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SYNERGY AND INTEGRATION

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上合组织国家的科学研究：协同和一体化
国际会议

参与者的英文报告

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

Part 2: Participants' reports in English

2019年2月26日，中国北京
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Materials of the International Conference
"Scientific research of the SCO countries: synergy and integration" - Reports in English

(February 26, 2019. Beijing, PRC)

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

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These Conference Proceedings combine materials of the conference – research papers and thesis reports of scientific workers. They examines tecnical and sociological issues of research issues. Some articles deal with theoretical and methodological approaches and principles of research questions of personality professionalization.

Authors are responsible for the accuracy of cited publications, facts, figures, quotations, statistics, proper names and other information.

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Foreword

We thank all participants of our conference "Scientific research of the SCO countries: synergy and integration" for the interest shown, for your speeches and reports. Such a wide range of participants, representing all the countries that are members of the Shanghai Cooperation Organization, speaks about the necessity and importance of this event. The reports of the participants cover a wide range of topical scientific problems and our joint interaction will contribute to the further development of both theoretical and applied modern scientific research by scientists from different countries. The result of the conference was the participation of 56 authors from 7 countries (China, Russia, Uzbekistan, Kazakhstan, Azerbaijan, Tajikistan, Kyrgyzstan).

This conference was a result of the serious interest of the world academic community, the state authorities of China and the Chinese Communist Party to preserve and strengthen international cooperation in the field of science. We also thank our Russian partner Infinity Publishing House for assistance in organizing the conference, preparing and publishing the conference proceedings in Chinese Part and English Part.

I hope that the collection of this conference will be useful to a wide range of readers. It will help to consider issues, that would interest the public, under a new point of view. It will also allow to find contacts among scientists of common interests.

Fan Fukuan,
Chairman of the organizing committee of the conference
"Scientific research of the SCO countries: synergy and integration"
Full Professor, Doctor of Economic Sciences,
member of the Chinese Academy of Sciences

前言

我们感谢所有参加本次会议的"上海合作组织国家的科学研究：协同作用和整合"，感谢您的演讲和报告。代表所有上海合作组织成员国的广泛参与者都谈到此次活动的必要性和重要性。参与者的报告涵盖了广泛的主题性科学问题，我们的联合互动将有助于不同国家的科学家进一步发展理论和应用的现代科学研究。会议结果是来自7个国家（中国，俄罗斯，乌兹别克斯坦，哈萨克斯坦，阿塞拜疆，塔吉克斯坦，吉尔吉斯斯坦）的83位作者的参与。

这次会议的召开，是学术界，中国国家权力机关和中国共产党对维护和加强科学领域国际合作的高度重视的结果。我们还要感谢我们的俄罗斯合作伙伴无限出版社协助组织会议，准备和发布中英文会议文集。

我希望会议的收集对广大读者有用，将有助于在新的观点下为读者提供有趣的问题，并且还将允许在共同利益的科学家中寻找联系。

范福宽，
教授，经济科学博士，中国科学院院士，会议组委会主席"上合组织国家科学研究：协同与融合"

在水泥工业中建立数字工业企业的概念
THE CONCEPT OF ESTABLISHING
A DIGITAL INDUSTRIAL ENTERPRISE
IN THE CEMENT INDUSTRY

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注解。 本文讨论了水泥企业现状和发展战略的各个方面。 分析制定了工业企业的核心特征。 特别关注基于"工业4.0"技术实施数字工厂概念。 作者强调了数字技术项目实施后水泥企业运作主要指标的积极变化意义。
关键词：发展战略，数字经济，数字企业，网络物理系统，数字化生产，水泥工业。
Annotation. *The article discusses aspects of the current state and development strategy of cement enterprises. Key characteristic of an industrial enterprise are analysed and formulated. Particular attention devoted to the implementation of the digital plant concept based on the technologies "Industry 4.0". The author emphasises on the significance of positive changes of the main indicators of the functioning cement enterprise after the implementation of digital technology projects.*
Keywords: *development strategy, digital economy, digital enterprise, cyber-physical systems, digital production, cement industry.*

Cement industry occupies an important place in the structure of the national economy of the Russian Federation, being the main part of the investment and construction complex and part of the mining industry. The basis of all production processes is an integral part of the technological process - the extraction and primary processing of limestone in the quarry of a cement enterprise. The volume of production of cement and products based on it are bright indicators of the current state in the construction sector, allowing to make preliminary short-term forecasts for the commissioning of real estate [2].

