on the clinical course of the disease, more pronounced analgesic effect, and regression of clinical manifestations, as well as improvement of quality of life indicators.

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门诊眼科医生对儿童人群的临床检查：其有效性和权宜之计
**CLINICAL EXAMINATION OF THE CHILDREN'S
POPULATION BY AN OUTPATIENT OPHTHALMOLOGIST: ITS
EFFECTIVENESS AND EXPEDIENCY**

Shutova Svetlana Raisovna

Ophthalmologist

Oblast Ophthalmological Dispensary, Tyumen, Russia

Bedash Kalinka Ivanova

Candidate of Medical Sciences, Associate Professor

Institute for Continuous Professional Development

Tyumen State Medical University

Ophthalmologist

Oblast Ophthalmological Dispensary, Tyumen, Russia

Afanasyeva Alyona Andreevna

Ophthalmologist

Oblast Hospital № 19, Tyumen, Russia

抽象的。

目的 - 分析由地区综合诊所的眼科医生三年对儿童进行预防性医学检查的有效性。

材料与方法。对秋明州“州医院 № 19”（秋明州）国家预算医疗机构眼科医生2018-2020年的工作进行了回顾性分析。

结果。所分析的综合诊所的儿童人口结构显示了秋明州医疗和人口状况的总体趋势——接受药房检查的儿童人口增加。对儿童预防性检查期间发现的病理学分析表明，其中大部分是屈光病理学造成的：近视、远视、调节障碍 - 2018年 - 91.7%，2019年 - 91.8%。在对学前机构病理的详细分析中，远视（36%）位居首位。第二位是近视（24-27%），第三位是调节障碍（17-25%）。在学龄儿童中，根据体检，近视率居首位（46%）。

结论。对3年儿童动态临床检查的有效性分析表明，眼部病理指标几乎处于同一水平（持续高），屈光和功能病理普遍存在——近视、远视和调节障碍。进行临床检查有助于早期发现功能障碍阶段的病理，这些障碍可以成功地接受保守治疗。

关键词：临床检查、预防检查、儿童人群、学龄前、近视、远视。

Abstract.

Purpose - to analyze the effectiveness of prophylactic medical examination of the child population by an ophthalmologist of a district polyclinic for three years.

Material and methods. A retrospective analysis of the work of an ophthalmologist of the State Budgetary Healthcare Institution of Tyumen Oblast "Oblast Hospital № 19" (Tyumen) for 2018-2020 was carried out.

Results. The structure of the child population of the analyzed polyclinic showed the general tendency of the medical and demographic situation in Tyumen Oblast - an increase in the child population subject to dispensary examination. The analysis of the revealed pathology during preventive examinations of the child revealed that most of it is accounted for by refractive pathology: myopia, hyperopia, violation of accommodation - in 2018 - 91.7%, in 2019 - 91.8%. In a detailed analysis of pathologies in preschool institutions, the first place is taken by hyperopia (36%). In second place is myopia (24-27%), in third place is accommodation disorder (17-25%). In school-age children, according to medical examinations, myopia is in the first place (46%).

Conclusion. Analysis of the effectiveness of clinical examination in dynamics for 3 years in children revealed that the indicators of eye pathology are practically at the same level (consistently high), refractive and functional pathology prevails - myopia, hyperopia, and accommodation disorder. Conducting clinical examination contributes to the early detection of pathology at the stage of functional disorders, which are successfully amenable to conservative treatment.

Keywords: clinical examination, preventive examination, children's population, preschool, myopia, hyperopia.

Relevance. At the present stage, according to the order of the Ministry of Health of the RF of August 10, 2017 № 514n "On the Procedure for conducting preventive medical examinations of minors" (changes from 13.06.2019, order of the Ministry of Health of the RF № 396n), outpatient doctors are actively conducting clinical examination of the child population. In modern scientific literature, there are works devoted to the effectiveness of the ongoing medical examination, and the inexpediency of its implementation from an economic point of view [1, 2]. However, some authors talk about the need for early treatment of binocular vision pathology [3]. In addition, the increase in patients with refractive amblyopia, emphasizes the relevance of clinical examination, both in organized and unorganized populations in order to increase the diagnosis of refractive errors in childhood. This is necessary for early rehabilitation measures, both conservative and surgical methods of treatment [4]. The medical and demographic situation in Tyumen Oblast has undergone some changes: in general, the number of both children and adults and persons subject to prophylactic medical examination has increased [5].

The data obtained as a result of clinical examination can be used to make organizational decisions in order to increase the effectiveness of rehabilitation measures in the conditions of the polyclinic link, day and round-the-clock hospitals.

Purpose of the study. To analyze the effectiveness of prophylactic medical examination of the child population by an ophthalmologist at a district polyclinic for three years.

Material and methods. A retrospective analysis of the report of the ophthalmologist SBHCI TO "Oblast Hospital № 19" for 2018-2020 was carried out. The polyclinic serves 114,421 people, of which 27,723 (24.2%) are children aged 0 to 17 years. 31,152 (27.2%) people live in the service area of feldsher-obstetric stations. Among the child population, according to the order, 9725 (35.1%) were subject to medical examination in 2018, 9815 (35.4%) in 2019. Since March 2020, due to the COVID 19 pandemic, preventive examinations and medical examination of the population have not been carried out (only 300 preschool children were examined).

Results and discussion. The age structure of the child population examined by an ophthalmologist as part of a clinical examination is presented in tab. 1 and corresponds to the average statistical indicators for the Russian Federation [6].

Table 1 - Age composition of the child population examined by an ophthalmologist as part of a clinical examination

Years	2018	2019	2020
Total	9725 (100%)	9815 (100%)	300 (100%)
Children 7-17 years old	6125 (63%)	6320 (64.4%)	-
Children 1-6 years old	3600 (37%)	3495 (35.6%)	300 (100%)

Table 2 – The structure of the child population of the Tyumen region

Years	2018		2019		2020	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
Total amount	21871	100	21986	100	22103	100
Children under 1 year	1320	6.0	1332	6.0	1354	6.1
Unorganized	4934	22.6	4952	22.5	4976	22.5
Kindergartens	5128	23.4	5179	23.6	5192	23.5
Schoolchildren	9286	42.5	9301	42.3	9340	42.3
Adolescents	1203	5.5	1222	5.6	1241	5.6

The structure of the child population of the analyzed polyclinic showed the general tendency of the medical and demographic situation in Tyumen Oblast - an increase in the child population subject to dispensary examination by 232 children (tab. 2). In the structure of the child population, 71.4% are children attending kindergartens and schools, the share of unorganized children is 28.6%.

The analysis of the revealed pathology during preventive examinations of the child population showed that most of it is due to refractive pathology: myopia, hyperopia, violation of accommodation - in 2018 - 91.7%, in 2019 - 91.8%. The pathology of binocular vision accounts for - in 2018 - 4.5%, in 2019 - 4.3%. The indicators are presented in tab. 3.

Table 3 - The structure of the revealed pathology during preventive examinations

Years	2018		2019		2020	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
Total	3800	100	3890	100	97	100
Disturbance of accommodation	585	15.4	589	15.1	10	10.3
Myopia	1500	39.5	1570	40.4	35	36.1
Strabismus	170	4.5	168	4.3	3	3.1
Hypermetropia	1400	36.8	1412	36.3	34	35.1
Amblyopia	130	3.4	135	3.5	13	13.4
CPVO	15	0.4	16	0.4	2	2.1

In general, in the period from 2018-2019. there is an upward trend in eye diseases (by 90 people during 2019). The data for 2020 is not very informative, this situation is associated with the introduced quarantine measures in connection with Covid-19.

A detailed analysis of pathologies in preschool institutions (hereinafter PI) is presented in tab. 4, 5. The first place among the revealed pathology in preschool children is taken by hyperopia. In most cases, it is the physiological norm for the development of the visual system. In second place is myopia, in third place is a violation of accommodation. This can be explained by the early acquaintance of children with various gadgets, PCs, TVs, uncontrolled and prolonged use, inheritance of myopia.

Table 4 - Indicators of preventive examinations in preschool institutions

Years	Subject to examination	Examined	Med. examination coverage	Children with diseases revealed, total	
	Abs.n.	Abs.n.	%	Abs.n.	%
2018	2500	2500	100	595	23.8
2019	2624	2624	100	684	26.1
2020	2491	300	12.0	97	32.3

Table 5 - The structure of the identified pathology in PI

Years	2018		2019		2020	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
Values						
Myopia	166	27.9	170	24.9	35	36.1
Hypermetropia	253	42.5	270	39.5	34	35.1
Disturbance of accommodation	104	17.5	171	25.0	10	10.3
Strabismus	36	6.1	35	5.1	3	3.1
Amblyopia	30	5.0	32	4.7	13	13.4
CPVO	6	1.0	6	0.9	2	2.1

Analyzing the data of preventive examinations of schoolchildren (tab. 6.7), we can say that in children of this category, myopia is in the first place. This situation is associated, from our point of view, with the following factors:

- digitalization of education, carried out in the country since 2016, and since 2018 implemented within the framework of the national project "Digital School", has significantly intensified the use of digital teaching aids in schools (interactive whiteboards and panels, computers, electronic tablets, etc.);

- the use of electronic gadgets with liquid crystal screens (smartphones, computers, laptops, electronic tablets) at leisure and at home when preparing lessons, searching for information, electronic games, communicating on social networks;

- in connection with the Covid-19 pandemic, educational organizations in Russia switched to distance learning, which remained until the end of the 2019/2020 academic year. Long-term and irrationally organized use of electronic gadgets dramatically increases the load of the visual analyzer, which cannot but lead to the development of visual impairments and computer visual syndrome.

Table 6 - Indicators of preventive examinations by schools

Years	Subject to examination	Examined	Med. examination coverage	Children with diseases revealed, total	
	Abs.n.	Abs.n.	%	Abs.n.	%
2018	6125	6125	100	2800	45.7
2019	6320	6320	100	2850	46.5
2020	5521	-	-	-	-

For the period 2018-2019, there is no significant dynamics in the detection of vision pathology. In the period 2020, clinical examination was not performed due to the introduced quarantine measures.

Table 7 - The structure of the revealed pathology in schools

Years	2018		2019		2020	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
Values						
Myopia	1300	46.4	1320	46.3	-	-
Hypermetropia	800	28.6	770	27.0	-	-
Disturbance of accommodation	500	17.9	563	19.8	-	-
Strabismus	90	3.2	91	3.2	-	-
Amblyopia	100	3.6	96	3.4	-	-
CPVO	10	0.4	10	0.4	-	-

In the general picture, having analyzed the indicators of clinical examination for three years, it can be concluded that the indicators of the revealed pathology are practically at the same level (indicators are consistently high). In all age categories of children, refractive and functional pathology prevails - myopia, hyperopia, accommodation disorder.

Conclusions. In preschool children, hyperopia comes out on top, which, more often, is a natural stage of refractogenesis. In schoolchildren, myopic refraction comes first. This can be attributed to excessive eye strain while reading, watching TV and spending a long time at a PC and various gadgets. Conducting clinical examination contributes to the early detection of pathology at the stage of functional disorders, which are successfully amenable to conservative treatment.

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碳酸氢盐缓冲系统作为维持人体酸碱平衡的主要机制
**THE BICARBONATE BUFFER SYSTEM AS THE MAIN
MECHANISM FOR MAINTAINING THE ACID-BASE BALANCE OF
THE HUMAN BODY**

Mikhailenko Boris Yurievich

Anesthesiologist-resuscitator

Arkhangelsk Oblast Clinical Hospital

Arkhangelsk, Russia

抽象的。 这篇文章描述了关于使用碳氢化合物缓冲系统调节酸碱平衡机制的现代思想, 及其操作的基本原理。 呼吸系统和泌尿系统在维持人体血液 pH 值方面的作用在碳酸氢盐缓冲液组成成分的定量含量变化的框架内进行分析。

关键词: 碳酸氢根离子, 氢离子, 二氧化碳, 酸碱平衡, 体内平衡

Abstract. *The article describes modern ideas about the mechanisms of regulation of acid-base balance using a hydrocarbonate buffer system, the basic principles of its operation. The role of the respiratory and urinary systems in maintaining the pH of human blood is analyzed within the framework of changes in the quantitative content of the constituent components of the bicarbonate buffer.*

Keywords: *bicarbonate ion, hydrogen ion, carbon dioxide, acid-base balance, homeostasis*

Introduction

The concentration of hydrogen ions in blood plasma is usually measured in units of pH. The normal range of acid-base balance of the human body is 7.35 - 7.45. [3] When the pH of the blood is shifted to the acidic or alkaline side by only 0.3, it causes severe disturbances in the functioning of the human body, and the shift in pH by more than 0.4 leads to fatal disorders and death. [5] In order to prevent such conditions, the human body needs a buffer system that will quickly equalize the acid-base balance in response to a sharp change in blood pH, and this system must be able to restore its buffer capacity in a timely manner. A bicarbonate buffer system is suitable for these criteria. This article discusses the basic understanding of the bicarbonate buffer system and the mechanisms of its regulation.

Hydrocarbonate buffer system

The main elements of the bicarbonate buffer system are: carbonic acid H_2CO_3

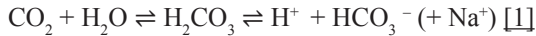
and base NaHCO_3 . The combination of carbon dioxide and water under the influence of the enzyme carbonic anhydrase leads to the appearance of a weak carbonic acid, which in turn dissociates into a hydrogen ion and a bicarbonate ion, these interactions are described by the following equation:



The NaHCO_3 base dissociates into sodium ion and bicarbonate ion:



Thus, the hydrocarbonate buffer system is described by the following equation:



The dissociation constant of carbonic acid is as follows:

$$K = \frac{\text{H}^+ * \text{HCO}_3^-}{\text{H}_2\text{CO}_3} \quad [1]$$

The amount of dissolved carbon dioxide is directly proportional to the number of undissociated carbonic acid molecules, respectively, to determine the amount of hydrogen ions, which determines the pH of the blood, as follows:

$$\text{H}^+ = K * \frac{\text{CO}_2}{\text{HCO}_3^-} \quad [1]$$

Considering the linear relationship between undissociated carbonic acid molecules and the partial stress of carbon dioxide, which equals: 0.03 of carbon dioxide falls on every millimeter of pCO_2 . Accordingly, the formula takes the following form:

$$\text{H}^+ = K * \frac{0,03 * \text{pCO}_2}{\text{HCO}_3^-} \quad [1]$$

The concentration of hydrogen ions is usually measured in units of pH

$$\text{pH} = \text{pK} + \log \frac{\text{HCO}_3^-}{0,03 * \text{pCO}_2} \quad [1]$$

The pK value for the hydrocarbonate buffer system is 6.1, and thus we arrive at the Henderson-Hasselbach equation:

$$\text{pH} = 6,1 + \log \frac{\text{HCO}_3^-}{0,03 * \text{pCO}_2} \quad [1]$$

The normal content of bicarbonate ion in the human body is 22-26 meq/liter, and pCO_2 varies within 35-45 mmHg, however, these indicators may vary depending on gender, ethnicity and area where the person lives. [4]

The pK of the bicarbonate buffer system is early 6.1, and the bicarbonate buffer is most effective when the pK value is equal to the pH value, so at such values the concentration of carbon dioxide and the concentration of bicarbonate ion within the equation of dissociation of carbonic acid are equal to each other.[1] If

we take into account the normal pH values of the human body 7.35 - 7.45, then at values the content of bicarbonate ion is 20 times higher than the content of carbon dioxide. The main property that determines the bicarbonate buffer system as the most effective is the rapidity of the bicarbonate buffer, mainly due to the ability of the lungs to quickly remove carbon dioxide, and the kidneys to reabsorb and synthesize bicarbonate ion.

From the Henderson-Hasselbach equation, the basic principles of regulating the bicarbonate buffer system follow: 1. With an increase in the partial voltage of carbon dioxide, the equilibrium shifts to the acidic side and the condition will be called respiratory acidosis in order to equalize the blood pH, turn on renal regulation, which will bring bicarbonate ion into the system, thereby returning the value of acid-base balance to normal values, 2. In the case of a decrease in the partial voltage of carbon dioxide, the equilibrium will shift to the alkaline side, causing respiratory alkalosis, in which case the kidneys will begin to excrete bicarbonate ion. 3. With an increase in the content of bicarbonate ion in the blood, metabolic alkalosis will occur, the respiratory component of the regulation of acid-base balance will turn on, which will retain carbon dioxide, preventing it from being eliminated from the blood. 4. In the case of a decrease in the concentration of bicarbonate ion or the so-called state of metabolic acidosis, an increase in the minute volume of the lungs will occur, which will facilitate the removal of carbon dioxide from the blood.

The role of lung function in maintaining acid-base balance homeostasis

As a result of metabolic processes occurring in the human body, carbon dioxide is formed, which diffuses into the blood, is transferred to the lungs and is released into the atmosphere, normally the partial pressure of carbon dioxide is 40 mmHg, which is equivalent to 1.2 mol of dissolved carbon dioxide.[1]

The respiratory system, as already mentioned, regulates the acid-base balance by changing the partial tension of carbon dioxide by increasing or decreasing the minute ventilation volume, respectively, eliminating or retaining carbon dioxide in the blood plasma. The capacity of this regulation varies over a wide range, so with an increase in minute ventilation of the lungs by 50%, the blood pH will change from 7.4 to 7.63, and a decrease in minute ventilation by 25% will change the pH to 6.95.[1]

The regulation of lung function is controlled according to the principle of negative feedback, so with an increase in the acidity of the blood, chemoreceptors activate the respiratory center, which in turn, through the function of the lungs, increases the volume of minute ventilation. This chain of events leads to a decrease in the partial stress of carbon dioxide and a decrease in blood acidity. The response of the respiratory system to a change in blood pH develops within 3-15 minutes, and the development of the maximum buffer capacity can reach up to 12 hours,

and its total role is 1-2 times higher than other buffer systems combined. [1;5]

In the case of metabolic acidosis, minute ventilation of the lungs increases and, if the value of acid-base balance returns to a normal value, then this condition is called compensated metabolic acidosis, if the lungs have not coped with their function, then decompensated metabolic acidosis develops.[5] The opposite situation is also characteristic, in the case of the development of metabolic alkalosis, the respiratory system will decrease the minute volume of ventilation, and if the blood pH returns to the normal value, then compensated metabolic alkalosis occurs, if there is no return to the initial pH value, then decompensated metabolic alkalosis develops.[5] The respiratory system copes worse with a change in pH to the alkaline side, since it performs another important function - saturation of the blood with oxygen, and with a decrease in minute ventilation of the lungs, the respiratory center will give preference to a change in the partial oxygen tension rather than a change in pH.

The regulation of the acid-base balance of the blood by changing the minute volumetric ventilation will not eliminate the main reason for the change in blood pH in the case of metabolic acidosis or alkalosis, but will only save time until other systems are involved in the pH stabilization process.

Renal regulation of the bicarbonate buffer system for normal acid-base balance

The kidneys must be able to maintain normal blood bicarbonate levels through filtration. Every day the kidneys filter about 4320 meq of bicarbonate ion, and at normal pH, all of the filtered bicarbonate ion is reabsorbed back into the blood. [1] Filtration is carried out throughout the tubular system of the nephron, with the exception of the thin segments of the descending and ascending segments of the loop of Henle.[1]

An important function of the kidneys is also that in addition to filtration, it is necessary to synthesize new molecules of the bicarbonate ion. Such processes occur when an excess of acids accumulates in the human body or the pH of the blood decreases. In this case, the synthesis of new molecules of the bicarbonate ion, as well as the excretion of acids, leads to the equalization of the acid-base balance.

Another main function of the kidneys in maintaining homeostasis of acid-base balance is the secretion of hydrogen ions. With normal functioning of the kidneys, the secretion of hydrogen ions per day is approximately 4400 meq.[1]

80 - 90% of the reabsorption of bicarbonate ion occurs in the proximal sections of the renal tubules, 10% of reabsorption occurs in the thick segment of the ascending section of Henle's loop, and 5% is reabsorbed in the distal sections of the renal tubules and collecting ducts. [1;2]

In the proximal part of the renal tubules, as well as in the thick part of the ascending loop of Henle, an equilibrium concentration of hydrogen ions and bi-

carbonate ion occurs, so 4320 meq/day of bicarbonate ion is filtered into the lumen, into the lumen of these structures, also due to the cotransport system, approximately 4400 meq/day of the hydrogen ion, their excess, in relation to the bicarbonate ion, ensures the removal of non-volatile acids (approximately 80 meq/day). [1] Thus, one hydrogen ion is consumed for each reabsorbed bicarbonate ion. This mechanism for maintaining acid-base balance is provided as follows: with an increase in blood acidity, an excess of hydrogen ions appears, which, in the condition of deficiencies of the bicarbonate ion, is secreted into the urine, and all the bicarbonate ion is reabsorbed into the blood plasma. In the opposite situation, in the case of a lack of hydrogen ions, the entire bicarbonate ion cannot be reabsorbed and, accordingly, is disposed of in the urine.

An important part of the secretion of hydrogen ions takes place in the terminal section of the distal tubules and collecting ducts, which is responsible for acidification or alkalization of urine, in contrast to the proximal tubules and the ascending segment of Henle's loop, where hydrogen ions are in constant interaction with bicarbonate ion. The secretion of hydrogen ions is carried out due to the primary active transport, for each secreted hydrogen ion there is one reabsorbed bicarbonate ion. [1:2]

Conclusion:

Thus, within the framework of maintaining the acid-base balance of the human body, the hydrocarbonate buffer system plays a key role, has a large capacitive potential, and is able to quickly respond to changes in blood pH. The interaction of the respiratory and urinary systems ensures accurate regulation of acid-base balance, through the elimination of carbon dioxide, filtration and secretion of bicarbonate ion.