Currently in the Russian Federation there are 58 full-cycle cement plants and 7 grinding plants with a total capacity of 104.3 million tons of cement per year. Of

these, 5 enterprises in 2015-2017 stopped the production of cement with uncertain future prospects for the resumption of work [1].

Compared to 1990, significant changes occurred in the composition of the process equipment, primarily due to the introduction of dry lines and the decommissioning of inefficient morally and physically obsolescent lines equipped with shaft furnaces and outdated wet and dry production lines.

The volume of cement production in 2018 amounted to 53.6 million tons, slightly worsening the same indicator last year - 54.6. In general, the decline in the volume over the past five years amounted to 22.2 percent.

In the current situation, not only the transition to new technologies, but also the choice of a strategic decision on enterprise management is necessary to increase the volume of cement production. All this in turn will significantly improve both the market attractiveness and competitiveness of the enterprise [4].

Market strategies of cement companies may be based on internal problems and growth points, or on external circumstances of competition with other market participants and the lack of internal reserves for growth. So, one of the options for the company's strategy of behavior in the market is the preservation of the market share during the market stagnation, which was observed in 2015-2017, in essence, the preservation of the level of sales volumes. Another version of the market strategy is to increase the margins of the cement business as a result of optimizing the loading of more efficient capacities and the redistribution of supply volumes to more promising regions [7]. But it is precisely the course towards digitalization and the fourth technological revolution, which is actively supported by the governments of many countries, is the fundamental vector for choosing a long-term strategy. Creating an innovative industrial enterprise based on the digitalization of factories and customer relations is a strategic vector of financial stability. The introduction of the digital economy in the industry is associated with close cooperation with financial institutions, which together with social networks and digital aggregators (Uber, Yandex, Alibaba, etc.) are the locomotives of the digital movement, investment drivers and, most importantly, mentors accompanied by digital projects on real industrial enterprises. Digital production is, firstly, changing the approach to work from manual or semi-automatic registration and data processing to automatic collection and analysis of large amounts of data using IT technologies, secondly, from the sole expertise of a narrow specialist to the joint work of cross-functional groups, thirdly, from people management to chain management. The key components of a digital industrial enterprise are presented in tab. 1

<div align="right">*Table 1*</div>

Key features of the digital industrial enterprise

Main components	Perspective technologies and directions
Computerization and networking	• Providing the means for digital control of all major components of production (sensors, process control systems) • Combining in a common environment all the equipment for fixing the current environment and organizing the control action on the surrounding technical systems • Providing operational interaction using mobile funds (mobilization)
Storage data	• Ensuring an active semantic memory data production processes with discreteness up to a second
Data processing and integration of all processes	• Intellectual interpretation of environmental information; • Integration of digital technologies throughout the product creation chain; • Integration of partners (customers and suppliers) directly into the Company's processes (profile management, B2B, ...)
Digital control models	• Formation of virtual reality control through modeling and simulation of processes with different input parameters and historical data
Equipment and products - components of corporate management system	• Production equipment and products actively manage their production and logistics processes (planning and adapting their behavior according to the environment)

The concept of a digital cement enterprise has become a fundamentally new word in the field of strategic development [6]. Formation of an enterprise of this type includes several stages, which are discussed in Table. 2

<div align="right">*Table 2*</div>

The main stages of the formation of a digital enterprise

Main steps	Key results
1. Organization of automated (with human participation) monitoring and control of technological processes of production (APCS)	Management of key process operations
2. Organization of on-line monitoring and dispatching of all (critical) production facilities (equipment, workplaces of the main workers, service departments, etc.)	Real-time production management through standard workflows
3. Formation of a single digital information space of the enterprise for all production processes –complex automation of all end-to-end chains of business processes (integration of all systems, data storage with different levels of detail and discreteness, the use of predictive analytics, operational management of production, etc.)	Supply Chain Management
4. The introduction of new management models based on the support of the life cycles of processes	Service management as an integral part of production

Automation on cement production is subject to all technological processes. The basis of digitalization is artificial intelligence and machine learning technologies [3]. Thus, already at the quarries, unmanned and / or self-managed quarry equipment is being introduced into the process of raw materials production and, for example, the first project in Russia and the CIS, the Intellectual Career Project (introduced by SIBENCO in the "Chernogorsky"open pit mine, the Republic of Khakassia) [8]. At the same time, the automatic shipment of products to the consumer from the factory "at given coordinates" is a matter of the near future. Databases of customers, which will become the prototype of the circulation of artificial intelligence for the formation of a portrait of the buyer and invoicing in accordance with the specification of the order, payment discipline of the client, etc. have been already formed. The basis of customer relations is an algorithm for bidding and transparent pricing. Another element of the enterprise's digitalization is the introduction of mechanisms and sensors for monitoring the production and shipment of products — cyber-physical systems [5]. The quintessence of cement enterprise digitalization is the implementation of prescriptions based on the predicted behavior of the market, customers, and the state. In this regard, the digitalization of the enterprise smoothly and inevitably turns into the digitalization of the enterprise's relations with the outside world - primarily with customers, as well as with suppliers, construction organizations, financial institutions, the state and other market participants.

Thus, the concept of a digital enterprise [9–11] is a combination of complementary approaches that form the totally different quality of enterprise processes. The introduction and active use of digital simulation models of various processes, operational management of the production process and technological equipment, the accumulation of knowledge, experience and results of activities will ensure a high level of labor productivity, the possibility of remote collaboration, full cost control and predictability of all processes. The implementation of projects for introducing digital technologies of platform solutions may lead to the following changes in 2035 (probably earlier according to all technological forecasts) table 3.

Targets in the development of the cement industry in the Russian Federation by 2035

Indicators	Unit of measure	2017	2035
Specific fuel consumption per 1 ton of clinker	kg t.	163	95
Specific consumption of el. energy per 1 ton of cement	kWh / t c.	125	70
Clinker factor	%	90	50
The percent of man-made waste in the raw material mixture	%	25	55
Production per worker	thousand tons	1,7	10,0
CO_2 emissions per 1 ton of clinker	kg	560	290
Percent of alternative fuels	%	1,5	40

To successfully implement the above concept, it is necessary to assess the current level of maturity of the main components of a digital enterprise and develop a roadmap for the implementation of a portfolio of organizational and IT projects aimed at the phased introduction and development of digital approaches. It is necessary by a joint team with the functional departments of the enterprise to determine the necessary depth of digital transformations for each of the processes and to form an action plan for their implementation. Undoubtedly, essential organizational changes are needed to transform a manufacturing enterprise with a classical management scheme into a digital reality. Any technological change must be supported by organizational changes. At the same time, IT technologies from tools become full-fledged elements of a new digital management system, while people and culture become the key success factor for digital transformation of an enterprise.

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在非法活动中使用电子支付系统的风险
RISKS OF USING ELECTRONIC PAYMENT SYSTEMS IN ILLEGAL ACTIVITIES

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注解。 在全球化的背景下，电子支付系统是发展的关键技术之一。 它们在洗钱犯罪收益中的使用对全球经济产生了不利影响。 本文介绍了犯罪收益合法化的三阶段模型，其中考虑了电子支付系统固有的其他风险来源。 描述了使用电子支付来增加洗钱收益风险的基本操作。 提供了通过电子支付系统尽量减少洗钱风险来源的建议。
关键词: 电子支付系统，电子货币，非法金融交易，风险来源，犯罪收益合法化。

***Annotation.** In the context of globalization, electronic payment systems are one of the key technologies of development. Their use in the laundering of criminal proceeds adversely affects the global economy. The article presents a three-phase model for the legalization of criminal proceeds, within which additional sources of risks inherent in electronic payment systems are considered. The basic operations with an increased risk of laundering of proceeds from crime using electronic payments are described. Recommendations on minimizing the sources of risks of money laundering through electronic payment systems are given.*

***Keywords:** electronic payment systems, electronic money, illegal financial transactions, sources of risks, legalization of criminal proceeds.*

In modern market conditions, Russia is in the process of global reform of the payment system with a simultaneous process of automating human activity and the development of computer technology. Electronic payments crowd out customary payments in cash and non-cash form, which helps to reduce distribution costs.

The global market of electronic payment systems is developing rapidly and has become the object of close attention for the criminal environment, which opens up a new platform for the implementation of schemes for the legalization of criminal proceeds. Therefore, identifying and minimizing the sources of money laundering risks through electronic payment systems is an urgent problem, which explains the necessity and expediency of the study.

The use of electronic payment systems in illegal activities due to their fea-

tures. The lack of direct client interaction with employees of financial monitoring agents, the minimum set of requirements for identifying clients creating e-wallets, all this helps create the most favorable conditions for the use of electronic payment systems in order to launder criminal proceeds. With the development of Internet technologies, it is becoming more and more difficult to track the chain of crime, thus electronic payments cause great interest among criminals.

In addition to the problems of client identification in the absence of direct contact between the client and the financial monitoring agent, the problematic points are also:

- lack of legal regulation when encrypting global information;

- lack of law enforcement practice of resolving disputes during the electronic customer service;

- lack of a unified standard for financial documents in electronic form;

- lack of sufficient regulation at the legislative level of currency control when using electronic payment systems;

- lack of proper controls and oversight of cryptocurrency services;

- lack of preventive measures in most areas of electronic payment systems.