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Vladimir Opolye 灰色森林土壤长期施肥期间腐殖质含量动态
**DYNAMICS OF HUMUS CONTENT DURING LONG-TERM
APPLICATION OF FERTILIZERS ON GRAY FOREST SOILS OF
THE VLADIMIR OPOLYE**

Okorkov Vladimir Vasilyevich

Doctor of Agricultural Sciences, Head Research Officer

Upper Volga Federal Agrarian Scientific Center

抽象的。在灰色森林土壤的长期固定田间试验中, Vladimir Opolye 研究了长期使用化肥对耕地层腐殖质含量动态的影响。发现在8田粮草轮作的第一轮轮作中, 1吨牛粪使腐殖质存量增加55公斤/公顷, 1公斤矿物肥料氮增加9.8公斤/公顷。哈。对于第2次(8场)和第3次(7场)轮作以及第2至第4次(7场)轮作, 从1吨粪肥和1千克矿物肥料氮中增加的腐殖质储量为2-比第一轮低3倍。在不使用矿物肥料和第一轮后引入PK肥料的情况下, 腐殖质储量每年减少270-310公斤/公顷。结果表明, 第2至第4轮的零腐殖质平衡是通过几乎为零的氮平衡实现的。进一步增加正氮平衡只会略微增加土壤中的腐殖质储备。

关键词: 灰色森林土壤 Vladimir Opolye, 腐殖质含量和储量, 有机和矿物肥料, 回归方程。

Abstract. *In a long-term stationary field experiment on gray forest soils, Vladimir Opolye studied the effect of prolonged use of fertilizers on the dynamics of the humus content in the arable layer. It was found that in the 1st rotation of an 8-field grain-grass-cultivated crop rotation, 1 ton of cattle manure increased the stock of humus by 55 kg/ha, and 1 kg of nitrogen of mineral fertilizers - by 9.8 kg/ha. For the 2nd (8-field) and 3rd (7-field) rotation and for the 2nd through 4th (7-field) rotation, the increase in humus reserves from 1 ton of manure and 1 kg of nitrogen of mineral fertilizers was 2-3 times lower than in the 1st rotation. Without the use of mineral fertilizers and with the introduction of PK fertilizers after the 1st rotation, the humus reserves decreased annually by 270-310 kg/ha. It was revealed that the zero humus balance for the 2nd - 4th rotation was achieved with a nitrogen balance that was practically equal to zero. A further increase in the positive nitrogen balance only slightly increased the humus reserve in the soil.*

Keywords: *gray forest soil Vladimir Opolye, content and reserves of humus, organic and mineral fertilizers, regression equations.*

In the fertility of most soils and agriculture in Russia, humus plays an extremely important role. It is the main source of nutrition for cultivated plants, the basis for regulating the physicochemical, colloidal-chemical and agrophysical properties of soils [1-4]. In recent years, with the growth in the use of chemical plant protection products in a market economy, its ecological role has significantly increased and with an increase in the humus content, the price of land [3, 5]. Therefore, the most important task of agriculture is its simple or extended reproduction. Domestic researchers have developed models of changes in the humus content for various agricultural uses [6-11].

The consumption of soil humus for the creation of a crop in the models is determined by the consumption of nitrogen by the crop, taking its content in humus to be about 5% [11]. It is estimated that in the Russian Federation, 0.6-1.1 t/ha of humus is annually spent on the formation of the crop. Due to stubble-root residues and organic fertilizers in the 80s of the XX century, it was replenished only in the Northern and North-Western economic regions due to the high number of livestock (one conventional head per 1 hectare of arable land) and the widespread use of peat. In other regions, humus reproduction was 55-85% [10].

On arable soddy-podzolic soils of the Non-Black Earth Region, the annual humus mineralization under various agricultural crops, calculated on the basis of the removal of soil nitrogen by them and refined by the materials of domestic and foreign long-term experiments, was (t/ha) under grain crops 0.5-1.0, tilled 1.5-2.5, pure pairs 2-3.5.

On gray forest soils, Vladimir Opolye also conducted studies on the effect of organic and mineral fertilizers on changes in the content and quality of humus [12-14]. However, these studies continued, and the models needed clarification and adjustment.

The purpose of the research is to assess the effect of fertilization systems on the dynamics of humus content and nitrogen balance for crop rotation, the conditions for ensuring a deficit-free humus balance in a long-term stationary experiment on the gray forest soils of Vladimir Opolye.

Methodology. The studies were carried out in a long-term stationary experiment, laid down in 1991-1993 [15]. The soil of the experimental fields is gray forest medium loamy with the following initial characteristics of the arable layer: humus content 2.9 ... 4.0%; pH_{KCl} - 5.1 ... 5.5; hydrolytic acidity (N_G) 3.2 ... 3.5, the amount of absorbed bases - 19.4 ... 22.4 mg-eq/100 g; the content of mobile phosphorus (according to Kirsanov) - 130 ... 200, exchangeable potassium (according to Maslova) - 150 ... 180 mg/kg of soil.

At the beginning of the 1st rotation, liming was carried out for complete hydrolytic acidity. Against this background, we studied the effect of various doses of bedding manure (0, 40, 60 and 80 t/ha), which was applied after harvesting annual

grasses on hay, the effect of mineral fertilizers (0, PK, NPK, 2NPK) and their combination on the yield of field crops, changes in the agrochemical and chemical properties of gray forest soil.

In the first and second rotations, observations were carried out in an 8-field crop rotation with the following crop rotation: occupied fallow (vetch-oat mixture) - winter rye - potatoes - oats with over-sowing of grasses - grasses of the 1st year of use - grasses of the 2nd year of use - winter rye (spring wheat in the 2nd rotation) - barley.

In the 1st rotation, a single dose of NPK for cereals, annual and perennial grasses was equal to 40 kg/ha of each nutrient, for potatoes - 60, 60 and 80 kg/ha; for grasses of the 1st year of use, a double dose of full mineral fertilizer was N40P80K80. For spring wheat after grasses of the 2nd year of use in the 2nd rotation, N60P60K60 was used as a single dose, and N120P120K120 was used as a double dose. In 2000-2008, phosphorus-potassium fertilizers were not used for annual grasses; instead of N40P40K40 and N80P80K80, only N60 and N75 were applied in the spring.

Ammonium nitrate, double superphosphate (simple superphosphate) and potassium chloride or potassium salt were used. Phosphorus-potassium fertilizers were applied in the fall for the main soil cultivation, nitrogen fertilizers - in the spring for pre-sowing cultivation, for feeding winter and perennial grasses, for potatoes - in the spring for plowing.

In the 3rd and 4th rotations, after a busy fallow, winter (spring) wheat was sown, cultivated crops were excluded, the following fertilizer doses were used for winter and spring wheat after grasses of the 2nd year of use: P40K40, N40P40K40 and N80P80K80 (double dose).

During harvesting, the straw of grain crops was crushed and scattered over the field, then plowed.

The humus content in the soil was determined by the Tyurin method modified by Nikitin.

Results and its discussion. At the end of the 1st rotation of an 8-field crop rotation in fields 1 and 2, we studied the relationship between the humus content and the average annual use of organic (cattle manure) and mineral fertilizers per rotation. The humus content increased from the use of both organic and mineral fertilizers (tab. 1).

Table 1 - Influence of fertilization systems on the change in the content and reserves of humus for the 1st rotation of an 8-field crop rotation in the topsoil

Indicator	Relationship equation (n = 16)	R ²
Field 1 (1998)		
Humus, %	$3.48 + 0.0197 x_1 + 0.0025 x_2$	0.929
Field 2 (1999)		
Humus, %	$3.25 + 0.0136 x_1 + 0.0034 x_2$	0.837
	$3.22 + 0.0048 x_2 + 0.0023 x_1^2 - 0.0002 x_1 x_2$	0.947
Average for fields 1 and 2 (1998-1999)		
Humus, %	$3.36 + 0.0169 x_1 + 0.0030 x_2$	0.952
	$3.38 + 0.0030 x_2 + 0.0017 x_1^2$	0.974
Humus reserves in the soil layer 0-20 cm, kg/ha	Field 1 (1998)	
	$90480 + 64.0 z_1 + 8.12 z_2$	0.929
	Field 2 (1999)	
	$84500 + 44.2 z_1 + 11.0 z_2$	0.837
	Average for fields 1 and 2 (1998-1999)	
	$87360 + 54.9 z_1 + 9.8 z_2$	0.947
<p>Note. x_1 - average annual dose of manure application, t/ha; x_2 - average annual application rate of ammonium nitrate nitrogen, kg/ha; z_1 and z_2 - total doses of manure (t/ha) and N fertilizers (kg/ha) per crop rotation.</p>		

It should be borne in mind that in the relationship between the humus content (%) and the average annual doses of manure and mineral fertilizers, the coefficients in front of x_1 and x_2 represent the sum of their influence on the change in the humus content during rotation (in this case, over 8 years). So, for example, the effect of 1 ton of organic fertilizers on the increase in humus reserves in the 0-20 cm layer per rotation for the 1st field can be calculated as follows (coefficient at z_1):

$z_1 = 0.0197: 8 \times 26000 = 64.2$ (kg/ha of humus), where 26000 kg/ha is the mass of humus corresponding to 1% of its content in the soil layer 0-20 cm (bulk density of the soil layer 0-20 cm 1.3 g/cm³).

1 ton of manure containing 4.2 kg of nitrogen, on average in 2 fields, increased the humus content in the arable layer by 55 kg, and 1 kg of ammonium nitrate nitrogen - by 9.8 kg. The value of the standard coefficient of humus formation from 1 ton of manure coincided with the results of generalization by the ARRIOPF researchers [9].

The degree of nitrogen immobilization of mineral fertilizers in the 1st rotation of the crop rotation varied from 47 to 65%. Its high average size (56%) for gray forest soils of Opolye (in comparison with light soddy-podzolic soils of the south-

ern taiga subzone [16]) is quite consistent with the increased absorption properties of soils with a heavier granulometric composition. Gray forest soils contained mixed-layer clay minerals in the silty fraction and were characterized by a high degree of SAC saturation with calcium and magnesium ions.

Since the balance of humus in the soil closely correlates with the balance of nitrogen, the balance of the latter in the variants of using only organic fertilizers was used to calculate the annual dose of manure, which ensures a deficit-free balance of humus. So, according to the results of the experiment described above in an 8-field crop rotation (field 1), when 40, 60 and 80 t/ha of bedding manure were applied in a busy pair per rotation, the nitrogen balance was -10.4, -3.4 and +6.7 kg/ha, respectively. Hence, a deficit-free balance of nitrogen and, accordingly, humus on gray forest soils of Opolye in the 1st rotation was observed at an average annual dose of manure of 8.3-8.5 t/ha, which coincided with the results of the model developed for the Vladimir region with the initial content of C humus 2.0% [10].

From the data (tab. 2), which shows the dynamics of the humus content in the arable layer at the end of the 1st through 4th rotations of crop rotation in field № 1, it can be seen that the maximum decrease in the humus content in the 4th rotation in comparison with the 1st d was observed in variants without the use of mineral and organic fertilizers, as well as the application of phosphorus-potassium fertilizers (-0.21 ... -0.28%). The use of a single dose of complete mineral fertilizer kept the amount of humus loss down to -0.09%. A double dose of NPK already provided a positive balance of organic matter (+ 0.04%).

Table 2 - Dynamics of humus content by crop rotation rotations in field № 1, %

Test option	Crop rotation, year			
	1-st, 1998	2-nd, 2006	3-rd, 2013	4-th, 2020
1. Control	2.88	2.89	2.69	2.60
2. Lime (background – B)	3.79	3.82	3.61	3.52
3. B + PK	3.70	3.71	3.61	3.49
4. B + NPK	3.16	3.09	3.15	3.07
5. B + 2 NPK	3.06	3.08	3.12	3.10
6. B + H40	3.08	3.04	2.96	2.87
7. B + H60	3.28	3.28	3.24	3.28
8. B + H80	3.08	3.04	3.10	3.07
9. B + H40 + PK	3.12	3.03	3.00	2.95
10. B + H40 + NPK	3.56	3.49	3.58	3.56
11. B + H40 + 2 NPK	3.59	3.62	3.64	3.63

12. B + H60 + PK	3.34	3.34	3.29	3.30
13. B + H60 + NPK	3.53	3.52	3.65	3.54
14. B + H60 + 2 NPK	3.44	3.43	3.52	3.44
15. B + H80 + PK	3.42	3.40	3.43	3.44
16. B + H80 + NPK	3.72	3.75	3.78	3.70
17. B + H80 + 2 NPK	3.42	3.40	3.52	3.53
Average per rotation	3.37	3.35	3.35	3.30

When using a single dose of NPK, the yield of cultivated crops increased sharply [15], which ensured a noticeable increase in the supply of stubble-root residues. Their transformation led to the replenishment of soil humus reserves, mineralized during the growing season of crops. With the introduction of a double dose of complete mineral fertilization, the annual productivity of crops in the crop rotation increased by 2-3 c/ha of soil, which increased the amount of humus replenishment due to plant residues. This was also facilitated by the higher participation of mineral fertilizers in the nutrition of crops in comparison with soil nitrogen.

It was also revealed that in the 4th rotation the humus content in the variants without the use of mineral fertilizers (1st and 2nd), the use of PK fertilizers continued to decrease. In comparison with the 3rd rotation in the 4th due to the increase in crop yields, the removal of nutrients, including nitrogen, increased. This led to a slight decrease in the humus content in this rotation in the applications of a single dose of NPK, its combination with organic fertilizers.

The processing of the data on changes in the humus content for 15 and 22 years (tab. 3) according to the parameters of the two-factor field experiment confirmed the decisive role of complete mineral and organic fertilizers in the influence on this parameter of fertility. On average, according to the variants of application of 0, 40, 60 and 80 t/ha of manure per rotation, a tendency for a higher decrease in the humus content in the variants without the use of nitrogen mineral fertilizers was observed, by 1.54-1.59 and 1.52 times, respectively.

Table 3 - Change in the content of organic matter in the 3rd and 4th rotations in comparison with the 1st, % (in the control, respectively -0.19 and -0.28%), field № 1

Manure dose per rotation, t/ha	Mineral fertilizers				Average for manure
	0	R240K240	N300P240K240	N515P480K480	
3rd rotation compared to 1st (1998-2013)					
0	-0.18	-0.09	-0.01	+0.06	-0.055

40	-0.12	-0.12	+0.02	+0.05	-0.043
60	-0.04	-0.05	+0.12	+0.08	+0.028
80	+0.02	+0.01	+0.06	+0.10	+0.048
Average for min. fertilizers	-0.080	-0.063	+0.048	+0.073	
4th rotation compared to 1st (1998-2020)					
0	-0.27	-0.21	-0.09	+0.04	-0.132
40	-0.21	-0.17	+0.00	+0.04	-0.082
60	+0.00	-0.04	+0.01	0.00	-0.008
80	-0.01	+0.02	-0.02	+0.11	+0.025
Average for min. fertilizers	-0.123	-0.100	-0.025	+0.048	

From phosphorus-potassium fertilizers, compared with options without mineral fertilizers (for the same options for using manure), a slight slowdown in the decrease in humus content was observed (from -0.080 to -0.063% for the 2nd and 3rd rotations and from -0.123 to -0.100 % for the 2nd, 3rd and 4th rotations). A more noticeable effect on the change in this parameter was observed from the use of a single dose of NPK. During the 2nd and 3rd rotations, the change in the humus content increased to 0.048%, during the 2nd to 4th rotations - from -0.123 to -0.025%. The use of a double dose of NPK increased this parameter to 0.073 and 0.048%, respectively (from -0.080 and -0.123%).

From the use of organic fertilizers in doses of 40 and 80 t/ha for the 2nd to 4th rotations (on average for 4 levels of application of mineral fertilizers), the decrease in the humus content was 1.9 times higher than for the 2nd and 3rd rotation (tab. 3).

Models of changes in humus content depending on fertilization systems (tab. 4) confirmed the decisive influence of the use of organic and nitrogen fertilizers on its increase. So, for the 2nd and 3rd rotations, 83.6% of the variation in the change in the humus content accounted for these fertilizers, the effect of phosphorus-potassium and their combination with organic - no more than 11.2%. For 1998-2020, this parameter changed by 86-89% under the influence of organic and nitrogen fertilizers and their interactions. Phosphorus-potassium fertilizers, in comparison with the background of liming, had little effect on the formation of humus.

Table 4 – Correlation of changes in the content and reserves of organic matter in the arable layer for the 3rd (over 15 years) and 4th (22 years) rotation of crop rotations compared to the 1st with the average annual use of fertilizers in field № 1

Parameter change over years of research	Number of years	Relationship equation	n	R ²	Dov. interval
% of humus for 1998-2013	15	$-0.13 + 0.0096x_1 + 0.0019x_2$	16	0,836	0,07
		$-0.16+0.0017x_2+0.0015x_3+0.0016x_1^2-0.0002x_1x_3$		0,948	0,04
% of humus for 1998-2020	22	$-0.204 + 0.0153x_1 + 0.0020x_2$	16	0,732	0,12
		$-0.256+0.0240x_1+0.0037x_2-0.0003x_1x_2$		0,857	0,092
% of humus for 1998-2020	22	$-0.22 + 0.0167x_1 + 0.0021x_2$	17	0,771	0,12
		$-0.26 + 0.0247x_1+0.0038x_2-0.0003x_1x_2$		0,887	0,09
humus reserves per year, kg/ha (1998-2013)	15	$-218 + 16.3x_1 + 3.21 x_2$	16	0,842	120
		$-266+2.90x_2+2.30x_3+2.68x_1^2-0.31x_1x_3$		0,952	72
humus reserves per year, kg/ha (1998-2020)	22	$-241 + 18.2x_1 + 2.4x_2$	16	0,732	140
		$-303 + 28.3x_1 + 4.4x_2 - 0.36x_1x_2$		0,857	107
humus reserves per year, kg/ha (1998-2020)	22	$-260 + 19.8x_1 + 2.5 x_2$	17	0,771	140
		$-307 + 29.4x_1 + 4.5x_2 - 0.36x_1x_2$		0,887	104

Notes. x_1 – average annual dose of organic fertilizers application, t/ha; x_2 – average annual application rate of ammonium nitrate nitrogen, kg/ha; x_3 – average annual dose of phosphorus-potassium fertilizers per P_2O_5 , kg/ha. At n = 16, changes in the content and reserves of humus were calculated from the background of liming.

In the 2nd and 3rd rotations in options without the use of organic and mineral fertilizers, there was an annual decrease in humus reserves in the 0-20 cm layer in the amount of about 270 kg/ha, and in the 2nd through 4th rotations - about 310 kg/ha. In the first case, 1 ton of cattle manure increased humus reserves in the soil

by at least 16.3 kg/ha, in the second - 18.2-29.4 kg/ha, and 1 kg of nitrogen of mineral fertilizers - by 2.9-3.2 and 2.4-4.5 kg/ha, respectively. These parameters are 2 times or more lower than in the 1st rotation of the crop rotation. These data indicate that without the use of mineral and organic fertilizers with existing agricultural technologies, the humus state deteriorates and the fertility of the gray forest soil in grain-grass crop rotations decreases. The use of fertilizers helps to reduce biological erosion of Opolye gray forest soils. Therefore, it is necessary to determine the conditions under which a zero or positive humus balance is achieved. One of the ways to solve this problem is to study the relationship between nitrogen and humus balances.

Table 5 presents data on the weighted average annual nitrogen balance for 3 rotations (2-4) and the average annual humus balance for the same period, calculated by the quadratic dependence for 17 variants (tab. 4). Their analysis showed that for 14 of 17 variants, excluding variants 14, 16 and 17, a close linear relationship was obtained between the nitrogen and humus balances:

$$y = -13,0 + 13,1 x, n = 14, r = 0,983, r^2 = 0,967, \text{ conf. int.} = 50,$$

where $4.5 > x > -23.7$ (kg/ha nitrogen) is the weighted average annual nitrogen balance for 2-4 crop rotations; $55 > y > -307$ (kg/ha of humus) - the average annual balance of humus for 2-4 rotations of crop rotations.

The zero humus balance is set at an average weighted annual nitrogen balance of 1.0 kg/ha.

Table 5 – Influence of fertilizers on the weighted average annual nitrogen balance and the average annual humus balance for the 2nd to 4th rotation of crop rotations on gray forest soils, kg/ha

Option №	Weighted average nitrogen balance	Average annual humus balance	Option №	Weighted average nitrogen balance	Average annual humus balance
1	-23.6	-307	10	-2.5	-36
2	-20.8	-307	11	3.4	51
3	-23.7	-307	12	-1.8	-71
4	-9.9	-110	13	1.8	0
5	3.5	44	14	13.9	54
6	-8.9	-149	15	-0.5	8
7	-0.3	-24	16	5.0	36
8	4.5	55	17	25.0	58
9	-6.6	-149			

Note. The designation of the options is the same as in table 2.

Consequently, the zero humus balance on the gray forest soils of Vladimir Opolye is achieved when the nitrogen balance is practically equal to zero. Further growth of the positive nitrogen balance only slightly increased the humus balance in the soil. A fairly stable dynamic equilibrium is established between the formation of humus and its mineralization. It depends on the soil and climatic conditions and agricultural technologies for the cultivation of agricultural crops (crop rotation, fertilization and processing systems, protective measures), primarily on the type of crop rotation.

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研究地球上气候变化的可能原因及解决方法
**STUDY OF THE POSSIBLE CAUSES OF CLIMATE CHANGE ON
THE PLANET AND WAYS TO SOLVE THE PROBLEM**

Valeriy Ye. Leonov

Doctor Technical Sciences, Full Professor

Anatoliy A. Gurov

Deep sea Captain, Assistant Professor

Kherson State Maritime Academy, Kherson, Ukraine

抽象的。地球上气候变化的一个可能原因是“温室”效应。科学家和专家对地球上的“温室”效应及其后果问题的看法分为截然相反的观点：1) 有“温室”效应，2) 没有“温室”效应。尽管对“温室”效应的看法相互矛盾，但可以说，大气盆地和海洋海洋环境年均温度升高的后果是非常消极的，可以预见是灾难性的。在过去的 60 年中，我们进行了分析和计算研究，其特征是不可再生性质的碳氢化合物原材料的最密集消耗，即二氧化碳的积累，这是“温室”效应的标志。从所进行的研究结果来看，空气流域中人为二氧化碳排放量的增长与空气流域年平均温度的升高是一致的。有很多方法，在全球范围内做出决定更加困难。实施减少海洋运输中“温室”气体成分排放研究工作的实例，将解决两个向量的任务——提高海运的经济效益和确保海运的环境安全。

关键词：“温室”效应，人造系统，海洋运输，二氧化碳，温度，海洋，海洋环境。

Abstract. *A possible cause of climate change on the planet is the "greenhouse" effect. The opinions of scientists and experts on the issue of the "greenhouse" effect on the planet and its consequences were divided into diametrically opposed ones: 1) there is a "greenhouse" effect, 2) there is no "greenhouse" effect. Despite the contradictory views on the "greenhouse" effect, it can be stated that the consequences of an increase in the average annual temperature of the air basin and the marine oceanic environment are very negative and predictably catastrophic. We have carried out an analysis and computational studies over the past 60 years, characterized by the most intensive consumption of hydrocarbon raw materials of a non-renewable nature, by the accumulation of carbon dioxide, a marker of the "greenhouse" effect. From the results of the studies carried out, a conclusion suggests itself about the congruence of the growth of anthropogenic carbon dioxide emissions in the air basin and the increase in the average annual*

temperature of the air basin. There are ways, it is more difficult to make a decision on a planetary scale. The examples of the implementation of research work to reduce the emission of components of "greenhouse" gases in marine transport, which will solve the two-vector task - to increase the economic efficiency of sea freight and ensure the environmental safety of sea freight.