The presence of such an abundance of deficiencies entails the risks of money laundering, which, in turn, can cause an increase in the risk of loss of reputation for credit institutions, adversely affect currency exchange rates and interest rates, and generally increase the amount of "dirty" money in a country's economy, which can contribute to the disruption of the economy, create a threat to both national and international security.

The process of money laundering is a complex chain of actions that allow to legalize money obtained by illegal means. With the development of technology, money laundering is also progressing. As a rule, in the end, criminal income is cashed out, since it is extremely difficult for law enforcement agencies to identify the source of cash.

The cash withdrawal process itself involves legal activities involving the transfer of non-cash cash to cash.

In turn, "illegal cash withdrawals" are accompanied by the concealment of persons interested in receiving cash, as well as those who develop and maintain cash withdrawal schemes and receive income from it in the form of certain percentages of the amounts transferred from non-cash to cash [1].

The most common scheme for the legalization of criminal proceeds is the three-phase model, which is widely used in international practice. This model includes three main stages:

• accommodation;

• stratification;

• integration.

These stages can be carried out simultaneously or partially overlap each other — this depends on the developed legalization mechanism and the requirements of the criminal organization.

The first stage of this model implies that the proceeds of crime are placed in mobile financial instruments. This stage is the most difficult to implement.

At the stage of stratification, criminal proceeds are detached from their sources of origin through numerous financial transactions. It is worth noting that with a successful first stage, the further actions of criminals are much more difficult to trace, since many financial operations overlap each other, thus it is more difficult for law enforcement agencies to track down the illegal motive of the operation itself.

At the final stage of this scheme, the process of money laundering itself takes place. So, with a successful phase of separation, persons involved in the legalization of criminally acquired property create the appearance of the legal origin of their wealth, introducing criminal money into the economy as honestly earned income. It should be understood that if during the period of the first two stages it was not possible to determine the illegality of funds, then at the integration stage, it is possible to detect criminal proceeds only through interdepartmental cooperation.

It should be understood that the nature of electronic payment systems creates additional difficulties at each stage of legalization. Thus, for each of the stages, there are sources of additional risk characteristic of electronic payment systems, presented in Table 1 [2].

Table 1 - Sources of risk of money laundering in the context of the implementation of the scheme for the legalization of criminal proceeds using electronic payment systems

Stages	Type of risk associated with the use of electronic payment systems
Accommodation	Client anonymity on some sites and in some electronic payment systems
	The lack of personal contact between agents of financial monitoring with clients, the difficulty of determining the accuracy of client identification
	The possibility of multiple registration of one client
	Remote access to the electronic payment system from anywhere in the world
	Relative "anonymity" of some methods of making payments (using prepaid cards)
Stratification	The speed of payments, which is a distinctive feature of electronic payment systems
	The global nature of operations, allowing to be outside the state borders, which greatly complicates the activities of financial intelligence units and law enforcement agencies
	The volume of transactions and amounts. It is difficult for providers of electronic payment services to determine the criteria for financial monitoring, since due to the ease of use of electronic payment systems, the number of transactions can be very large, which forces us to resort to other control measures.
	Lack of personal interaction. Since when using electronic payment systems, customer interaction is minimal, internal control is less effective.
	The absence or non-compliance of control measures by some electronic payment service providers
Integration	The possibility for a person who launders money to purchase any expensive goods and services in different parts of the world

As already mentioned, at the integration stage it is much more difficult to determine the legality of the origin of funds, if at the stages of placement and stratification the involvement of funds in "dirty" money was not revealed. It is worth considering the main operations that are operations with a high risk of money laundering using electronic payment systems and can help law enforcement agencies in identifying their sources of origin in the future:

- opening a client account in the electronic payment system in one country and further regular authorization in other countries;

- regular transfers to the client's account from third parties of funds from other electronic payment systems without any visible connection;

- regular customer purchases of expensive prepaid cards, the origin of funds for which it is difficult to track;

- the client uses credit cards registered in another country (special control over countries that do not comply with the FATF requirements);

- purchased goods are regularly shipped to another country;

- receipt of money on an e-wallet from countries that are not cooperating with the FATF or are on the black list;

- client's country of origin does not cooperate with FATF

- unexpectedly large amount of cash on a newly opened commercial Internet resource;

- unduly overpriced prices for goods purchased at auction or online auction, which may indicate collusion of the buyer and seller.