Key words: *"greenhouse" effect, man-made systems, marine transport, carbon dioxide, temperature, marine, oceanic environment.*

Introduction

The technogenic systems, in particular marine transport, are the basic «suppliers» of components of «greenhouse» gases, such substances and connections as dioxide of carbon, hydrocarbons, nitrous oxide, organic mineral dust, soot, pairs of water behave to that.

Opinions of scientists and experts through question of planetary «greenhouse» effect are diametrically opposite. And it, in our view, under itself has basis. Really, to answer a simple question, whether there is a «greenhouse» effect on a planet or he is not present, necessary to have the reliable materials got as a result of research works. To conduct experiments in the global scale of planet and space in the direction of study of «greenhouse» effect on the modern stage is not possible. Therefore this work is conducted on the offered hypothetical models. The methods of mathematical design, on the basis of that preferentially drawn conclusion about of presence or nonpresence of «greenhouse» effect on Earth, are used in calculation researches. A lack of any offered models of «greenhouse» effect is the absence and/or impossibility of verification of them on adequacy in the real terms of experiment on a planet and in space.

Analysis of publications of the examined question in fact

The idea of the mechanism of the "greenhouse" effect was first outlined in 1827 by Joseph Fourier in the article "Note on the temperatures of the globe and other planets", in which he considered various mechanisms of the formation of the Earth's climate, while he considered them as factors affecting the overall heat balance Earth, (heating by solar radiation, cooling due to radiation, internal heat of the Earth), and factors affecting heat transfer and temperatures of climatic zones (thermal conductivity, atmospheric and oceanic circulation).

In works [1,2] the detailed analysis over of possible reasons of origin and consequences of «greenhouse» effect is brought.

Scientists from the Californian University in Irwine (USA) reported about the threat of flood for 400 million persons from a rise in temperature, «greenhouse» effect [3].

The content of carbon dioxide in the Earth's atmosphere in August 2019 increased by three points relative to the same indicator in 2018, which means that

humanity cannot reduce CO₂ emissions into the atmosphere and slow down global warming, said the National Aeronautics and Space Administration (NASA, USA) [4].

In works [5-7] scientists propose to spray aerosols into the atmosphere of the air basin so as to reduce warming by 50%.

As a comment of authors of this article to work [5-7]:

1) from where to take in the enormous amounts of planetary scale dioxide of sulphur as a protective aerosol?

2) dioxide of sulphur in the stratospheric layer of atmosphere will be exposed to oxidization by an active oxidant by ozone to the sulphuric anhydride, and sulphuric anhydride at co-operating with the pairs of water, contained in atmospheric air, will result in formation of sulphuric acid.

The transport sector accounted for 22% of global carbon dioxide emissions in 2010 [8,9], including the shipping sector in 2013 accounting for 2.2% of global CO₂ emissions compared to 2.7% of CO₂ emissions in 2008 (IMO, 2014).

In works [3,10] materials on carbon dioxide emissions from public transport are given: in Sydney (Australia), the level of carbon dioxide emissions per passenger-kilometer was, g: 188 for an average car, 120 for a bus, 105 for a train ride, 171-by light rail. CO₂ emissions from each chain were approximated by the sum of emissions from all stages of the trip.

Results - one cannot do without reducing technogenic (manmade systems) emissions of components of "greenhouse" gases, one cannot solve the global problem of climate warming on planet Earth[11-13].

Formulation of the problem

By us, in order of discussion, for the last 60 years an analysis, calculation researches, is conducted on the accumulation of carbon dioxide - basic component of «greenhouse» gases on a planet[14]. This period of time was accepted coming from that exactly he is characterized by the most intensive consumption of hydrocarbon raw material of unrenovable character (oil, natural gas, coal, slates) and, accordingly, most emission of dioxide of carbon in an atmosphere and environment. The results of researches are shown on a figure 1.

The dynamics of an intensive increase in the total concentration of carbon dioxide in the environment (Curve 1, Fig. 1) is fully consistent with the intensive consumption of hydrocarbons over the same period of time. Curve 2 (Fig. 1) characterizes the growth dynamics of the concentration of carbon dioxide in the atmospheric air, which includes two sources of carbon dioxide formation - anthropogenic (predominant) and natural (Curve 4, Fig. 1). We had found that curve 2 (increasing of CO₂ concentration in the atmospheric air) and curve 3 (average annual increasing of atmospheric temperature over the same period of time) are practically parallel (congruent), which indicates that the accumulation of CO₂

in atmospheric air is related to the average annual increasing of atmospheric air temperature. And this, in turn, determines the role of carbon dioxide as the main component of "greenhouse" gases that stimulate the "greenhouse" effect, leading to a warming of the climate on Planet.

Interesting, in our opinion, is the nature of the change in the natural concentration of CO₂ in the atmospheric air, why there is a monotonic increase in the concentration of CO₂ over the analyzed period of time.. Excess natural carbon dioxide accumulates in the atmospheric air, which is consistent with the course of curve 4 (Fig. 1).

It should be noted that the results of computational and analytical calculations carried out by us [14] correspond to the data on the accumulation of carbon dioxide obtained by Japanese researchers (Main Meteorological Administration of Japan, NHK TV channel). The concentration of carbon dioxide in the atmosphere around Japan has become the highest during the observation period (2020-2021), which is carried out at three points in the northeast of the island of Honshu and on two remote islands in the southwest and east of Japan. The average indicators for 2020 were, respectively, 416.3 ppm, 417.2 ppm, 414 ppm. This is the highest CO₂ level ever recorded since 1987. Meteorologists record a tendency towards an increase in the concentration of CO₂ in the atmosphere. This is despite the decrease in CO₂ emissions amid a decrease in production in Japan due to the coronavirus. Scientists note that the concentration of CO₂ in the Earth's atmosphere is constantly increasing, and this leads to an increase in temperature and climate change. It should be noted that the practical data obtained recently by Japanese researchers sufficiently and fully correspond to the data obtained by us by calculation and analytical methods, as in terms of the CO₂ accumulation figures - 414-417.2 ppm. and according to the general conclusion about the interrelation of the average temperature of atmospheric air and the accumulation of CO₂ in the atmosphere (Fig. 1) [15].

Based on the foregoing about the technogenic prerequisites for the emergence and intensification of the "greenhouse" effect, it is possible to propose a "scenario" of the impact of planetary climate change on the environment, ecosystems, biota, biome, biosphere, and humans.

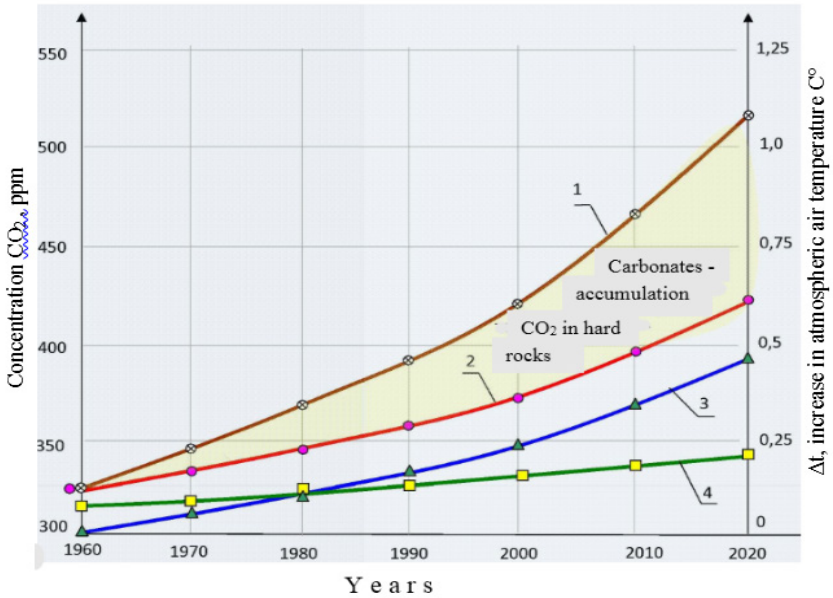


Figure 1 - Change in the concentration of carbon dioxide and the average annual increase in atmospheric air temperature depending on time (years): curve 1 - total anthropogenic CO₂ accumulation; curve 2 - anthropogenic accumulation of CO₂ in the atmospheric air; curve 3 - average annual increase in atmospheric air temperature; curve 4 - natural accumulation of CO₂ in the atmospheric air.

Legend: ppm-parts per million , Δt - the average annual increase in atmospheric air temperature, °C.

Ways to solve the global problem of the "greenhouse" effect

From a figure 2 follows that emission of carbon dioxide, both general and only as a result of incineration, goes down in a row «coal → fuel oil → natural gas → hydrogen». As an oxidant when incineration of hydrocarbon raw materials was used the air.

Technical suggestions, that will allow to bring down emission of dioxide carbon and, accordingly, bring down the action of «greenhouse» effect, are below given:

1. Development and realization of low-waste, resource-saving technologies, allowing to bring down formation of material wastes and, as a result, bring down the emission of dioxide of carbon.
2. Extraction, concentration, collection, translation in the liquid aggregate state, storage and transporting of the liquefied dioxide of carbon.

3. Chemical conversion of dioxide carbon by the method of the catalytic hydrogenization in methanol [16] and on the basis of methanol production of the plastic masses, urea-formaldehyde resins, hydrocarboxylic acids, fertilizers, pharmaceutical products and etc.

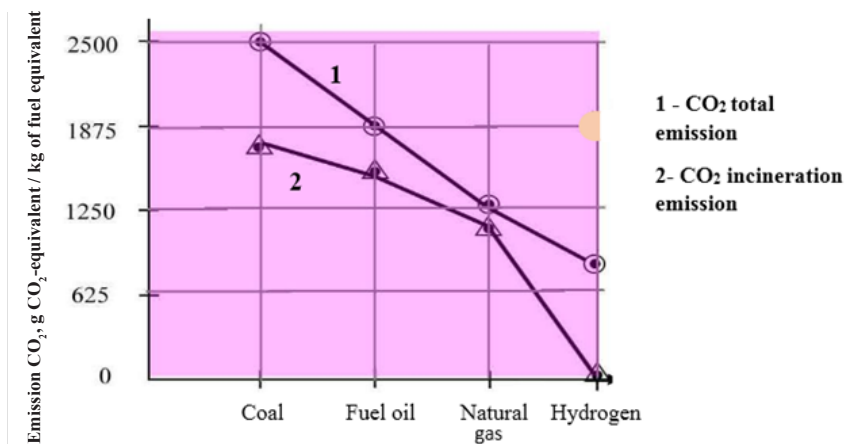


Figure 2 - Emission CO₂, g CO₂-equivalent / kg of fuel equivalent depending on the type of fuel burned

A pool of the Black sea is the powerful source of unconventional energy resources, namely: the sulphuretted hydrogen and ground crystallo-hydrates.

The scientific and technical problems of deployment of the hydrogen sulfide for the production of motor fuels and compounds include the next stages [2,13]:

- deep-water extraction of the sulphuretted hydrogen;
- effective processing of the sulphuretted hydrogen in a motor fuel and chemical compounds.

We have been worked out an original technical decision on the deep-water marine of the sulphuretted hydrogen (≈ 10000 м). A decision is protected by the patent of Ukraine [17].

At a complex extraction and processing of the sulphuretted hydrogen of the Black Sea the basic problems of ecological safety, financial viability, resource-saving, defence of marine environment are deciding:

- 1) the potential danger of «breach» through the seawater of toxic, explosive and fire-hazardous hydrogen sulfide is reduced;
- 2) the dependence of countries on imports of hydrocarbon energy is reduced;
- 3) the socio-economic and environmental damage to the environment of the

Black Sea countries is sharply reduced.

On April 23, 2021, at the initiative of the US President, large-scale negotiations on the "climate" crisis were held, and the leaders of 40 leading countries of the world were invited. According to the Global Carbon Atlas, China, the USA, India, Russia, Japan, Iran, Germany, Indonesia, and South Korea are the “leaders” in emissions of carbon dioxide, the main component of “greenhouse” gases. In the speeches of the leaders of the leading countries of the world, it was reported that by 2050 carbon dioxide emissions will decrease by 3-5 times.

Figure 3 shows the dependence of the change in carbon dioxide emissions in general around the world and for individual countries for the period from 1990 to 2050 [18]. Figure 3 shows that the maximum emission of carbon dioxide, both in individual countries and around the world, falls on our time, 2015-2020, and by 2050, carbon dioxide emissions should decrease by more than seven times. This begs the question of how, on a global scale, carbon dioxide emissions can be reduced sevenfold. As we have shown (Fig. 2), it is practically impossible to achieve this within the framework of hydrocarbon energy, hydrocarbon raw materials (HCRM) of a non-renewable nature. It remains to assume the change HCRM of the era to non-hydrocarbon feedstock (NHCFS). Depending on the adopted strategy, specific technical decisions will be made.

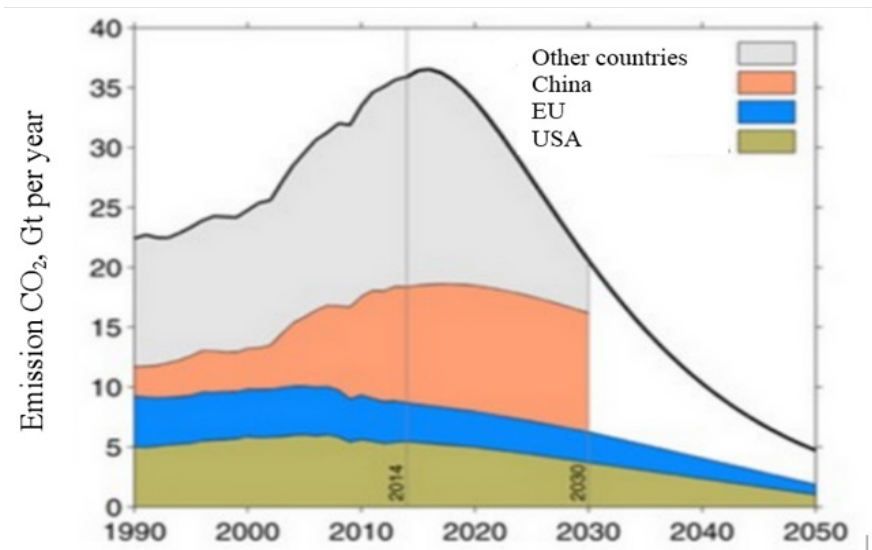


Figure 3 - Dependence of the emission of carbon dioxide into the air basin depending on the time [18]

For the decline of emission of hydrocarbons in atmosphere in the process of exploitation of tankers, gas carriers, chemical tankers, LPG carriers, innovative technical decisions are worked out to practical realization on a marine transport [1,2,13].

When hydrocarbons are emitted into the atmospheric basin, economic damage is caused during the transportation of oil products and environmental damage to the air basin. Below is a logistic scheme for the transportation of oil, its processing into "light" oil products and refueling of vehicle engines, from which it follows that in the case of absorption of hydrocarbons after the capacitive equipment, the emission of hydrocarbons into the air basin decreases 30 times compared with the option without absorption of hydrocarbons.

To reduce the emission of hydrocarbons into the atmosphere during the operation of tankers, gas carriers, chemical gas carriers, methane carriers, innovative technical solutions have been developed for practical implementation in sea transport [2,13].

To select the most effective technology, we carried out research using the following methods of absorption of hydrocarbons from steam-air mixtures:

- 1) absorption;
- 2) adsorption;
- 3) catalytic;
- 4) low temperature condensation;
- 5) homogeneous oxidation of hydrocarbons at elevated temperatures.

Based on the performed feasibility studies of the above methods of absorption of hydrocarbons in comparable conditions, it was determined that the most effective method in this case is adsorption (point 2).

The technology of hydrocarbon absorption by the adsorption method has been developed (Fig. 4)

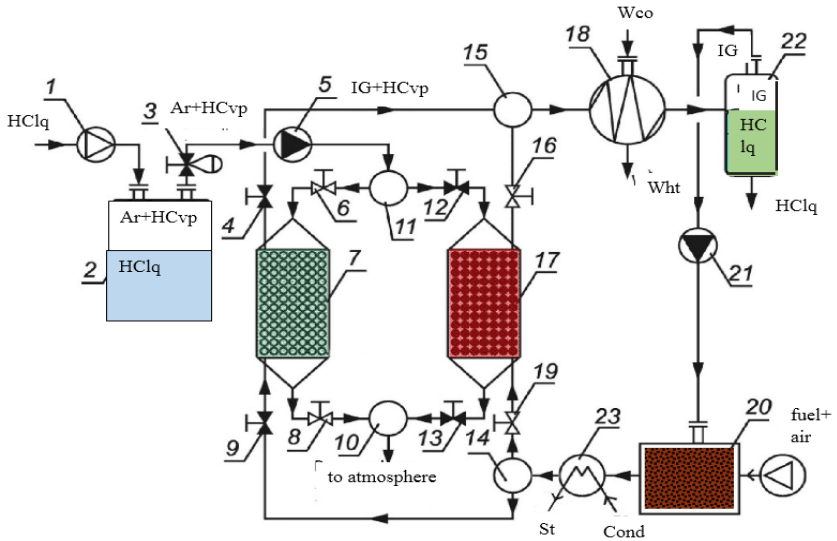


Figure 4 - Schematic diagram of vapor recovery hydrocarbons [2, 14]

The technology includes the following main stages:

1. Collection and compression of the air-hydrocarbon mixture outgoing from the storage pos. 2
2. Adsorption of hydrocarbons vapors in the adsorber pos. 7.
3. Regeneration of the saturated adsorbent in the adsorber pos. 17 in an inert gas stream at increased temperature.
4. Cooling of hydrocarbons vapors in the refrigerator-condenser pos. 18
5. Separation of inert gas and liquid hydrocarbons in the separator pos. 22.
6. Return of inert gas after separator pos. 22 in the regeneration cycle.
7. Return of gasoline (liquid hydrocarbons) to the storage pos. 2.

The developed hydrocarbon absorption scheme is resource-saving and environmentally safety. This is especially becoming relevant at the present time, since the world's reserves of non-renewable hydrocarbon raw materials are intensively depleted and limited, dangerous for the environment, biosphere and humans.

The technology for capturing hydrocarbon vapors complies with the Kyoto Protocol on 1997 (Japan), Paris Agreement COP-21 (2015) on the reduction of emissions of “greenhouse” gas components.

Conclusions.

Thus, as a result of the work performed, the following conclusions can be drawn:

1. Losses of hydrocarbons during transportation and storage of petroleum products have two negative vectors - economic and environmental.
2. Research on the absorption of hydrocarbon vapors under static and dynamic conditions has been carried out.
3. Resource-saving technologies for absorption of hydrocarbons from vapor-air environ have been developed.
4. Experimental-industrial tests of the hydrocarbon absorption process were carried out.
5. The technical and economic considerations of the expediency of introducing the technology for the utilization of hydrocarbon vapors have been developed.

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过氧化合物对大麻芒的脱木素及纤维素特性
**DELIGNIFICATION OF HEMP AWN WITH PEROXO
COMPOUNDS AND CHARACTERISTIC OF THE CELLULOSE**

Pen Robert Zusievich

Doctor of Technical Sciences, Lead Research Officer

Shapiro Ida Lvovna

Candidate of Technical Sciences, Senior Research Officer

Reshetnev Siberian State University of Science and Technology

抽象的。地球上气候变化的一个可能原因是“温室”效应。科学家和专家对地球上的“温室”效应及其后果问题的看法分为截然相反的观点: 1) 有“温室”效应, 2) 没有“温室”效应。尽管对“温室”效应的看法相互矛盾, 但可以说, 大气盆地和海洋海洋环境年均温度升高的后果是非常消极的, 可以预见是灾难性的。在过去的 60 年中, 我们进行了分析和计算研究, 其特征是不可再生性质的碳氢化合物原材料的最密集消耗, 即二氧化碳的积累, 这是“温室”效应的标志。从所进行的研究结果来看, 空气流域中人为二氧化碳排放量的增长与空气流域年平均温度的升高是一致的。有很多方法, 在全球范围内做出决定更加困难。实施减少海洋运输中“温室”气体成分排放研究工作的实例, 将解决两个向量的任务——提高海运的经济效益和确保海运的环境安全。

关键词: “温室”效应, 人造系统, 海洋运输, 二氧化碳, 温度, 海洋, 海洋环境。

Abstract. *The hemp awn (*Cannabis sativa*) was delignified with the reaction mixture "acetic acid - hydrogen peroxide - sulfuric acid catalyst - water" at a sulfuric acid concentration of 0.45%, a liquid module of 6, and a temperature of 85°C. The influence of the concentration of hydrogen peroxide and the duration of the process on the yield, strength properties and whiteness of technical cellulose was studied. With a yield of about 45%, it is comparable to the properties of bleached sulphate cellulose from hardwood (OB-0 grade in accordance with GOST 14940-96) and without additional expensive bleaching can be used in the production of many high-quality mass types of paper.*

Keywords: *hemp, awn, cellulose, delignification, hydrogen peroxide, peracetic acid, cellulose whiteness, cellulose strength*

In the XIX and early XX centuries in Russia, hemp (*Cannabis sativa* L - ordinary hemp) was one of the main crops. The area of its cultivation in 1928 reached

996 thousand hectares. But in 1961 the USSR joined the UN convention, which prohibited varieties with a narcotic content of more than 0.2%, and hemp sowing dropped sharply [1]. As a result of breeding work, varieties of industrial hemp were bred, in which the content of tetrahydrocannabinol (THC) and other psychoactive substances does not exceed 0.01%, and in 2011 industrial cultivation of this crop was allowed in Russia. For 2013, 23 varieties and hybrids of cannabis are included in the Russian state register of breeding achievements approved for use. The area under agricultural hemp in Russia is growing. It is expected that by 2025 the sown area will reach 20 thousand hectares, and the hemp yield will be 8.5 centners per hectare [2].

About 65% of the mass of hemp trusts is fibrous awn. One of the most promising areas of industrial use of technical hemp is the production of pulp and paper products. Currently, about 40% of all deforestation meets the needs of the paper industry. One hectare of hemp can produce the same amount of cellulose as 4-7 hectares of forest. A field planted with hemp bears fruit every year, while trees need at least 20 years to reach the condition necessary for production. Also noteworthy is the high strength inherent in hemp cellulose paper.

Oxidative delignification of plant raw materials with peroxo compounds is considered as a "green" and resource-saving alternative to the existing industrial methods of cellulose production. To date, the results of a large number of studies in this area have been published, including reviews [3-6]. The essence of the method consists in processing plant materials with a solution of hydrogen peroxide and acetic acid. In this reaction system, acetic acid undergoes a catalyzed oxidation to peracetic acid, which, in its middle, oxidizes lignin, converting it into a soluble state. Sulfuric acid is used as catalysts, as well as its combinations with tungstic acid, tungstate and sodium molybdate, titanium dioxide.

We have studied the effect of the conditions of one-stage delignification ("cooking") of hemp awn by the oxidative method on the yield and properties of technical cellulose.

The raw material for the research was awn from hemp brand "Surskaya". The chemical composition is determined by conventional methods [7]: mass fraction of cellulose (Kurschner-Hoffer method) 41.2%; lignin (sulfuric acid method modified by Komarov) 23.4%; extractives (extraction in a Soxhlet apparatus with an azeotropic ethanol-toluene mixture) 4.64%; ash 1.10%.

The prepared awn was delignified with the reaction mixture "acetic acid - hydrogen peroxide - sulfuric acid catalyst - water". Delignification conditions: initial concentration of acetic acid in the cooking solution 6 g-mol/dm³ (36%); sulfuric acid concentration 0.046 g-mol/dm³ (0.45%); liquid module 6.0; isothermal cooking temperature 85°C. Variable brewing factors:

X_1 – initial concentration of hydrogen peroxide in the cooking solution (variation range 3 ... 5 g-mol/dm³);

X_2 – cooking duration (variation interval 180 ... 270 minutes).

These factors varied according to a three-level design of the second-order experiment on cube elements [8] (table 1).

The pulp washed after cooking was ground in a CRA apparatus (Yokro mill) for 2 minutes to a grinding degree of 34 ... 36 °ShR. Paper casts of 75 g/m² were made on a Rapid-Keten sheet-molding machine. The experimental results were characterized by the following output parameters:

Y_1 – concentration of residual hydrogen peroxide in the liquor, %;

Y_2 – concentration of residual peracetic acid in the liquor, %;

Y_3 – cellulose yield, %;

Y_4 – breaking length, m;

Y_5 – elongation to break, %;

Y_6 –bursting resistance, kPa;

Y_7 – tear resistance, mN;

Y_8 – whiteness of castings, %.

The results of the experiments are shown in table 1.

Table 1. Conditions and results of the experiment

Mode number	Variable factors		Output parameters							
	X1	X2	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
1	4	225	4.59	1.43	47.3	10032	2.41	249	196	74
2	3	180	3.99	0.85	53.9	8500	2.25	198	236	57
3	4	180	5.78	1.52	48.8	10236	2.42	272	210	67
4	5	180	6.20	1.71	45.6	11333	2.51	273	166	79
5	3	225	3.65	0.76	52.1	12000	2.40	238	166	60
6	4	225	4.59	1.23	48.1	11850	2.42	253	172	74
7	5	225	5.52	1.52	45.4	10777	2.47	253	166	84
8	3	270	2.80	0.95	50.8	10910	2.46	281	196	63
9	4	270	3.82	1.42	47.4	9906	2.42	245	220	81
10	5	270	3.57	0.95	44.3	10108	2.40	250	176	88
11	4	225	4.59	1.45	47.9	10090	2.45	249	190	72

Mathematical processing of the results was performed using the Statgraphics Centurion software package. The dependence of each of the output parameters Y on variable factors was approximated by polynomial second-order regression equations [8]:

$$\hat{Y} - b_0 + b_1X_1 + b_2X_2 + b_{11}X_1^2 + b_{22}X_2^2 + b_{12}X_1X_2.$$

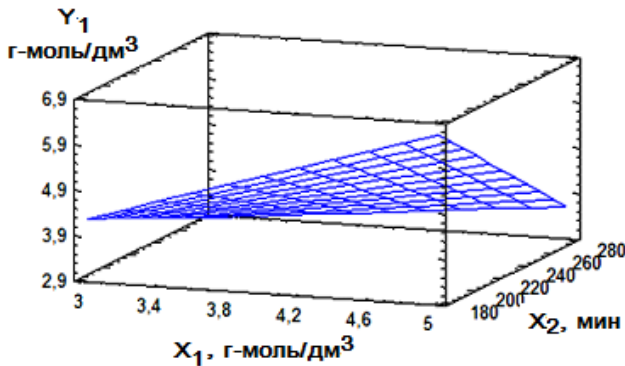
The terms with an estimate of the confidence probability of the regression coefficients of less than 95% were excluded from the equation with the recalculation of the remaining coefficients. Statistically significant coefficients (threshold significance level 0.05) are shown in table 2.

Table 2. Coefficients and statistical characteristics of the regression equations

b_{ij} coefficients and statistical characteristics	Output parameters							
	Y₁	Y₂	Y₃	Y₄	Y₅	Y₆	Y₇	Y₈
<i>b</i> ₀	-1.153	-3.493	79.9	10523	0.556	-346.2	267.0	-7.42
<i>b</i> ₁	2.608	1.345	-10.0	–	0.445	142.3	-15.0	22.6
<i>b</i> ₂	0.019	0.016	-0.021	–	0.007	2.48	-0.074	-0.002
<i>b</i> ₁₁	–	–	0.803	–	–	–	–	–
<i>b</i> ₂₂	–	–	–	–	–	–	–	–
<i>b</i> ₁₂	-0.008	-0.005	–	–	-0.002	-0.588	–	0.0167
Determination coefficient	0.928	0.694	0.980	–	0.919	0.731	0.247	0.983
Forecast standard error \dot{Y}	0.332	0.213	0.491	524	0.022	13.7	23.2	1.86

Regression equations were used to graphically represent the results in the form of three-dimensional response surfaces [9].

The dependences of the concentration of residual values of hydrogen peroxide Y_1 and peracetic acid Y_2 in the liquor on variable factors (fig. 1) are almost identical and predictable, they are due to the nature of the above-mentioned successive oxidative reactions.



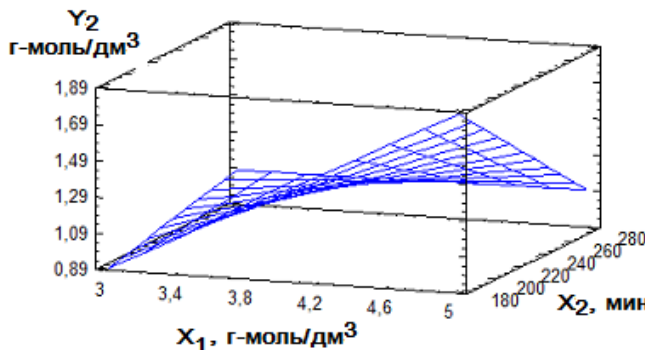
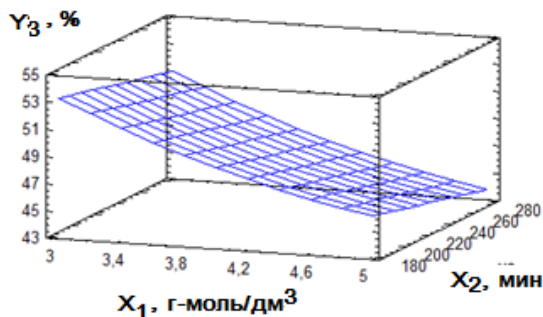


Figure 1. Dependence of the concentration of residual hydrogen peroxide in the liquor on the variables of cooking

The yield of technical cellulose decreases linearly with an increase in the initial concentration of hydrogen peroxide and the duration of cooking within the used range of their variation (Y_3 , Figure 2).

The tensile strength of paper castings (breaking length Y_4) remained unchanged under the experimental conditions (did not go beyond the "noise background"; all regression coefficients are statistically insignificant, tab. 1). Since the breaking strength is highly dependent on the strength of the individual fibers, it can be argued that awn hemp fibers are resistant to the action of the cooking liquor components. The magnitude of the elongation of the paper samples under tension Y_5 , on the contrary, is largely due to the strength of the interfiber bonds, the dependence of this parameter on the cooking conditions is ambiguous (Y_5 , figure 2). These results are consistent with other strength properties - resistance to bursting and tearing, this is clearly seen when comparing figures 2 and 3.



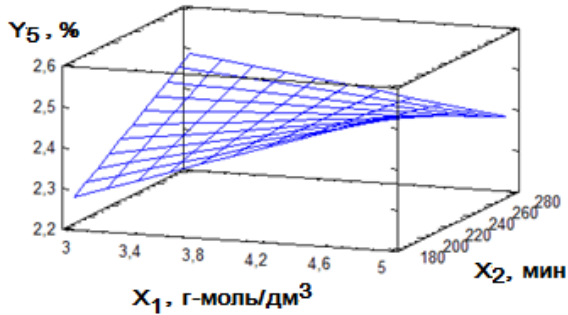


Figure 2. Dependence of pulp yield Y_3 and elongation at break Y_5 on variable cooking factors

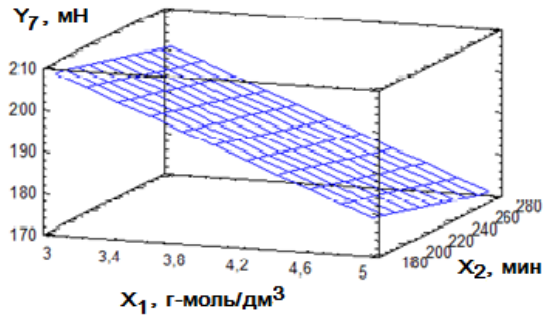
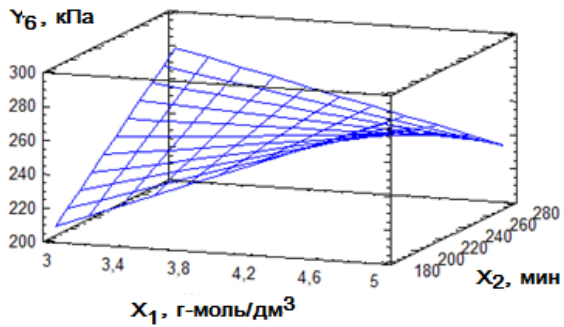


Figure 3. Dependence of the resistance of castings to punching shear Y_6 and tearing Y_7 on the variable factors of cooking

The whiteness of cellulose Y_8 grows from 58 to 89% in proportion to a decrease in the yield of Y_3 from 54 to 44% (the linear correlation coefficient is -0.966); therefore, we do not present the graph of the response surface of this parameter here. Note that according to GOST 14940-96, bleached sulfate cellulose from hardwood (aspen) of all grades, including OB-0, must have a whiteness of at least 86%. Consequently, the discussed awn hemp pulp without additional expensive bleaching can be used instead of bleached hardwood sulphate pulp in the production of many high-quality mass grades of paper.

The work was carried out within the framework of the state assignment of the Ministry of Education and Science of Russia for the implementation of the project "Technology and equipment for the chemical processing of plant raw materials biomass" by the team of the scientific laboratory "Deep processing of vegetable raw materials" (topic number FEFE-2020-0016).

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人造废料质量对空墙石强度的影响
**INFLUENCE OF MANUFACTURED WASTE QUALITY ON THE
STRENGTH OF EMPTY WALL STONE**

Karshyga Akishev

Senior Lecturer

Toraigyrov University, Pavlodar, Kazakhstan

Tulegulov Amandos

Associate Professor, Head of Department

Kazakh University of Technology and Business

抽象的。目前，商界对利用巴甫洛达尔地区工业企业废弃物生产建筑产品的工艺流程非常感兴趣，该工艺可以确保降低制造产品的成本，解决该地区的环境问题，创造新的建筑材料并节约成本。传统原料。不幸的是，人造废物的质量并不总是能让我们制造出优质的建筑产品。影响空心墙石强度的参数之一是工业废物的含水量。本文介绍了实际研究，可以评估使用具有不同水分含量的工业废物以及由此产生的空心墙石强度所产生的风险。为了评估人造废物的质量，使用了统计分析方法。

关键词：技术废料，强度，含水量，空心墙石，飞灰，铝土矿污泥，类别，参数，。统计方法。

***Abstract.** Currently, the business community is very interested in the technological process of production of construction products using waste from industrial enterprises of Pavlodar region, which ensures a reduction in the cost of manufactured products, solving environmental problems of the region, creating new building materials and saving traditional raw materials. Unfortunately, the quality of man-made waste does not always allow us to make good quality construction products. One of the parameters affecting the strength of a hollow wall stone is the moisture content of industrial waste. The article presents practical studies that allow assessing the risks arising from the use of industrial waste with different moisture content and the resulting strength of a hollow wall stone. To assess the quality of man-made waste, statistical methods of analysis were used.*

***Keywords:** Technogenic waste, strength, moisture content, hollow wall stone, flown ash, bauxite sludge, class, parameter,. statistical method.*

Introduction

Often in practice, when delivering raw materials (industrial waste) to production, suppliers do not comply with the requirements for the quality of fillers for concrete mixtures. This may be a discrepancy between the granular composition, the presence of impurities, high humidity, and more. Not all enterprises carry out input quality control of raw materials, which entails an increase in the number of rejects, a decrease in the quality characteristics of products [1-2].

Materials and methods

Man-made wastes used to replace traditional raw materials in the production of hollow wall stone are presented in Fig. 1-2 are by-products of the production of thermal stations and metallurgical enterprises of Pavlodar region.



Figure 1. Flown ash



Figure 2. Bauxite sludge



Figure 3. Hollow wall stone

Ekostroyinii-PV LLP produces construction products, including hollow wall stone with the addition of the above presented man-made waste into concrete mixtures as fillers Fig. 3.

In the research, moisture content was taken as the main parameter of the quality of industrial waste. Incoming control of the moisture content of man-made waste supplied to the enterprise is carried out on the basis of TU 34 4014-74 and recommendations for the use of bauxite slimes in concrete solutions [3-4]. The technological line for the production of construction products presented in Fig.4 allows the production of products of various construction assortments. Produced with the use of man-made waste with different moisture content, hollow wall stones were subjected to compression tests after 28 days, Fig.5 (as a traditional raw material used cement grade M400, river sand, crushed stone of fraction 10-20) in each batch of 6 samples. The produced products, every other day, are stored on pallets and stored in the open air. The values of the readings for the humidity of man-made waste and the strength of the hollow wall stone are included in Table 1.



Figure 4. Technological waste production line for construction products



Figure 5. Compression test of hollow wall stone

Table1. The values of the moisture content of man-made waste and the strength of the hollow wall stone

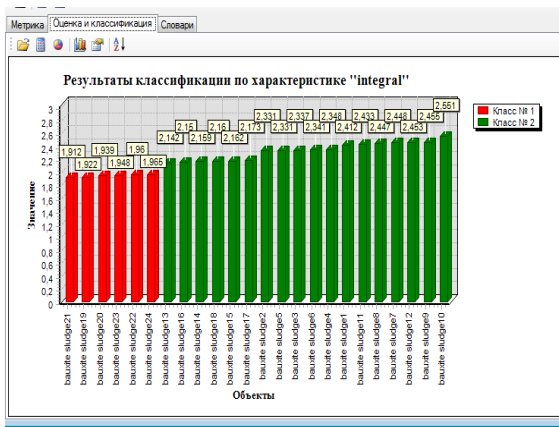
№ batch	Technogenic waste name	W Moisture content(%)	M Mass of stone hollow (kg)	R (MPA)	Raverage (MPA)
1	Flown ash	8	18	4.01	4,09
		8	18.3	4.1	
		8	18.5	4.12	
		8	18.45	4.07	
		8	18.43	4.15	
		8	18.55	4.13	
2	Flown ash	10	18.9	3.9	3.71
		10	19.01	3.7	
		10	19.2	3.67	
		10	19.15	3.7	
		10	19.12	3.69	
		10	19.27	3.71	
3	Flownash	13	20.9	3.5	3.515
		13	21	3.4	
		13	21.1	3.42	
		13	21.2	3.7	
		13	21.25	3.25	
		13	21.01	3.32	
4	Flown ash	5	18	4.45	4.65
		5	17.98	4.7	
		5	17.87	4.66	
		5	17.91	4.57	
		5	17.86	4.8	
		5	17.90	4.72	
5	Bauxite sludge	13	19.1	3.59	3.55
		13	19,15	3.51	
		13	19.2	3.53	
		13	19.19	3.57	
		13	19.12	3.52	
		13	19.09	3.58	

6	Bauxite sludge	15	19.5	3.41	3.44
		15	19.52	3.4	
		15	19.49	3.45	
		15	19.55	3.49	
		15	19.47	3.43	
		15	19.41	3.46	
7	Bauxite sludge	9	18.2	4.01	4.04
		9	18.4	4.05	
		9	18.33	4.09	
		9	18.37	4.07	
		9	18.44	4.01	
		9	18.49	4.03	
8	Bauxite sludge	4.5	17.03	4.65	4.66
		4.5	17.21	4.6	
		4.5	16.99	4.61	
		4.5	17.24	4.7	
		4.5	17.19	4.68	
		4.5	17.26	4.72	

Result and discussion

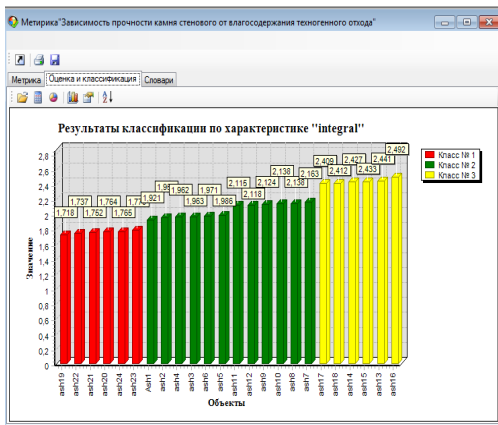
In practice, non-compliance with the quality parameters of the raw materials used in the technological process of manufacturing construction products increases the decrease in the number of manufacturing defects, which in turn causes non-fulfillment of the production plan and disruptions in the supply of products to potential customers [5-6].

We will use the software product [7] and with the help of statistical methods of analysis (Ward, average connection) of the connection, we will classify the strength indicators of a hollow wall stone, depending on the moisture content of man-made waste. Picture 6 shows the classification of the strength indicators of a hollow wall stone from the values of the moisture content of flown ash. According to the results of the classification, 3 classes are identified, the most qualitative parameters are presented in 1 cluster (red) where the hollow wall stone has the highest strength indicators. The second grade shows a decrease in strength by over 20%. The lowest indicators of strength of the stone of the hollow wall in the 3 cluster.



Picture 6. Classification of indicators of strength of hollow wall stone, for flown ash

Picture 7 shows the classification of indicators of the strength of a hollow wall stone, depending on the moisture content of bauxite sludge. According to the results of the classification, 2 classes were produced. Class 1 corresponds to the indicators of the highest strength and the lowest moisture content of bauxite sludge. In the second class, the characteristics of indicators are located quite close to each other, which ensured the distribution into one class. The Euclidean distance was chosen as the measure of proximity in the classification of the quality indicators of technogenic waste.



Picture 7. Classification of strength indicators of hollow wall stone for bauxite sludge

Conclusion

- Increased moisture content leads to a decrease in the strength of the hollow wall stone to 25% and more.
- The increased moisture content leads to an increase in the weight of the hollow wall stone by 18%.
- Increased moisture content causes additional consumption of traditional raw materials, which in turn increases the cost of finished products.
- Increased moisture content of man-made waste can cause downtime of technological equipment due to sticking of molds, inability to press and reduce the efficiency of production of construction products.
- It is not recommended to use man-made waste with a moisture content of more than 5% in the manufacture of construction products.

Acknowledgement

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富含蛋白质-碳水化合物组合物的碎肉
**ENRICHMENT OF MINCED MEAT WITH THE PROTEIN-
CARBOHYDRATE COMPOSITIONS**

Absalimova Mamura Absattarkyzy

Doctoral Candidate

Almaty Technological University

Baybolova Lyazzat Kemberbekovna

Doctor of Technical Sciences, Full Professor

Almaty Technological University

Glotova Irina Anatolievna

Doctor of Technical Sciences, Full Professor

Voronezh State Agrarian University named after Emperor Peter the Great

抽象的。评估了富含蛋白质-碳水化合物组合物的碎肉的功能特性。与营养价值相比,荞麦和鹰嘴豆粉的最佳添加量已经确定。已经进行了碎肉食谱的优化。

关键词: 强化肉末, 荞麦粉, 鹰嘴豆粉, 功能特性

Abstract. *The functional properties of minced meat enriched with protein-carbohydrate compositions were evaluated. The optimal amount of adding buckwheat and chickpea flour to minced meat has been established in comparison with their nutritional value. Optimization of minced meat recipes has been carried out.*

Keywords: *enriched minced meat, buckwheat flour, chickpea flour, functional properties*

The scientific basis for a modern food production strategy is the search for new sources of protein and vitamins. It is known that protein is a vital building material for the human body. Plant-based food protein sources have a high bioavailability due to their protein content, relatively good digestibility and nutritional value, and their low fat content. The currently existing new ideology in the field of protein consists in the production of combined meat products based on meat and vegetable protein raw materials obtained from various sources, subject to the mutual enrichment of their compositions, a combination of functional and technological

properties, an increase in biological value, an improvement in the organoleptic characteristics of finished products, a decrease in its cost. Providing the population with high-quality food products in sufficient volume will help improve the nutritional structure of the population as a whole.

Studies of Kazakhstani and foreign authors have shown that it is promising to use processed products of grain and leguminous crops in the technology of combined meat products, which provide high nutritional and biological value, contribute to an increase in the flexibility of recipes, a stable and uniform distribution of ingredients, and minimization of losses in the production process, which ultimately leads to a product of consistent quality. The introduction of raw materials of plant origin into minced meat can be considered as one of the ways to obtain high-quality meat products with controlled properties [1, 2].

The aim of the study is the possibility of enriching minced meat with protein-carbohydrate compositions (PCC) based on vegetable raw materials. To achieve this goal, the main functional properties of the combined minced meat were studied, formulations were optimized and developed, and a comparative assessment of the biological value of minced meat with PCC was carried out. To obtain PCC, chickpea and buckwheat flour was used as plant raw material, which was added to minced meat in an amount of 10% and 20% instead of the meat part. The functional properties were used to determine the chemical composition, the quantitative content of amino acids, vitamins and mineral components in comparison with the control. Functional indicators were determined by the system-analytical method of research in a Microsoft Excel spreadsheet processor with the "Search for a solution" add-in [3]. As a result of the studies carried out, it was found that when 10% PCC is added, there is an increase in protein, carbohydrates and other indicators of the functional orientation. The development of the minced meat recipe with the addition of chickpea and buckwheat flour was carried out by replacing a part of the minced meat in the Assorti minced recipe with protein-carbohydrate compositions, the production of which provides for a protein mass fraction of at least 12.5%, a fat mass fraction of no more than 27.0 %, in accordance with ST RK GOST R 52675-2009. A technological scheme for obtaining minced meat with the addition of PCC is presented. The objective of the study was also a comparative assessment of the biological value of the developed minced meat with a control sample.

The optimization of the control sample formulation is shown in figure 1.

№	А	В	С	D E F G				H	I J K L				M	N	
				Массовая доля, %					Цена, тт./кг	Содержание компонентов в репертуре,					
Ингредиенты		Х ₁	Репертура, кг	жира	белка	углеводов	воды	жира		белка	углеводов	воды	Цена, тт	ЭЦ, ккал	
3	говядина 2 категории	X ₁	45,0	9,80	20,00	0,00	70,20	2250,0	4,41	9,00	0,00	31,59	101250,00	75,69	
4	баранина 2 категории	X ₂	20,0	9,60	19,80	0,00	70,60	1950,0	1,92	3,96	0,00	14,12	39000,00	33,12	
5	курица	X ₃	20,0	8,20	21,20	0,00	70,60	1250,0	1,64	4,24	0,00	14,12	25000,00	31,72	
6	жир говяжий	X ₄	15,0	99,60	0,00	0,00	0,40	2500,0	14,94	0,00	0,00	0,06	37500,00	134,46	
12	Итого			100,00											
13	Состав продукта, %				22,9	17,2	0,0	59,9		22,9	17,2	0,0	59,9	202750,00	
14	Функция цели							202750,00						Энергетическая ценность, ккал	274,99
15	Балансовые уравнения				22,9	17,2	0,0	59,9						Энергетическая ценность, ккал	1151,38
16	Норма для пожилых, г				40,0	50,0	20,0								2500,00
17	Соответствие норме, %				57,3	34,4	0,0								11,00
18	Соответствие норме, доли				0,573	0,344									0,1100
19	НСРС-Ур				0,582										НСЭЦ: 0,110

Fig. 1 – Summary data of the recipe composition of the control sample of minced meat with the calculated values of the cost of 100 kg of the product, partial indices of the balance of the recipe composition and energy value

Figure 2 shows a data matrix for designing a recipe for a multicomponent minced meat with a protein-carbohydrate composition, in the production of which buckwheat flour was used. This matrix was introduced into an Excel spreadsheet processor, together with the necessary formulas and balance equations, to optimize the recipe for a semi-finished meat product with PCC and balance it in terms of mineral, vitamin, fatty acid and amino acid composition.

№	А	В	С	D E F G				H	I J K L				M	N	
				Массовая доля, %					Цена, тт./кг	Содержание компонентов в репертуре,					
Ингредиенты		Х ₁	Репертура, кг	жира	белка	углеводов	воды	жира		белка	углеводов	воды	Цена, тт	ЭЦ, ккал	
3	говядина 2 категории	X ₁		9,80	20,00	0,00	69,20	2250,0	0,00	0,00	0,00	0,00	0,00	0,00	
4	баранина 2 категории	X ₂		9,60	19,80	0,00	69,70	1950,0	0,00	0,00	0,00	0,00	0,00	0,00	
5	курица	X ₃		8,20	21,20	0,00	69,70	1250,0	0,00	0,00	0,00	0,00	0,00	0,00	
6	жир говяжий	X ₄		99,60	0,00	0,00	0,30	2500,0	0,00	0,00	0,00	0,00	0,00	0,00	
7	ПЭК в том числе: мука гречневая	X ₅		1,20	13,60	71,90	9,00	500,0	0,00	0,00	0,00	0,00	0,00	0,00	
8	порошок клубней топинамбура	X ₆		0,01	7,9	79,52	5,55	845,0	0,00	0,00	0	0	0,00	0	
9	плазма крови	X ₇		0,1	84,0	0	8	1932,0	0,00	0,00	0,000	0,000	0,00	0,0000	
10	казеинат натрия	X ₈		1	86,0	2	6	3600,0	0,00	0,00	0	0	0,000	0,00	
11	Вода	X ₉		0	0	0	100	200,0	0,00	0,00	0	0	0,000	0,00	
12	Итого			0,00											
13	Состав продукта, %				0,0	0,0	0,0	0,0		0,0	0,0	0,0	0,0	0,00	
14	Функция цели							0,00						Энергетическая ценность, ккал	0,00
15	Балансовые уравнения				0,0	0,0	0,0	0,0						Энергетическая ценность, ккал	0,00
16	Норма для пожилых, г				40,0	50,0	20,0								2500,00
17	Соответствие норме, %				0,0	0,0	0,0								0,00
18	Соответствие норме, доли				0,000	0,000	0,000								0,0000
19	НСРС-Ур				0,000										НСЭЦ: 0,000

Fig. 2 – Data matrix for designing a recipe for semi-finished meat product with PCC

As can be seen from figure 4, the data matrix shows the ingredient composition of minced meat with the addition of a protein-carbohydrate composition. And also the chemical composition of each of the ingredients used and the price per kilogram of the corresponding type of raw material are presented.

Next, in the "Search for a solution" dialog box, we entered the optimization parameters of the objective function, variable cells and the necessary constraints in accordance with the recipe, as shown in figure 3.

Параметры поиска решения ×

Оптимизировать целевую функцию: ↑

До: Максимум Минимум Значения:

Изменяя ячейки переменных: ↑

В соответствии с ограничениями:

\$C\$10 >= 2

\$C\$11 >= 10

\$C\$12 = 100

\$C\$3 >= 30

\$C\$3:\$C\$11 >= 0

\$C\$4 >= 20

\$C\$5 >= 20

\$C\$6 >= 10

\$C\$7 >= 4

\$C\$8 >= 3

\$C\$9 >= 1

Добавить

Изменить

Удалить

Сбросить

Загрузить/сохранить

Сделать переменные без ограничений неотрицательными

Выберите метод решения: ↓ Параметры

Метод решения

Для гладких нелинейных задач используйте поиск решения нелинейных задач методом ОПГ, для линейных задач - поиск решения линейных задач симплекс-методом, а для негладких задач - эволюционный поиск решения.

Fig. 3 Parameters of finding a solution when optimizing the recipe for semi-finished meat products with PCC

Figure 3 also shows the selection of the "Minimum" icon, which indicates the search for a solution to optimize the recipe with a minimum cost of 100 kg of product.

Thus, the options for minced meat recipes were optimized with the replacement of meat raw materials with PCC № 1, with the addition of buckwheat flour and PCC № 2, with the addition of chickpea flour in the amount of 10% and 20%.

The obtained results of the study are presented in tables 1-3.

Table – 1. Chemical composition of the test samples

Indicators	Samples				
	Control	Sample № 1 (PCC based on buckwheat flour 10%)	Sample № 2 (PCC based on chickpea flour 10%)	Sample № 3 (PCC based on buckwheat flour 20%)	Sample № 4 (PCC based on chickpea flour 20%)
Fat, %	22.9	17.3	17.5	16.5	16.6
Protein, %	17.2	18.2	18.6	17.5	18.2
Carbohydrates, %	0	4.2	3.1	5.3	4.3
Water, %	59.9	59.2	60.0	59.4	59.9

Table 1 shows that the largest amount of protein contains experimental sample № 2 (18.6%), with the addition of 10% protein-carbohydrate composition based on chickpea flour. With the addition of PCC based on buckwheat flour, sample № 1 shows a higher percentage of protein (18.2%). A further increase in the PCC content of minced meat leads to a decrease in the amount of protein. The highest percentage of carbohydrates (5.3%) shows sample № 3, with the addition of PCC based on buckwheat flour in the amount of 20%, where the protein content also exceeds the control sample.

Table – 2. Amino acid composition of the test samples

Amino acid score, %	Samples				
	Control	Sample № 1 (PCC based on buckwheat flour 10%)	Sample № 2 (PCC based on chickpea flour 10%)	Sample № 3 (PCC based on buckwheat flour 20%)	Sample № 4 (PCC based on chickpea flour 20%)
Valine	159.4	160.3	157.0	150.7	143.9
Isoleucine	113.1	363.9	362.9	354.2	351.4
Leucine	118.1	120.4	119.0	111.2	109.0
Lysine	85.1	107.8	107.4	92.4	109.6
Methionine + Cystine	114.3	100.9	100.5	93.0	84.4
Threonine	52.3	211.4	209.8	198.5	212.2
Tryptophan	116.5	136.7	132.8	135.3	136.2
Phenylalanine + Tyrosine	139.8	139.3	138.3	126.3	124.7

Table 2 shows the amino acid rate of the control and test samples. As a result of the study, it can be seen that prototypes № 1-2 do not have limiting amino acids, when prototype № 3 contains two limiting amino acids (lysine - 92.4%, methionine + Cystine - 93%) and the amino acid rate of prototype № 4 contains one limiting amino acid (methionine + cystine - 84.4%).

Table – 3. Fatty acid composition of the test samples

Lipid composition, %	Samples				
	Control	Sample № 1 (PCC based on buckwheat flour 10%)	Sample № 2 (PCC based on chickpea flour 10%)	Sample № 3 (PCC based on buckwheat flour 20%)	Sample № 4 (PCC based on chickpea flour 20%)
Saturated fatty acids	11.98	8.66	8.66	8.46	8.24
Monounsaturated fatty acids	8.91	6.75	6.77	6.43	6.40
Polyunsaturated fatty acids	0.97	0.97	1.03	0.82	1.03

Table 3 shows the decline in saturated and monounsaturated fatty acids with an increase in the percentage of protein-carbohydrate compositions № 1-4. While the content of polyunsaturated fatty acids increases with the addition of 10% PCC № 2, and with a further increase in the percentage of filler, the indicator remains stable (1.03%).

Table 4 shows variations in minced meat recipes with the addition of protein-carbohydrate compositions.

Table – 4. Optimization options for minced meat recipes and their cost

Ingredients	Samples, kg/100				
	Control	Sample № 1 (PCC based on buckwheat flour 10%)	Sample № 2 (PCC based on chickpea flour 10%)	Sample № 3 (PCC based on buckwheat flour 20%)	Sample № 4 (PCC based on chickpea flour 20%)
beef of 2 category	45	30	30	30	20
lamb of 2 category	20	20	20	20	20
chicken	20	30	30	20	30
beef fat	15	10	10	10	10

PCC including: buckwheat flour	-	3	3	4	4
Jerusalem artichoke tubers powder	-	2.5	2	3	3
blood plasma	-	1	0.5	1	1
sodium caseinate	-	0.5	1	2	2
Water	-	3	3.5	10	10
Total, kg	100	100	100	100	100
Price, tg	202750.00	176944.50	177456.00	172167.00	162167.00

As a result of the study, it can be concluded that the most optimal formulations of minced meat with the addition of PCC are recipes № 1 and № 2. The use of a protein-carbohydrate composition based on buckwheat and chickpea flour in an amount of 10% improves the functional properties of minced meat, namely, to increase the amount of protein by 1-1.4%, carbohydrates by 4.2-3.1%.

When using PCC № 1 and № 2 in these percentages, the amino acid rate does not contain limiting amino acids. Minced meat is enriched with vitamins and minerals necessary for human life through the addition of buckwheat and chickpea flour as part of PCC.

Thus, the resulting minced meat can be considered products of increased nutritional and biological value, while reducing the cost by 12.5-12.7% in comparison with the control sample.

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钴钼催化剂的综合利用
**COMPLEX UTILIZATION OF COBALT-MOLYBDENUM
CATALYSTS**

Khatsrinova Yulia Alekseevna

Quality Manager of LC "NanoAnalytika"

Khatsrinov Alexey Ilyich

Doctor of Technical Sciences, Full Professor, Head of Department

Kazan National Research Technological University

抽象的。 本文致力于开发一种用于分离和利用废催化剂中钴和钼化合物的技术。 使用将废催化剂与氢氧化钠熔合的方法。 已建议将丙酮用于共萃取。 因此,通过在溶液中设置一定的 pH 值,可以将溶液中的钴化合物与钼化合物分离。 这将减少废物量并改善工业区的生态。

关键词: 钴、钼、利用、催化剂。

Abstract. *The article is devoted to the development of a technique for the separation and utilization of cobalt and molybdenum compounds in spent catalysts. The method of fusing the spent catalyst with sodium hydroxide was used. Acetone has been proposed for co-extraction. As a result, it was possible to separate cobalt compounds from molybdenum compounds in solution by setting a certain pH value in it. This will reduce the amount of waste and improve the ecology of industrial areas.*

Keywords: *cobalt, molybdenum, utilization, catalysts.*

Introduction

Compounds of cobalt and molybdenum, in particular, their oxides are used in many industries: chemical, petrochemical, metallurgical and mechanical engineering. Molybdenum (VI) oxide is also widely used as catalysts for various organic transformations, and as products for obtaining the metals themselves and their compounds [1]. Molybdenum (VI) oxide is also widely used as catalysts for various organic transformations, and as products for obtaining the metals themselves and their compounds [1]. Consequently, obtaining these substances from spent cobalt-molybdenum catalysts seems to be very urgent.

Cobalt - molybdenum-containing catalysts are widely used in petrochemical

and chemical technology for hydrogenation, hydrocracking, oxosynthesis and many other processes. Residues and wastes of such chemical industries in most cases contain small amounts of cobalt and noticeable amounts of organic substances, and amount to tens of thousands of tons per year [3].

The possibility of such processing will significantly reduce the amount of waste, which will improve the ecology of industrial areas, as well as return valuable cobalt and molybdenum compounds to technological cycles.

For this, it is necessary to develop a technology for the utilization of cobalt-molybdenum catalysts and to study the possibility of obtaining molybdenum oxides from spent molybdenum-containing catalysts.

To achieve this goal, the properties of molybdenum oxides and carbides were studied, which showed the existence of certain phases, the composition of which changes in narrow temperature ranges. Thus, molybdenum oxide can exist both in the α - phase (molybdenum oxide (IY)) and δ - phase (molybdenum oxide (YI)), γ - phase, β - phase, χ - phase (oxides of intermediate composition).

Based on the properties of molybdenum compounds, it was decided to use the method of differential thermal analysis. Using this method, it was necessary to determine the temperature regimes for obtaining substances from the initial sample. The spent molybdenum catalyst is a black oily powder with a pungent unpleasant odor, which is a mixture of molybdenum oxides and organic, aliphatic compounds.

Differential thermal analysis was carried out on a derivatograph of the PES system, according to four curves recorded on calibration paper in the axes: temperature (with a step of 100°) and weight loss (with a step of 5%). As a result of the analysis of derivatograms, an assumption was made about the possibility of the formation of several different substances, at temperatures of 380°C , 540°C , 700°C , which may correspond to molybdenum oxides.

The firing of the spent molybdenum-containing catalyst was carried out in a muffle furnace at three temperatures, lasting about two hours and gave the following results:

1. At $T = 380^\circ\text{C}$, a gray substance was obtained.
2. At $T = 540^\circ\text{C}$, a greenish-gray substance was obtained.
3. At $T = 700^\circ\text{C}$, a yellow substance was obtained. White needle-like crystals were removed from its surface

Then the experiment was repeated. Its difference was that the sample was placed in an already heated furnace at temperatures of 380°C , 540°C , 700°C . The phenomenon of "thermal shock" was observed, however, as a result of the experiment, substances of a similar color were formed. So the question of the possibility of the formation of molybdenum carbides under the given firing conditions is still open.

The substance obtained at 380°C resembles molybdenum oxide (IY) in its properties - small crystals of violet-gray color. The substance obtained at 540°C resembles in its properties the oxide of variable valence (Mo_2O_{11}). The substance obtained at 700°C resembles molybdenum oxide (YI) in its properties - yellowish-white crystals under a microscope, representing a mixture of transparent needles and opaque spherical agglomerates. White crystals resemble molybdenum oxide monohydrate (YI) ($\text{MoO}_3 \cdot \text{H}_2\text{O}$) in properties.

To identify the obtained substances and the possibility of detecting molybdenum carbides in the products of firing, we carried out a spectrophotometric analysis. The processing of IR spectra for the structural groupings of atoms and absorption bands confirmed that the substances obtained in the process of firing are molybdenum oxides. In addition, spectrophotometric analysis showed that the substances obtained by firing with a gradual increase in temperature and "thermal shock" are of the same nature, and the question of molybdenum carbides remains open. However, the possibility of utilization of spent molybdenum-containing catalysts is not limited to the production of oxides and carbides of molybdenum. Currently, the possibility of processing oxides and carbides into a valuable strategic metal - molybdenum - is being studied.

The object of the study was the catalysts of four grades of the following composition (table).

Table. Elemental composition of catalysts

Elements, %	Catalyst 1	Catalyst 2	Catalyst 3	Catalyst 4
C	3.7	9.8	10.6	
O	33.2	24.5	32.1	42,71
Al	27.5	13.6	20.1	39,7
Si	–	0.9	1.9	
V	–	2.9	–	
Fe	–	10.9	24.6	0,06
Ni	–	4.3	2.5	
Co	3.8	–	1.8	3,54
Mo	31.8	39	35.8	13,5
Ca	–	0.87	–	

These catalysts contain up to 30-40% molybdenum compounds.

The method of decomposition of spent catalysts combined in itself: the process of melt formation based on the spent catalyst with its subsequent dissolution. For this, it is important, on the basis of the physicochemical properties of the catalyst components, to correctly select the conditions for carrying out the sintering and

dissolution processes: temperature, time, reagents and their ratio. The intensity of its dissolution will be determined by the surface area of the contact between the phases and the structure of the melt: the degree of porosity and pore size, the size and shape of grains, and so on.

Weighed portions of the test specimens are placed in a quartz crucible and loaded into an incineration furnace, where the crucibles are uniformly heated to 900°C. During the experiment, heat and weight effects are recorded.

The method of decomposition of the spent catalyst combined in itself: the process of formation of a melt based on the spent catalyst with its subsequent dissolution.

Samples of blue catalyst 4 were fused in porcelain crucibles with sodium hydroxide in a mass ratio of 1:6 and a temperature of 330°C.

Further, the melt is dissolved in water, followed by boiling with 3% hydrogen peroxide solution for 10 minutes, which ensures complete oxidation of molybdenum in solution from trivalent to pentavalent.

Then, the aqueous extract was filtered on a vacuum pump and the pH of the solution medium was measured.

Thus, on the basis of the physicochemical properties of the components of the spent catalyst, the conditions for the process of its decomposition were selected: temperature, time, reagents and their ratio.

There are several types of roasting: calcination, oxidizing, chlorinating, reducing and sintering, which are named from the nature of the occurring chemical phenomena.

Using high-temperature firing, in this work, the spent catalyst is sintered with sodium hydroxide at a temperature of 330°C, as well as the conversion of molybdenum and cobalt compounds obtained as a result of precipitation into the compounds we need: cobalt and molybdenum oxides.

Results and discussion

When developing a method for the joint determination of molybdenum and cobalt in solution, it is necessary to take into account the following factors for determining the content of each element separately: the ability to form colored thiocyanate complexes in solution, their stability under various media, as well as the possibility of their extraction by organic solvents and the range of their determination. All stained thiocyanate complexes dissociate significantly. Due to the stepwise formation of thiocyanate complexes and their different colors (for the same cation), it is imperative that the concentration of the reagent be the same in the test and standard solutions. For the possibility of joint extraction of thiocyanate complexes, organic solvents are used that do not mix with water; they dissolve the colored thiocyanate complexes well, removing them from the aqueous layer. For the extraction of colored thiocyanates, diethyl ether, amyl alcohol, acetone, and

other solvents are most often used.

Deposition conditions: the product of ion activities in powers corresponding to stoichiometric coefficients must be greater than the table value. Therefore, the pH value corresponding to precipitation does not remain strictly defined; it depends on concentration, temperature and other conditions and fluctuates within certain limits [4]. Thus, it is possible to separate cobalt compounds from molybdenum compounds in solution by adjusting it to a certain pH value, gradually increasing the pH value by adding alkali. The method is based on the fact that when metal hydroxides are precipitated at low pH values, hydroxides of other metals formed at higher pH values are not yet precipitated.

In order to obtain information about the object of research, differential thermal, IR spectroscopic analysis of green and blue granules of the spent cobalt-molybdenum catalyst was carried out.

The formation of endothermic effects in the temperature range 100–160°C on the DTA curves can be explained by the removal of adsorbed moisture from the samples under study during heating.

According to the obtained results of differential thermal analysis, it can be assumed that the green granules are crystalline hydrate, when heated, the removal of crystallization water occurs, accompanied by a rearrangement of the structure of the substance. To confirm the assumption that the green granules are crystalline hydrate, IR spectroscopic analysis of the green and blue granules of the spent catalyst was performed.

The IR spectrum of green granules of the spent catalyst showed in the region of 3600-3200 cm^{-1} the presence of a number of bands (3095, 3300, 3500) inherent in the stretching vibrations of O-H and at 1630-1600 cm^{-1} of the band characteristic of the bending vibration of H-O-H [5]. Whereas the IR spectrum of blue granules in the region of 3600-3200 cm^{-1} has only one broad band, the formation of which can be explained by the adsorption capacity of the substance. In the region of 1200-1000 cm^{-1} of the IR spectrum of green granules, a band of medium intensity is observed, it is absent in the IR spectrum of blue granules.

To explain this phenomenon, it was proposed to heat green and blue granules at temperatures of 120, 350, 600°C for two hours. When the blue granules were heated at temperatures of 120, 350, 600°C, no changes in the structure were observed. For green granules, on heating at temperatures of 120, 350, 600°C, the structure of the substance changed, for example, at a temperature of 350°C, partial amorphization of the structure was observed and a decrease in the intensity of the band in the range of 1100-950 cm^{-1} , at 600°C the band completely disappeared and the structure of the substance became completely amorphous [5]. On the basis of the obtained results of differential thermal and IR spectroscopy, it was concluded that green granules are crystalline hydrate, which, when heated from 400 to

600°C, completely loses water. The loss of water in the granules is characterized by a color change from green to blue.

The data obtained correlate with the properties of cobalt compounds, which indicate that during heating in air in the range of 400-600°C, cobalt (II) oxide transforms into cobalt (II, III) oxide with a change in the color of olive green to blue [6].

Conclusions

1. The optimal conditions for the preparation of the utilization catalysts were selected: fusion with sodium hydroxide in a mass ratio of 1:6 at a temperature of 330°C for 3 hours, followed by dissolution of the melt with water.

2. The obtained melts were investigated for the presence of molybdenum compounds: by the method of IR spectroscopic analysis; by the method of differential thermal analysis, by the method of X-ray structural analysis; by the method of photocolometric analysis.

3. A method for the determination of molybdenum in the solutions under study has been worked out, based on the joint extraction of thiocyanate complexes of cobalt and molybdenum in the presence of potassium thiocyanate and tin (II) chloride. A common extractant, acetone, was selected for joint extraction.

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全面解决乌兹别克斯坦“清洁气候”、生态及特种水泥生产问题
COMPREHENSIVE SOLUTION TO THE PROBLEM OF "CLEAN CLIMATE", ECOLOGY AND PRODUCTION OF SPECIAL TYPES OF CEMENT IN UZBEKISTAN

Ruziev N.R.

*Candidate of Technical Sciences
Navoi Mining and Metallurgical Combine*

Iskandarova M.

*Doctor of Technical Sciences, Full Professor, Head Research Officer
Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan*

Negmatov S. S.

*Doctor of Technical Sciences, Full Professor, Academician of the Academy of Sciences of Uzbekistan
Director of the SUE "Fan va Tarakkiet"*

Namazov Sh.S.

Doctor of Technical Sciences, Full Professor, Academician of the Academy of Sciences of Uzbekistan, Head of laboratory of the Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan

抽象的。 本文介绍了大规模利用无机来源的工业废物，如筛选石灰石、磷石膏和铜冶炼生产中的回收渣的硫代氧化铝熟料低能耗技术开发的研究成果。 值得注意的是，当原料混合物在 1150–1200° C 下焙烧时，熟料中会形成硫磺矿物：硫铝酸盐 (C4A3S)、硫代硅酸盐 (C5S2S) 和亚硫酸铁酸盐 (C4F3S) 钙，它们自主共存，而不是以它们的形式存在 固溶体，但以它们为基础的水泥在强度上，并不逊色于传统的硅酸盐水泥。

关键词：硫磺矿物，硫铝酸盐，硫硅酸盐，硫铁酸盐，水化作用，磷石膏，石灰石筛分，铜冶炼渣，原料混合物，低温焙烧，硫铁熟料，硫铁水泥，人造砾石，强度，结构，工艺，环保效率。

Abstract. *The article presents the results of research on the development of a low-energy technology of sulfo-alumina clinkers with a large-scale utilization of industrial waste of inorganic origin, such as screening of limestone, phosphogypsum and recycled slags from copper smelting production. It is noted*

that when raw mixtures are fired at 1150-1200°C, sulfominerals are formed in clinkers: sulfoaluminate ($C_4A_3\check{S}$), sulfosilicate($C_3S_2\check{S}$), and sulfoferrite ($C_4F_3\check{S}$) calcium, which coexist autonomously, and not in the form of their solid solutions, but cements based on them in terms of strength, they are not inferior to traditional Portland cement.

Keywords: *sulfominerals, sulfoaluminate, sulfosilicate, sulfoferrite, hydration interaction, phosphogypsum, limestone screening, processed copper smelting slag, raw material mixture, low-temperature roasting, sulfo-iron clinker, sulfo-iron cement, artificial conglomerate, strength, structure, technological, environmental efficiency.*

The production of nanocement makes it possible to revise the development strategy of the world cement industry: to reduce by 2-3 times the specific emissions of CO₂, SO₂ and NOX, and, accordingly, to radically reduce the fuel consumption of the existing cement plants [1]. This is especially true in connection with the need to radically reduce CO₂ emissions under the Paris Climate Agreement. The cement industry, producing about 4.5 billion tons of cement annually, emits about 4 billion tons of CO₂ into the atmosphere, which is about 8% of world emissions [2].

It is known that in terms of energy and material consumption, the building materials industry, in particular the production of cement, takes the second place after metallurgy, therefore, today an important place is occupied by the development of modern technologies that reduce emissions, save energy and resources, firing special types of low-temperature clinkers, production of modified active mineral additives of cements with high performance properties, and for this, whenever possible, use secondary mineral raw materials that have passed a certain stage of pretreatment.

In this regard, all over the world, taking into account the constant increase in prices for fuel and energy resources, and therefore the cost of Portland cement, research is being carried out aimed at the development of low-basic raw materials mixtures for obtaining special types of clinker using low-burning technology and cements based on it. At the same time, it is necessary to conduct research in priority areas focused on solving the following scientific and technological problems: search and study of the suitability for use in clinker production of raw materials containing compounds that help to reduce the firing temperature; study of the ability of pretreated metallurgical, chemical, mining and processing industry waste to reduce carbon dioxide emissions into the atmosphere and reduce the firing temperature of the raw mixture to obtain clinker, the cement on the basis of which will not be inferior in strength to traditional Portland cement; development of scientific and technological foundations for obtaining low-temperature clinkers using highly reactive types of natural and man-made raw materials [3-6].

In our republic, the intensive development of the construction industry and other industries dictates the need to increase the volume of production of building materials and products, including cement and cement concrete, improve their quality and reduce costs. For this, it is of great scientific and practical importance to find effective solutions to a number of existing problems associated with reducing the harmful effects of emissions on the climate.[7]. This is also clearly indicated in the Resolution of the President of the Republic of Uzbekistan, in which special attention is paid to solving problems of "organizing the production of new types of innovative building materials", "introducing scientific achievements into production processes" and "developing and implementing technologies for processing and using secondary raw materials", as well as to reduce energy consumption in the production of clinker with the release of cement with increased resistance to frost, frequent fluctuations in the atmosphere, corrosion and other factors [8].

- Based on this, we put forward an idea aimed at solving 3 major problems - the environmental, technological and economic nature of the metallurgical industries (improving environmental protection through the disposal of industrial waste - limestone screenings and recycled slags from copper smelting), chemical (phosphogypsum) and cement industry (a decrease in carbon dioxide emissions into the atmosphere due to a decrease in the consumption of a carbonate-containing component in the composition of the raw mixture for firing a semi-finished product - clinker by reducing its saturation coefficient due to partial replacement of limestone with phosphogypsum and carrying out the firing process at a temperature not higher than 1150-1250°C). At the same time, a comprehensive study of the processes of mineral formation of new raw mixtures and the stable existence of clinker minerals, the production of special types of cement with high technical and operational properties (resistance against the effects of frost, sharp changes in climatic conditions, aggressive sulfate salts) and low cost are provided.

When performing experimental work, the objects of research were low-temperature sulfo-iron (SAI) raw mixtures, clinkers, and cements based on them. The raw materials were screening of limestone formed as a waste of lime production at the lime plant of JSC "Almalyk MMC", waste of slag processing of the copper smelter of JSC "Almalyk MMC" (WSPCS) and phosphogypsum of JSC Ammophos-Maxam (tab. 1). The synthesis of sulfoclinkers was carried out by firing in an electric furnace with silite heaters.

Table 1
Chemical composition of raw materials

Material	The content of oxides, wt. %								
	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	R ₂ O	P ₂ O ₅	SO ₃	ppp
Phosphogypsum	14.1	1.11	0.69	2.15	27.3	0.3	1.7	35.3	17.4
WSPCS	36.5	7.68	48.07	0.29	2.76	2.51	-	0.92	0.1
Limestone screening	6.58	2.50	1.15	0.80	48.7	0.36	-	0.33	39.5

The kinetics of mineral formation and the completeness of the process during the firing of sulfo-alumina raw materials were monitored by X-ray phase analysis. The strength of the samples was determined on small sample cubes with a face size of 1.41 cm and a composition of 1:0.

The calculation of the composition of sulfo-iron raw mixtures and the determination of the chemical and mineralogical composition of clinkers were carried out by setting the values of the saturation coefficient (SC) and sulfo-silicate modulus (n_s). The physical and mechanical properties of cements are determined in accordance with GOST 310.1-310.4. The phase composition of SAI clinkers and cement stones was studied using X-ray phase and electron microscopic research methods.

The calculation of the composition of the raw mixtures was carried out with the values SC=0.667 and 0.80; n_s =1.0; 1.5; 2.0. At the same time, the content of WSPCS in the raw compositions ranged from 9.6 to 17.6%, phosphogypsum - from 25.63 to 42.16%, limestone dropout - from 48.2 to 57.21% (tab. 2). The reactivity of SAI raw materials was studied in the temperature range 800-1250°C with an exposure every 100°C. It was found that the optimal temperature for the synthesis of SAI clinker with SC=0.667 and 0.80 is 1150°C, and with SC=0.90 and SC=1.0-1200°C. Depending on the SC values and the SAI mineral content of clinkers, it is within the limits given in tab. 3.

Table 2
Ingredient ratio of SAI raw mixtures

SC	n_s	Content of mixture components,%		
		WSPCS	Phosphogypsum	Limestone screening
0.667	1.0	17.16	25.63	57.21
	1.5	14.54	33.16	52.30
	2.0	9.9	51.1	39.0
0.80	1.0	14.81	26.92	58.27
	1.5	10.85	40.82	48.33
	2.0	9.6	42.16	48.24

Table 3
Mineralogical composition of SAI clinkers

Values		The content of the main minerals, wt. %:			
SC	n_s	$C_4A_3\check{S}$	$C_4F_3\check{S}$	$C_5S_2\check{S} + C_2S$	$C\check{S}_{exc}$
0.667	1.0	8.17	20.23	78.40	-
	1.5	7.26	17.39	76.96	3.88
	2.0	5.83	11.67	74.04	19.69
0.80	1.0	4.00	18.00	76.00	-
	1.5	6.28	12.68	71.08	11.9
	2.0	6.32	11.88	72.72	13.07

X-ray phase analysis of clinkers confirms the full compliance of their actual mineralogical composition with the calculated data. Electron-microscopic studies of the surface of the SAI cleavage of clinker with $SC=0.80$ and $n_s=2.0$, fired at $1200^\circ C$ is represented by a melted mass of the smallest rounded grains of $C_4F_3\check{S}$, in which similar grains of sulfoaluminate are dissolved and chaotically located grains $C_5S_2\check{S}$ elongated with melted edges. In some places these grains are arranged in blocks, and in some places - in a circle (fig. 1).

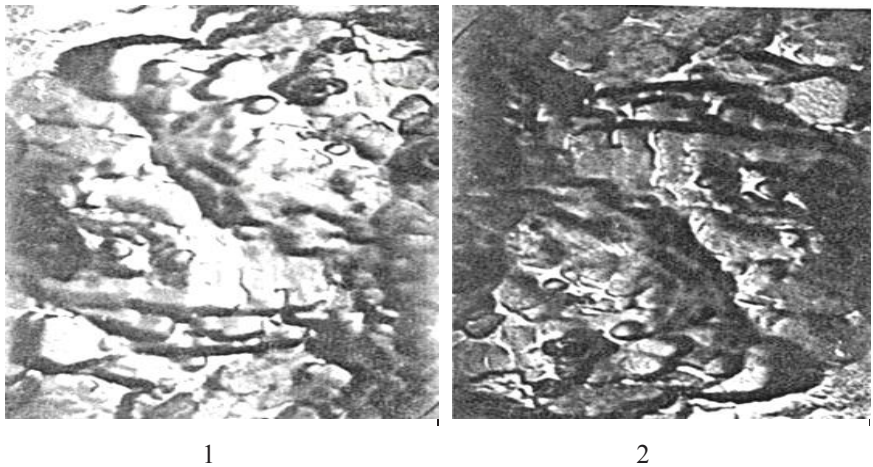


Figure 1. Relief of the cleaved surface of SAI clinkers with $SC=0.667$; $n_s=1.5$, fired at 1150 (1) and $1200^\circ C$ (2). $\times 1300$

The overall roughness of the relief indicates a high porosity, which is formed, apparently, due to the release of SO_2 during the firing of sulfo-iron-containing raw material mixture as a result of the partial decomposition of $\text{C}_4\text{F}_3\text{S}$ and $\text{C}_5\text{S}_2\text{S}$ respectively, into C_2F , C_2S and CS . This indicates the possibility of lowering the firing temperature of the raw material mixture by about 30-50°C to prevent the decomposition of low-heat sulphineral clinker.

By 3 days, hardening in water, standard samples of SAI cement with a composition of 1:3 gain about 75% of the brand strength, which allows them to be classified as fast-hardening cements, and the higher the SC and n_s values, the faster the cement stone gains strength. Strength indicators by 28 days at SC – 0.80; $n_s=1.5$ and 2.0 are respectively 52.12 and 54.36 MPa. (tab. 7).

Table 4
Physical and mechanical characteristics of SAI cements

Values		Setting time, h-min.		Compressive strength (MPa), at the age (days):			
SC	n_s	start	end	3	7	28	90
0.667	1.5	2-32	6-08	31.8	36.6	45.75	56.5
	2.0	2-04	5-42	33.2	36.8	47.22	58.7
0.80	1.5	2-38	5-38	36.4	38.6	52.12	60.6
	2.0	2-19	5-03	39.6	42.8	54.36	61.7
0.92 PC M-400		3-50	4-50		18.6	24.4	44.2

With the age of hardening, the process of hydration of SAI cements slows down, as a result, by 3 months the increase in their strength is at SC=0.667 from 10.75 to 11.48 MPa, respectively, at $n_s=1.5$ and 2.0, and at SC=0.80 ; $n_s=1.5$ and 2.0 - 8.48 and 6.54 MPa, respectively. The average strength of cements based on synthesized clinkers, depending on the values of SC and n_s , was 58.0 MPa.

The results of physicochemical studies of the processes of hydration, phase composition and genesis of the microstructure of the stone during hardening of SAI cements substantiate the factor of achieving its high physical and mechanical indicators. It was found that after 10 minutes, after contact with water, lines of weak intensity appear on the SAI diffractogram of the cement at $d/n=(0,731; 0,482; 0,301; 0,246; 0,231; 0,217; 0,206; 0,186; 0,182)$ nm, most likely related to high sulfate calcium hydrosulfoferrite $3\text{CaO}\cdot\text{Fe}_2\text{O}_3\cdot 3\text{CaSO}_4\cdot 32\text{H}_2\text{O}$. The CaSO_4 line with $d/n=0.345$ nm has a high activity, the intensity of which changes insignificantly up to 16 h. After 1 day of hardening, reflections of ettringite also appear on the diffractogram at $d/n=(0.592; 0.382)$ nm, the intensity of which significantly increases by 7 days. By day 28, the predominant phase is $3\text{CA}\cdot 3\text{CS}\cdot 32\text{H}$ and

$3CF_3CS_2H$, $Ca(OH)_2$ is absent, and the $CaSO_4 \cdot 2H_2O$ line has a low intensity. The lines of weak intensity at $d/n=(0.378; 0.366)$ nm and rather strong lines with $d/n=0.347$ nm indicate the presence of anhydrous C_4F_3S and $CaSO_4$, in the cement-water system, which indicates the ongoing process of hydration. This sequential nature of the hydration process ensures the gradual compaction and hardening of the forming SAI cement stone.

After mixing with water on the smooth surface of the grains of SAI cements, initially welded to each other, the smallest scale-like hydrated neoplasms begin to grow, which by 7 days, hardening completely cover the surface of the cleavage of the hardened cement stone. The surface relief of the SAI cement stone already by 14 days acquires sufficient density due to the formed acicular and prismatic crystals of ettringite and its iron-substituted analog, which by 21 days form blocks with a rough surface and grooved edges that grow together into large aggregates, which by 28 days develop into crystalline intergrowths and form blocks of crystal aggregates, the intercrystalline space of which is filled with new portions of hydration products C_4A_3S , C_4F_3S and C_5S_2S (fig.2).

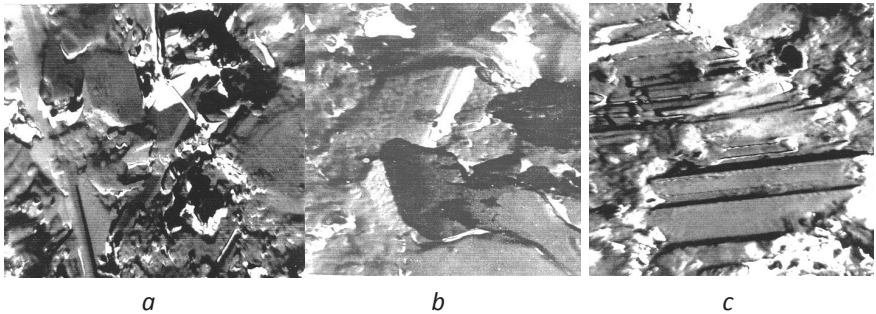


Figure 2. Relief of the surface of the stone chip SAI cement, hardened: a - 14 days; b - 21 days; at - 28 days

The indicated hydrated compounds, due to the related crystalline structure, are tightly packed and the microstructure of the sulfo-alumina cement stone becomes block-layered, and thus, by strengthening, provide high indicators of its strength and other important operational properties.

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智能家居物联网技术中影响用户提供网络服务质量的因索分析
**ANALYSIS OF FACTORS AFFECTING THE QUALITY OF
NETWORK SERVICES PROVIDED BY THE USER IN SMART
HOME INTERNET OF THINGS TECHNOLOGY**

Al Namer Zainal

Postgraduate

Moscow Technical University of Communications and Informatics

抽象的。物联网技术智能家居系统基于广泛的知识库运行，并存储实现能源效率和用户舒适度目标所需的所有信息。它的智能也是在多智能系统内部实现的，这也保证了系统对外的开放性。作为第一个估计，它是通过对配置文件管理策略建模来开发和验证的。

今天，世界上所有的公司，逐渐转向更先进、更有效的方法，都以战略管理方法论为指导，其中包括许多不同的工作、基础和辅助工具。

开发服务提供过程的功能图的权宜之计不仅在于质量体系“工作”的可视化表示，还在于它允许您识别和消除此活动组织中可能存在的差距，当必要的表演者可能无法执行某些功能时。将来，这将确保质量体系的清晰运作。

关键词：物联网、物联网智能家居系统、网络服务质量、可操作性、传输速度、可靠性、延迟、能效、感知质量。

Abstract. *The internet of things technology smart home system operates on an extensive knowledge base, and stores all the information necessary to achieve the goals of energy efficiency and user comfort. Its intelligence is also realized inside a multi-agent system, which also ensures the openness of the system to the outside world. As a first estimate, it is developed and verified by modeling a profile management strategy.*

Today, all companies in the world, gradually moving to more advanced and efficient methods, are guided by the methodology of strategic management, which includes many different working, basic and auxiliary tools.

The expediency of developing a functional diagram of the service provision process lies not only in a visual representation of the "work" of the quality system, but also in the fact that it allows you to identify and eliminate possible gaps in the organization of this activity, when the necessary performers may not be available to perform some functions. In the future, this will ensure a clear functioning of the quality system.

Keywords: *Internet of Things, IoT smart home system, Quality of network services, operability, transmission speed, reliability, latency, energy efficiency, quality of perception.*

The definition of "**smart home**", which first appeared in 1985, and the "Internet of Things" technology, which was first mentioned in 1999 in practice, denotes two different concepts of home automation: home automation (SMART-HOME) and residential building automation (BUILDING AUTOMATION). [1]

SMART technology is a new approach to organizing the set goals, which allows you to combine all the available information at an early stage, determine the list of necessary materials, set the deadlines for the work and set specific and understandable tasks for all participants in the process. SMART-HOME is a solution in which the operation and control of all systems at the level of an individual household is automated, providing a specific room with a high level of security and all the necessary living conditions, while remotely without unnecessary interference from service organizations. The building is equipped with special monitors with sensors that help to detect threats to both the system and the residents themselves. [4]

It should be noted that the topic of the quality of network services in the smart home of the Internet of Things has not been sufficiently studied. Since this section describes the concept of *quality of network services*, it is necessary, first of all, to define this concept.

Quality of Service (QoS) is the overall effect of a service that determines the user's satisfaction with the service. In a broad sense, it is customary to distinguish two types of service quality assessment. That is the quality of service (QoS) and quality of experience (QoE). The definition of the first type is given in ITU-T Recommendation E.800 [5].

QoS - is the aggregate of all the characteristics of a service that affect its ability to meet the stated or implied needs of the user of the service. This indicator should include a certain number of network characteristics considered as the most important from the point of view of their impact on the quality of service. These are such parameters as: bandwidth; reliability of the network / network elements; delay (ms) and delay variation (jitter); coefficient (probability) of losses (%); survivability of the network - the ability to maintain the operability of the network in the event of failure of individual elements. [6,7]

The bandwidth (or data rate) of a network service is defined as the effective transmission rate, which is measured in bits per second.

The reliability of the communication network and its elements is determined by a number of parameters, among which the availability factor is most often used. The availability factor is the ratio of the time of the object's working state to the

total observation time. With absolute reliability (in the ideal case), the availability factor should be equal to 1, which means 100% network availability. Such a value is practically unattainable, therefore the availability factor is normalized by values that are smaller, but close enough to one. Data packet transmission latency is defined as the delivery time of a data packet from entering the network to exiting the network.

QoE – is the overall acceptability of the service as perceived by the subjective end-user. In this case, the perceived quality includes all systemic effects "from end to end" (client, terminal, network, server program). In general, acceptability may depend on user expectations and context. In this regard, the perceived quality is defined as the aggregate measure of the satisfaction of the user working with the network service.

Quality of Experience (QoE) by the user includes the entire path from source to destination (subscriber terminal, network, service infrastructure, etc.) and may be influenced by the human factor associated with the individual's inherent expectations or the content of the information received (content). Differences in individual perception and individual preferences can influence the user's assessment. Consequently, measurements of the quality of perception should be carried out on the basis of the survey of the ratings received from the group of participants. At the same time, the perception is influenced by the level of culture, motivation, factors of concentration of attention, the emotional state of the expert, etc. [2].

Table 1. Content analysis of the "smart home" concept

№	Conceptual characteristics of the concept, updated by the surrounding context	Description
1	Security/crime Prevention	<ul style="list-style-type: none"> • protection against leaks; • short circuit protection in the power supply network; • fire protection (smoke sensor); • autonomous power supply (diesel generator); • automatic fire extinguishing system; • alarm to call service. • perimeter integrity control (doors and windows); • imitation of the presence of the owners; • automated control of access to the premises; • video surveillance of the adjacent territory; • automatic lighting of the territory upon entry; • control of protective shutters; • the ability to call private security; • receiving pictures from any CCTV camera via the Internet

		<ul style="list-style-type: none"> • prevention of situations that threaten human health: protection from fire, gas leaks, etc. • the necessary comfort and safety to ensure optimal childcare, video babysitting, etc.
2	High technologies of computerization	ZigBee, Z-Wave, Wi-Fi, Bluetooth
3	Energy efficiency	It is no coincidence that energy companies are among the most ardent supporters of various smart home systems that include remote meter reading. Under such a system, wasteful use of energy can be so obvious and unnecessary that it becomes a social taboo'
4	Multifunctionality	The multi-agent approach provides multifunctionality of the system, robustness to system errors, as well as optimization of computing resources
5	Comfort, reliability	In 1984, the National Association of Home Builders (NAHB), which coined the term "smart home", developed the idea of a computer-controlled home, be it a home or an apartment, that would allow owners to live more comfortable lives and spend less time on routine household tasks' (MILLMANH. // MAG: COMPUTE! 1991 (Ost)).
6	Contemporaneity	Various automation standards are also being developed for SMART spaces

There are other factors that affect user-generated quality ratings. This is, first of all, the user's previous experience with network devices (for example, experience with devices), etc.

Depending on the subject of service assessment, methods of quality assessment are distinguished from the point of view of the consumer and the manufacturer. Evaluation methods from the perspective of the consumer are aimed at evaluating aspects of the service that are perceived by the consumer and/or are of particular importance to him.[3]

This category includes the following methods:

objective

- included observation;
- trial purchase;
- expert supervision;

Subjective

- critical;
- process rooms;
- problematic.

Evaluation methods from a manufacturer's point of view characterize an “internal” view of quality. They are subdivided into personnel-oriented methods and

management-oriented methods.

Modeling any management system (company, project, urban space) as a method of obtaining integral estimates of efficiency for a variety of indicators of various options for management systems is quite simple and economical. The model of the control system takes into account the impact of various input and output parameters that characterize it, the controllability of information flows at various levels of the control hierarchy, as well as the presence of feedback (cybernetic) communication.

When developing a mathematical model for assessing the reliability of the integrated system "Smart House", a unified technique of the general logical-probabilistic modeling method is used, which is characterized by the following main stages:

- analysis of initial data for modeling;
- determination of the structural diagram of the "Smart House" system for the formalized formulation of the problem of modeling the assessment of its reliability and determination of the initial data (probabilistic, time parameters of the elements of the "Smart House" system);
- acceptance and formulation of the main restrictions and assumptions;
- formation of a list of assessed reliability indicators;
- formalized formulation of the problem of modeling and calculation, including the development of a diagram of the functional integrity of the "Smart House" system and setting a logical criterion for its functioning;
- construction of a logical model of the Smart House system performance;
- construction of a computational probabilistic model that allows to quantify the investigated property of reliability of the "Smart House" system;
- calculation of the estimated reliability indicators, analysis of the data obtained.

It is necessary to formulate a logical criterion of functioning (LCF) of the "Smart Home" system, that is, under what conditions the "Smart Home" system performs its target function.

The logical criterion for the functioning of the "Smart Home" system is interpreted as follows, see table.2. the system performs its target function, that is, it is operational when all its subsystems are operational: both the access control and management system, etc.

All structural elements of the Smart Home system are being restored. This means that during the operation of the "Smart House" system, the restoration of elements begins immediately after the moment of their failure and is carried out with a constant intensity, regardless of the number of simultaneously failed elements in the system. This provision is permissible, since in the projected "Smart House" system all elements are highly reliable, and the intensity of their restora-

tion is many orders of magnitude higher than the failure rate. In this case, one temporary failure of two or more elements in a short recovery time interval is extremely unlikely and can be neglected.

Table. 2. Description of the equipment of the "Smart House"

№	Equipment name	Quantity, pcs.	Mean time between failures, h (no less)	Recovery time, h
1	Monitoring and control panel "S2000M"	1	20 000	24
2	Signal and launch unit "S2000-SP1"	39	20 000	24
3	Switching device "UK-VK"	31	20 000	24
4	Terminal device "GSM UO-4S"	1	20 000	24
5	Radio receiving device "Astra-RI-M RPU"	1	20 000	24
6	Radio transmitting device "Astra-RI-M RPKD"	3	20 000	24
7	Access controller "S2000-2"	4	20 000	24
8	"JB-EX06P" exit button	3	200 000	24
9	IO 102-6 detector	3	200 000	24
10	IO 102-14 detector	23	200 000	24
11	Electromechanical lock "CISA 11 931.60.1"	2	150 000	24
12	Electric roller shutter drive "ALTUS RTS"	2	150 000	24
13	Crane with electric drive "JW5025"	9	50 000	24
14	Electromechanical rotary device	1	50 000	24
15	Water leakage sensor "NEPTUNE SW 005"	5	60 000	24
16	Gas leak sensor "COMPUTHERM M5000"	1	60 000	24
17	Contactless reader "S2000-PROXY"	3	60 000	24
18	UPS "SKAT-1200 S"	6	40 000	24
19	Battery 12 V; 1 Ah	3	40 000	24
20	Battery 12 V; 26 Ah	3	40 000	24

21	Fire alarm control panel "Signal 20P"	3	20 000	24
22	IO 409-34 detector ("Ik ar-5A")	30	60 000	24
23	IO 329-2 detector ("Glass-2")	15	60 000	24
24	Fire smoke detector IP 212-78 ("Aurora-DN")	58	60 000	24

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过程运输温度相关货物的自动化
**AUTOMATION OF THE PROCESS TRANSPORTATION
TEMPERATURE-DEPENDENT GOODS**

Shpakovich Dmitriy Alekseevich

Postgraduate

Industrial University of Tyumen

Antipova Alyona Nikolaevna

Candidate of Geological and mineralogical Sciences,

Associate Professor

Industrial University of Tyumen

运输温度相关货物的过程需要按照温度和湿度等特定标准。不遵守运输温度相关的要求条件,通常会导致保质期减少数十倍。这会导致不合格的商品被送到商店的情况。通常它是由于驱动程序故障或制冷技术设备不足而发生的。目前市场上的控制器制冷机组,不足以在运输过程中进行监控。据统计,有12%的运输货物违反运输条件和不符合规定的货物送到商店。

质量运输温度相关货物的改进可能基于旨在排除人为因素的过程运输的自动化。需要创建一个特殊的系统来统一运输的所有技术过程。引入这样的系统可以降低运输公司的成本并减少为运输服务的时间。

关键词: 智能系统, 食品运输, 冰箱, 冷暖设备, 监控过程自动化

Annotation. *The process of transportation temperature-dependent goods need accordance with specific criteria such as temperature and humidity. Non-observance required condition of transportation temperature-dependent, as rule, lead on to reduce sell-by date dozens of times. It can lead to the situation when the non-conforming goods are delivered to the store. As a rule it happened because of drivers failure or insufficient technical equipment of the refrigeration. Controller refrigeration units, currently on the market, inadequate to monitoring during transportation. According to the statistics 12% of goods transported with the violations of conditions of transportation and the non-conforming goods are delivered to the store.*

Improvement of quality transportation temperature-dependent goods may be based on automation of the process transportation aiming to excluding the human factor. It is needed to create special system which united all technological processes of transportation. Incorporation such system can keep transport

company costs' down and cut down the time to service the transports.

Keywords: *intelligence system, transportation of food, refrigerator, refrigerating-heating appliance, automation of monitoring process.*

Transportation temperature-dependent goods is represented technical process, which need rapid monitoring and automation of the process to improve quality of goods' delivery. To identify the process which needed automation firstly, it is necessary to do functional simulation of transportations process temperature-dependent goods. Functional simulation represents compilation of diagram IDEF0 [1,2].

Picture 1: The context diagram of working shipping service temperature-dependent goods. It consist of:

Input:

- cargo data (weight, size);
- order data (loading point, route, unloading point).

Output data:

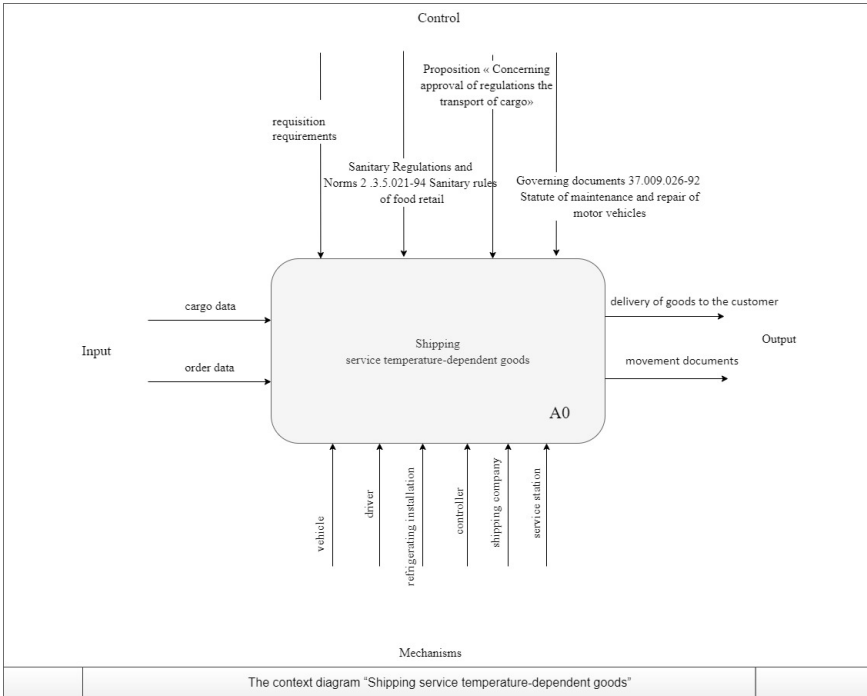
- delivery of goods to the customer;
- movement documents.

Control:

- Sanitary Regulations and Norms 2.3.5.021-94 Sanitary rules of food retail;
- Governing documents 37.009.026-92 Statute of maintenance and repair of motor vehicles [3];
- Proposition « Concerning approval of regulations the transport of cargo» [4];
- requisition requirements

Mechanisms, the implementation and realization

- driver;
- vehicle;
- refrigerating installation;
- controller;
- shipping company;
- service station.



Pic.1 - The context diagram "Shipping service temperature-dependent goods"

It consist of:

All of the transportation process divided in 4 main groups:

- order formation;
- transportation;
- data processing;
- maintenance at service stations, unplanned repairs or planned maintenance.

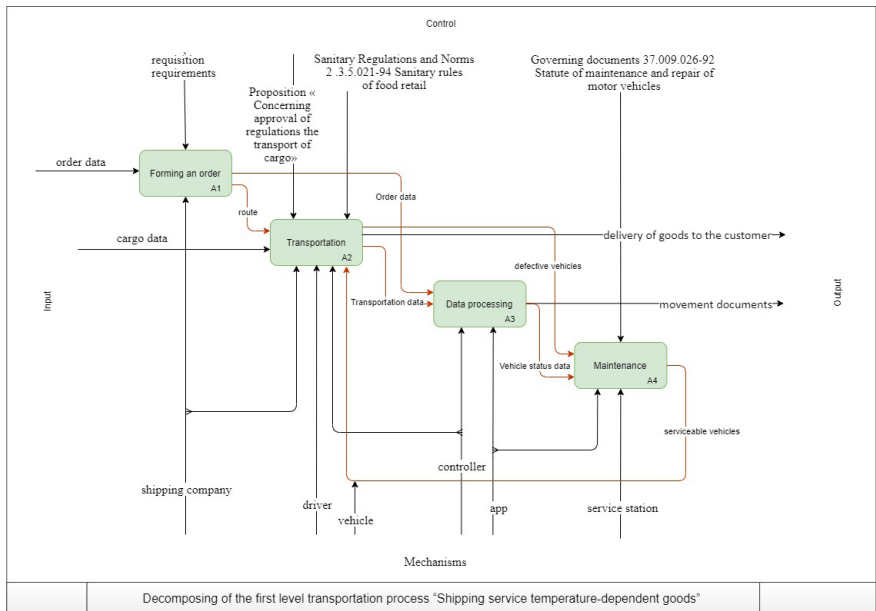
The process of order formation starts from interaction between producers and shipping company. The route of transportation is indicated. The received order is entered by the shipping company into the register, a number is assigned to it. By this identifier, any employee of the shipping company can find out what kind of cargo it is, its weight and other technological information, as well as the time of departure, the allocated transport. The transportation data is transferred for further processing and recording in a data log file.

The transportation process begins after the goods are loaded onto the vehicle. During transportation, the operator controls the entire fleet of vehicles, receives technological reports from each vehicle, monitors and makes important decisions

on scheduling repairs, maintenance and operation of the vehicle fleet [5]. The operator carries out the processing of data during the trip.

This employee chooses the time of maintenance and scheduled repairs of the vehicle fleet, starting, if necessary, the maintenance process at service stations.

Decomposing of the first level transportation process presented on the Picture 2. It consist of detailing actions of order formation, determining the route of transportation, preparation of shipping documents, transportations, data processing and maintenance.



Pic. 2 – Decomposing of the first level transportation process “Shipping service temperature-dependent goods”

The based on the structure were identified main system’s functions [6].

1. Main system’s functions, which need automation of the process:

- tracking of transportation parameters in a refrigerating installation in real time (temperature, humidity);
- monitoring the operating parameters of the refrigeration and heating device in real time (refrigerant pressure, refrigerant temperature, engine speed, errors).

2. Residual functions which need automation:

- monitoring tracking the transportation route in real time (time, speed, transit).
- registration on maintenance.

3. Functions for the future automation:

- predicting faults;
- report listing the parameters of transport to the customer.

4. Functions which not practicable to automation:

- cargo handling;
- transportation.

The developed system will reduce the human factor in setting up and operating the system. Operational control is carried out using a mobile application, with duplication of information in the AWP of each interested participant in a particular transportation [7]. The developed system will reduce the human factor in setting up and operating the system. Operational control is carried out using a mobile application, with duplication of information in the AWP of each interested participant in a particular transportation [7].

The system assumes the replacement of the standard controller of the refrigeration and heating device (in the process of revision of the equipment already in operation or at the time of the assembly of the refrigeration and heating device at the manufacturing works) and consists of software and hardware.

Hardware part consist of:

- microprocessor controller STM32;
- modular block GPRS/LTE;
- modular block GPS/ GLONASS;
- permanent memory store temperature recording device ;
- power contour;
- cabin modular block;
- modular block CANx2, K-line, 1-wire, Bluetooth, RS-485, i2c;
- transistor outputs (N-channel, galvanically isolated) 10 pieces (50V, 50A);
- output 5V, 1A;
- SPI invertible low-current inputs (+/-), with stabilization and overvoltage protection;
- transistor outputs (N-channel, galvanically isolated) 16 pieces (50V, 1200mA);
- 4 relay switch NC и NO with stud;
- 10 analog inputs (+ \ -), with overvoltage protection;
- sensors for temperature, pressure, humidity, Hall sensor.

All controller outputs are protected against short circuit, overload and wire breakage. The device has IP67 waterproof connectors. It has vibration resistance, frost resistance, anticorrosion, tanti-tamper security. Operating temperature range from -40 to +85 C.

The implementation of interaction with the The implementation of interaction with the refrigeration and heating device for the driver is greatly simplified through the development of a mobile application and an intelligent assistant

integrated into it. The mobile application will run on iOS and Android operating systems. A web version of the application has been developed for the operator. The JavaScript language will be used to implement the server-side and interactive elements of the client-side [8].

The application requires the following software to function:

- operating system GNU/Linux;
- JavaScript framework– React;
- data base management system – PostgreSQL.

Through the use of such artificial intelligence methods as decision trees, bagging and random forest in the architecture of the system, the system becomes a model of self-learning artificial intelligence. This will allow, without human intervention, to quickly respond to system changes and implement adaptive control.

The introduction of such a system will lead to an increase in the quality of transportation of temperature-dependent products, a decrease in the costs of transport companies, and also reduce the time spent on servicing transport.

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“能源的演变”：非传统可再生能源的发展对传统电力系统功能的影响：技术和经济问题

"THE EVOLUTION OF ENERGY": THE IMPACT OF THE DEVELOPMENT OF NON-TRADITIONAL RENEWABLE ENERGY SOURCES ON THE FUNCTIONING OF THE TRADITIONAL ELECTRIC POWER SYSTEM: TECHNICAL AND ECONOMIC PROBLEMS

Golubev Vadim Alexandrovich

Student

Verbnikova Victoria Andreevna

Student

Novikova Olga Valentinovna

Candidate of Economic Sciences, Associate Professor

Peter the Great St. Petersburg Polytechnic University

抽象的。过去 20 年来，世界范围内非传统可再生能源的发展趋势让我们有理由考虑每个国家的前景，同时兼顾现有的传统能源供应体系以及其他技术和能源的发展潜力。原则。随着可再生能源发电在能源系统中所占份额的增加，系统稳定性问题出现。神经网络和储能系统的加入可以提高区域能源系统的可靠性和稳定性。这两个系统不仅可以被视为战略投资项目，还可以被视为安全措施。

关键词：能源，可再生能源，稳定性

Abstract. *Over the past 20 years, the trend in the development of non-traditional renewable energy sources around the world gives grounds to consider the prospects for each country, taking into account the existing traditional energy supply system and the potential for the development of other technologies and principles. With the increase in the share of renewable energy generation in the energy system, the problem of system stability appears. The neural network and the addition of a storage system can increase reliability and stability of the regional energy system. Both this systems can be considered not only as strategic investment projects, but safety measures as well.*

Keywords: *energy, renewables, stability*

Introduction

At the International Economic Forum held in June 2021 in St. Petersburg, the following questions were repeatedly raised: what technologies can help traditional energy to move into a low-carbon age, whether the share of renewable sources in the global energy balance will continue to grow, and why the policy of reducing emissions can be a chance for small nuclear and hydro power. The relevance of the study of the risks of renewables development without taking into account the already emerging negative facts of reducing energy security has become even more obvious after the global outages of consumers in the United States occurred in the region with a significant share of energy generation from renewables .In 2019 in California there were a series of blackouts that were caused by undersupplement of electricity. Experts doubt that the main reason is that unstable power output has caused these outages. [1]

Analysis

The authors have studied technological solutions that can reduce the risks of similar situations in any country [2]. Thus, the researchers distinguish two groups of the impact of the development of non-traditional renewable energy sources on the traditional electric power system: the reduction of CO₂ emissions and the changing dynamics of the system, which leads to new stability problems.

Based on data, provided by BP [3] we made a forecast using statistic methods of extrapolation of time distributed data. The results are shown below and shows upstreaming trends for renewables in all over the world.

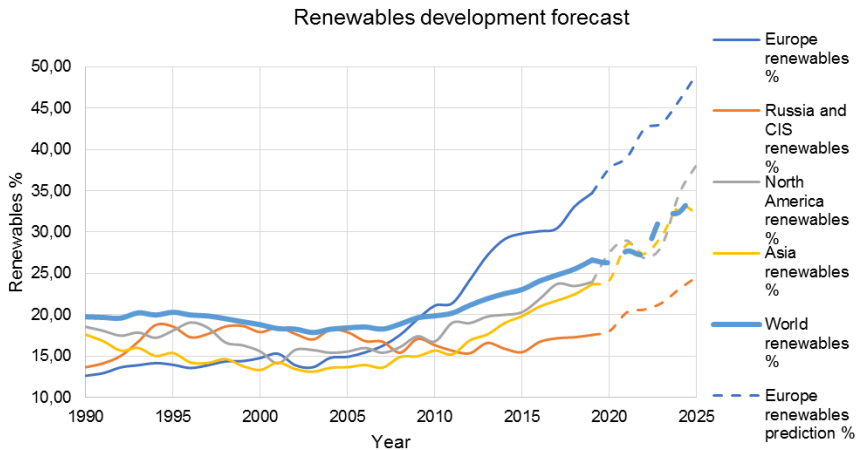


Figure 1 Renewable sources of energy development forecast

Today California’s energy system consists of around 30% of renewable power supply that cause difficulties in terms of operation.

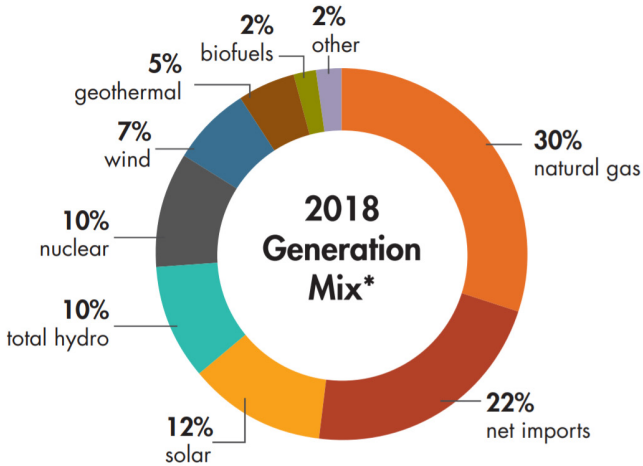


Figure 2 Energy generation in California

The main problem is that renewable sources such a wind and solar are too inconsistent, so it causes power shortage during peaks of a power demand. This leads to the next problem of imported electricity from other states, which in some cases couldn’t be provided in time. This is the main reason of blackouts.

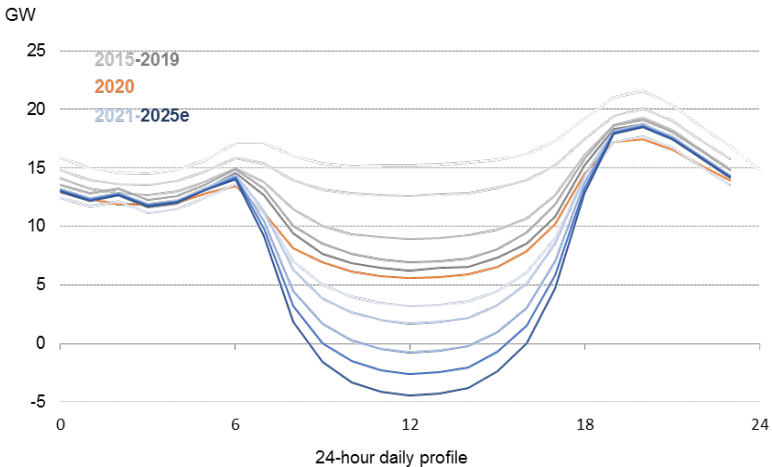


Figure 3 Daily electricity import in California

This leads us to the problem statement, which includes mismatching peaks of energy production and consumption. Moreover, it's not the only problem in the region. On a graph below in figure 2 it is shown that there is a high dependence on import electricity from neighboring states in California, which in some cases can cause a blackout due to a high load.

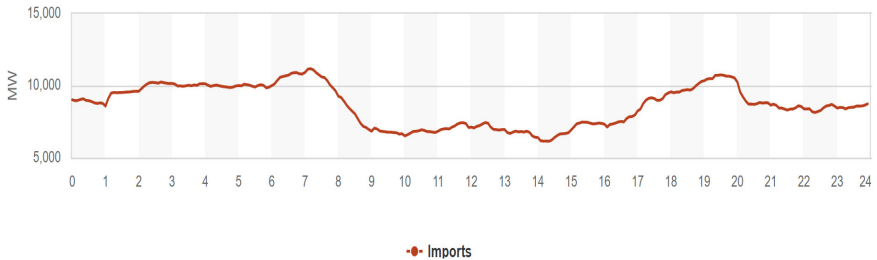


Figure 4 Import capacity throughout a year

Our research was based on a similar article [4] that showcase application of LSTM neural net to long-term time series data. For storage optimization we suggest using particle swarm optimization method that can solve non-linear dependencies that will show up during the problem statement.

We made a research of the Californian whole scale energy market and picked out key features of this region, which we have taken into account as we proceed our solution. Data was provided by EIA [5]

Household optimization model

To solve the problems listed above, we propose a project of installing energy storage systems in houses in the form of lithium-ion batteries, which store excess energy generated by solar power plants during lower consumption hours, mainly from 8 am to 4 pm, to increase the stability of the network operation mode. Energy companies could benefit from this saving a huge amount of money on penalties for outages. Due to this we suggest that installation and some of the operation costs will be covered by this energy companies.

We developed a model for household energy storage optimization. It can be shown that usage of an energy storage can reduce peaks in daily electricity demand. However, this effect can be achieved, if a large number of households (around 40-60%) suggest installation of such systems.

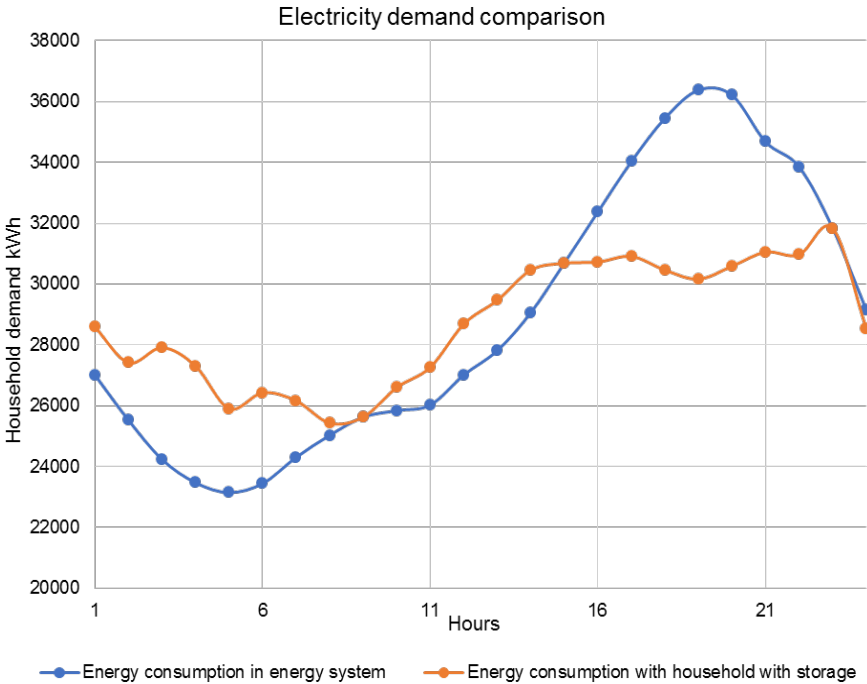


Figure 5 Energy demand comparison

Forecast model

To solve the problem of dependence from supplement from other regions we suggest using a neural network that will allow us to plan more precisely, and because of that minimize the demand in external sources of energy. The model includes different features of the region, for example: average temperature, amount of a sunlight during this period of time and generation output, which was differentiated to types of a power plants.

We made a research that lead us to a conclusion that current prediction energy demand model is not as accurate, so it can potentially cause undersupplement in the region. Using data provided by CISCO we developed a model, using neural networks and in terms of prediction it is much more accurate than the current model. In this case we used a day-ahead data to prove accuracy of the model. Our model has reached a 99% accuracy rate, which makes this model suitable for a future usage in forecasting and planning.

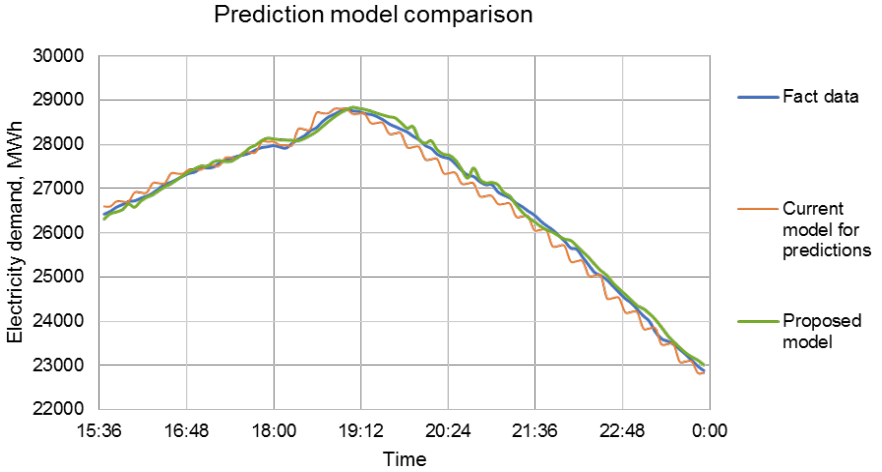


Figure 6 Prediction model comparison

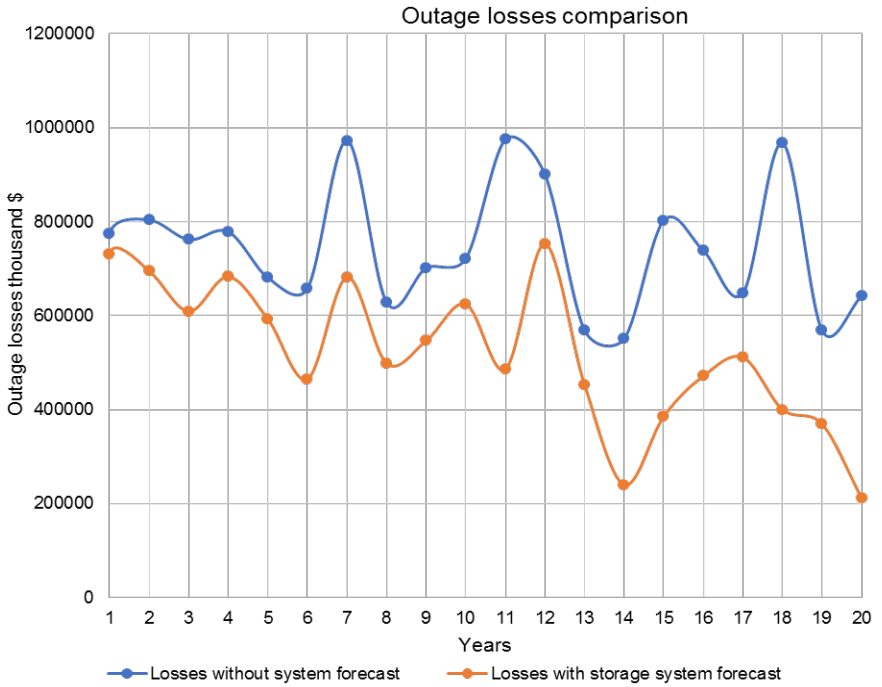


Figure 7 Potential losses of energy companies in California

Nowadays there is a hardware that can be implemented as a solution for household storages that meets needs of a developed project. Usage of artificial intelligence as well as data, that is collected by the software, could expand the current functions making current products more versatile and valuable on a market.

One of the positive sides of such project is to reduce penalties that companies have to pay for outages. In terms of modeling the variety of different scenarios for outages in California region, it can be proposed that there is a valuable effect for companies, so it can force them to invest in energy storage for households that will greatly reduce the cost for citizens.

The project is designed to have an implementation period of 15 years with capital expenses 2,1 billion \$ in total throughout 20 years of simulation. One downside, however, is increased risk of investment, which is hedged by a source investment – WCI initiative and higher profitability index (1,36).

All economic indicators and project characteristics are based on mathematical simulation models of economy with addition of discounting method and were evaluated, using real data as a benchmark for comparison.

The neural network is an originally-developed project, designed to fit California's energy system special features as an example of the potential profit and sustainability of this technology. The joint use of our neural network and the Schneider Electric software will significantly enhance the effect of the implementation.

The economic efficiency of neural networks and storage devices may be calculated as a decrease in predicted consumption of 2%, which leads to everyday savings at least 233,7 thousand \$.

Another beneficial factor, which is qualitative unlike the others, is the increased reliability and stability of the regional energy system. Both the neural network and the addition of a storage system can be considered not only as strategic investment projects, but safety measures as well.

Results

In the next 10 years, international technology transfers will be actively developed due to a common understanding of the mutual impact of environmental friendliness of the economy and energy systems around the world. This study confirms the relevance of the development of storage technologies and operational management of the energy system containing an increasing number of renewable energy sources, as well as operational international cooperation in the energy technology market, where China has long been established as an important participant.

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COVID-19 大流行在我们地球上发生和传播的病因
**THE ETIOLOGY OF THE OCCURRENCE AND SPREAD OF THE
COVID-19 PANDEMIC ON OUR PLANET**

Belashov Aleksey Nikolayevich

Theoretical physicist, author of over 60 inventions, discoveries of five constants, four physical quantities, many mathematical formulas and laws of physics in the field of electrical and magnetic phenomena, electrostatics, electrical engineering, hydrodynamics, astronomy, astrophysics and stellar astronomy.

ORCID 0000-0002-4821-8004

抽象的。这篇文章专门讨论 COVID-19 病毒大流行在我们地球上发生和传播的病因。这种情况是由于科学家之间关于这种自然现象起源的持续争论造成的。一些科学家相信它的实验室起源，而另一些科学家则相反，认为它是一种自然现象。然而，每个人都忽视了我们地球上各种放射性核素引起病毒大流行的主要来源，忘记了病毒感染的出现仅起源于活细胞。迄今为止我们不知道的病毒大流行新毒株的出现是由外层空间和那些最好不要入侵的科学领域的进步和活跃活动引起的，因为这对我们的社会和不可逆转的气候变化对我们的社会造成了后果。星球将不为人知。关键词：COVID-19，病毒的出现，病毒的传播，病毒的相互作用，我们星球生态系统中病毒的存在，病毒防护。

Abstract. *The article is devoted to the etiology of the occurrence and spread of the COVID-19 viral pandemic on our planet. This circumstance is caused due to the ongoing disputes between scientists about the origin of this natural phenomenon. Some scientists believe about its laboratory origin, while others, on the contrary, consider it a natural phenomenon of nature. However, everyone overlooks the main source of the appearance of a viral pandemic arising from various types of radionuclides on our planet, forgetting that the appearance of a viral infection originates only in a living cell. The emergence of new strains of a viral pandemic, hitherto unknown to us, is caused by progress and vigorous activity in outer space and those areas of science that it is better not to invade, since the consequences for our society and irreversible climate changes on our planet will not be known.*

Keywords: *COVID-19, the emergence of viruses, the spread of viruses, the*

interaction of viruses, the existence of viruses in the ecosystem of our planet, protection from viruses.

Since ancient times, mankind has been trying to understand the evolutionary mechanisms of the emergence, spread and interaction of viruses on our planet. Despite all the advances in science, new strains of viruses threaten humanity with major epidemics, just like tens of millions of years ago. However, virologists studying this problem do not take into account one very important circumstance that any viruses can appear and show their activity only in a living cell with the help of radionuclides that have been falling on our planet from outer space for many millions of years.

The causes of radioactive contamination of our planet are radionuclides that have a source of ionizing radiation, containing radioactive material that is formed from cosmic rays of galactic origin coming to the planet Earth from the depths of the Universe, as well as from flares on the Sun. However, living organisms on our planet for millions of years have basically changed and adapted to these radiations.

At this time, the main danger for humanity is the appearance of uncontrolled radioactive radiation emanating from a large number of nuclear reactors of spacecraft, which are located in outer space around our planet. The reasons for this concern are that they are poorly protected from ionizing radiation and, after working out their term, are not utilized, but continue to emit radionuclides that are associated with unnatural protective alloys manufactured on our planet, to the radiation of which many living organisms are not yet adapted.

Moreover, it should be emphasized that the natural infection of our planet by a source of ionizing radiation from cosmic rays of galactic origin or during solar flares leads to local infection of a certain area of our planet. Infection with a source of ionizing radiation from uncontrolled and constant radioactive radiation emanating from a large number of nuclear reactors of spacecraft leads to planetary pandemics, since they constantly spray radionuclides over the entire surface of our planet and it is very difficult to change these circumstances under current conditions.

Many scientists believe that viruses are microscopic pathogens that infect cells of living organisms for self-reproduction and consist of one type of nucleic acid, DNA or RNA, which is protected by an envelope containing proteins, lipids, carbohydrates, or a combination of these. A typical virus ranges in size from 15 to 350 nm, so it can only be seen with an electron microscope.

It should be emphasized that this is an erroneous opinion, since only living cells affected by various radionuclides should be considered viruses, which later become non-cellular infectious agents rooted in a living cell, which is capable of further division and transferring altered information to a new cell. Changes in

living cells by sources of ionizing radiation took place on planet Earth from the beginning of its formation, but in this case, living organisms have not yet adapted to new conditions.

Moreover, the formation of viruses began to occur on our planet, when there were still no living organisms containing nucleic acids, DNA or RNA, containing proteins, lipids, carbohydrates, or their combinations. Isotopes of radionuclides are substances in the atomic nucleus of which there is a different number of neutrons, which during their half-life can penetrate into living cells and produce their mutation, and during division of a living cell, reproduce a renewed living cell in a changed form, together with a pathogenic one.

Having landed on the surface of our planet, radionuclides begin to invade living cells of any organisms and plants, producing mutation and damage to all types of organisms, from plants and animals to bacteria and archaea. In support of this hypothesis, it can be said in the affirmative that the nucleic acids of DNA or RNA could not appear in an inanimate organism, and even more so put on a protein shell.

Moreover, it should be emphasized that the number of radionuclides causing changes in living organisms is estimated at more than 2000 with unstable isotopes and about 270 species with stable isotopes. Depending on the amount of radionuclides that cause changes in living organisms, each type of radionuclide prefers to penetrate and accumulate only in that living cell that perceives it as its own or cannot resist this pathogenic virus. For example, during the half-life of radionuclides, human lungs prefer elements such as plutonium-238, plutonium-239 or uranium-233. The thyroid gland prefers iodine-125 during the half-life of radionuclides. During the half-life of radionuclides, the kidneys prefer cesium-137, and so on...

Among the many negative factors and processes that can affect the human body and its healthy functioning, the radiation field and the effect of ionizing substances on the tissues and organs of the human body play an important role. Radiation exposure or contact with many radionuclides contained in the atmosphere of our planet through contact with human molecules and tissues can lead to multiple biological and chemical mutations and cause dangerous diseases. It should be said that a person is constantly in conditions of radiation influence. However, if natural streams of ionizing substances do not have a negative impact and can rarely cause the development of any pandemics or other somatic ailments, then artificial contamination with human-made radionuclides is extremely dangerous and negative. In this case, with the appearance of uncontrolled radioactive radiation emanating from a large number of nuclear reactors of spacecraft that are located in outer space around our planet, this process becomes irreversible.

In conclusion, we can say that it is very difficult to protect against uncontrolled

radioactive radiation emanating from a large number of nuclear reactors of spacecraft that are located in outer space around our planet. However, it is even more difficult to make a universal vaccine against various types of pathogenic viruses, since they are taken in different ways in different organisms. Pathogenicity is the ability of microorganisms (viruses, chlamydia, mycoplasma, rickettsia, bacteria, fungi) to cause an infectious process, that is, to penetrate the human or animal body, use it as an environment for their life and reproduction and cause pathological changes in organs and tissues. For example, it may depend not only on the type of living organism, on the latitude where it is located, but also on the living conditions of these organisms, their way, behavior, nutrition or interaction with other types of living beings.

In my opinion, we need to gradually get rid of uncontrolled radioactive radiation emanating from a large number of nuclear reactors of spacecraft that are located in outer space around our planet, or move to new safer technologies that do not create such problems for all of humanity, which will be difficult to get rid of. Such technologies already exist, but if this is a costly undertaking, then it is necessary for all countries using spacecraft to unify all alloys and materials used for nuclear reactors used in outer space.

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边界条件中具有特征参数的 Sturm-liouville 算子二次铅笔的 Ambarzumyan 型
定理

**AMBARZUMYAN TYPE THEOREM FOR A QUADRATIC PENCIL
OF STURM-LIOUVILLE OPERATORS WITH EIGENPARAMETER
IN THE BOUNDARY CONDITIONS**

Babajanov B. A., Babajanov A.B., Matkarimov M.R., Yakubov H.E.
Urgench State University

注解。在本文中,将常规 Sturm-Liouville 问题的经典 Ambarzumyan 定理
扩展到具有依赖于边界条件的谱参数的能量相关的 Sturm-Liouville 问题。

关键词: Sturm-Liouville 算子的二次铅笔; 唯一性定理; 安巴祖米扬定
理; 逆问题; 特征值的渐近。

Annotation. In this paper, the classical Ambarzumyan's theorem for the
regular Sturm-Liouville problem is extended to energy-dependent Sturm-Liouville
problem with a spectral parameter depending on the boundary condition.

Keywords: Quadratic pencil of Sturm-Liouville operators; uniqueness
theorem; Ambarzumyan's theorem; inverse problem; asymptotic of eigenvalues.

Introduction

In 1929, Ambarzumyan investigated the Sturm-Liouville operator with Neu-
mann boundary conditions, and proved that if its spectrum consists of zero and
infinitely many other square integers, then the potential is zero. From a historical
viewpoint, the work of Ambarzumyan [1] was the first paper in the theory of inverse
spectral problems associated with Sturm-Liouville operators. Ambarzumyan's
theorem was generalized in many directions [2-6]. In [7], Ambarzumyan's theo-
rem was extended to the quadratic pencil of the Sturm-Liouville operators with
spectral parameter contained in the boundary conditions by adding an additional
condition for the potential. Boundary value problems with spectral parameter in
boundary conditions have received much attention in the recent research literature
[8-10]. Various physical applications of such problems were found in [11].

In this paper we prove Ambarzumyan's theorem for the quadratic pencil of
the Sturm-Liouville operators with spectral parameter contained in the boundary
conditions without any additional condition for the potential.

Quadratic pencil of the Sturm-Liouville operators arises in various models of
quantum and classical mechanics. For instance, to this form can be reduced the

corresponding evolution equations (such as the Klein–Gordon equation [12, 13]) that are used to model interactions between colliding relativistic spinless particles. Another typical example is related to vibrations of mechanical systems in viscous media, see [14].

We consider the boundary-value problem

$$\begin{cases} -y'' + q(x)y + 2\lambda p(x)y = \lambda^2 y, & 0 \leq x \leq \pi, \\ y(0) + \lambda(h - hy(0)) = 0, & h \in \mathbb{R}, \\ y'(\pi) = 0 \end{cases}$$

where λ is a spectral parameter and the functions $p(x) \in C^1[0, \pi]$ and $q(x) \in C[0, \pi]$ are real.

We denote by $\lambda_n, n \in \mathbb{Z}$, the spectrum of the problem (1). It is well known [15] that the sequence $\{\lambda_n : n = 0, \pm 1, \pm 2, \pm 3, \dots\}$ satisfies the classical asymptotic form

$$\lambda_n = n + \frac{b_1(\pi)}{\pi n} + \frac{\gamma_n}{n},$$

where $b_1(\pi) = \int_0^\pi [q(x) + p^2(x)] dx$ and $\sum_n \gamma_n^2 < \infty$.

Let $\{n : n = 0, \pm 1, \pm 2, \dots\}$ be spectrum of the problem

$$\begin{cases} -y'' = \lambda^2 y, & 0 \leq x \leq \pi, \\ y'(0) + \lambda(h - hy(0)) = 0, \\ y'(\pi) = 0. \end{cases}$$

The main results of this paper are as follows.

Theorem. If $\lambda_n = n, n \in \mathbb{Z}$ then, $q(x) = p(x) = 0, \forall x \in [0, \pi]$.

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