The FATF international organization defines to organizations a number of basic duties, which, first of all, include due diligence of customers, both new and existing, timely notification of supervisory authorities of all suspicious transactions, including those conducted through electronic payment systems [3].

Risk management in organizations is carried out by internal control services; accordingly, their methodological support should be adapted to interact with electronic payment systems, and all existing sources of income laundering risk should be considered accordingly.

You can offer several basic approaches to reducing the risk of using electronic payment systems for illegal purposes.

First, to minimize the risks of using electronic payment systems, legislative steps are necessary. One of the possible steps to improve legislation can be the introduction of mandatory identification of all users of means of payment and an attempt to create an extrajudicial mechanism for influencing electronic means of payment, whose details are located on the Internet. As well as the development and implementation of regulatory documents that will reflect the requirements for organizations aimed at minimizing the risks of using electronic payment systems in illegal activities.

Secondly, it is necessary to improve the system of internal control in credit and financial organizations whose activities are related to the use of electronic payment systems. Its improvement is possible by studying modern software products and mechanisms that will contribute to controlling the use of electronic means of payment for illegal purposes. It is also worth exploring and implementing the most relevant technologies for controlling the use of electronic payment systems for illegal purposes successfully used by foreign countries. The goal of this approach is to adapt the internal control system, which will include specific aspects related to the nature of electronic payment systems. For its successful implementation it is necessary to develop and implement recommendations on the adaptation of internal control under the conditions of use of electronic payment systems, including additional functions for the internal control service and requirements for staff

members in this service. Organizations, in turn, must necessarily follow the recommendations of the supervisory authority and supplement their internal control rules with new tasks related to improving the quality of risk management in the context of using electronic payment systems.

Thirdly, it is necessary to strengthen the influence of regulatory authorities in the framework of minimizing the sources of risks associated with the use of electronic payment systems for illegal purposes. The purpose of this recommendation is to enhance the role of regulators in minimizing the risks associated with the possible use of electronic payment systems in illegal activities. The supervisor needs to create a separate unit, the main functions of which will be the development of guidelines for financial monitoring agentsaimed at reducing the sources of risks associated with the possible use of electronic payment systems in illegal activities based also on current legislation. It is also necessary to have a group of inspection bodies following the implementation of recommendations in the area of minimizing the risks of using electronic payment systems in illegal activities. Agents, in turn, must follow the recommendations of the supervisory authority and improve the already existing risk reduction system by applying accumulated experience in using electronic payment systems and reducing the risk of their use in illegal activities.

The development and adoption of appropriate measures to control and regulate electronic payment systems, the development of necessary recommendations, taking into account their characteristics, as well as the strengthening of control by regulatory bodies taking into account the specifics of functioning of electronic payment systems, will significantly reduce their use for illegal purposes.

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俄罗斯能源供应合同法律规制的特点
FEATURES OF LEGAL REGULATION
OF THE ENERGY SUPPLY CONTRACT IN RUSSIA

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注解。 文章确定了与消费者签订的能源供应合同的主要特征。 作者确定了该领域立法监管的问题，确定了能源供应合同与供应合同之间的差异。
关键词：能源供应合同，电力购销合同，供应合同，用户，能源供应组织，保证供应商，公民 – 消费者。

Annotation. *The article identifies the main features of the contract for energy supply, concluded with the consumer. The authors identified the problematic aspects of legislative regulation in this area, determined the differences between the energy supply contract and the supply contract.*

Keywords: *energy supply contract, electric power purchase and sale contract, supply contract, subscriber, energy supplying organization, guaranteed supplier, citizens-consumers.*

Russia is one of the leading energy powers in the world. It has considerable reserves of energy resources, huge capacities for their processing and transportation. In this regard, the task of research and improvement of the legal framework aimed at the dynamic development of the energy industry in Russia, ensuring the balance of interests of all participants in public relations in the energy sector, competent use of resources for economic development, and strengthening the export potential of the country, acquires special relevance and significance.

One of the industries of interest in the legal space is electric power. The relevance of the study of contractual legal relations in this industry is determined by the fact that Government Resolution No. 526 of July 11, 2001 approved the main directions of its reform, which consisted in the separation of some important functions in this

area, namely: power transmission and operational dispatch management, production and sale of electricity, repair and service. So instead of the former vertically integrated companies that performed these functions, specialized structures were created. Among them are generating, power sales, network, uniting the main and regional distribution networks, the subjects of operational dispatch management [6, p.47].

Considering the delivery of electric energy from the producer to the end consumer, it is important to note that a certain structure of contractual relations is taking shape. The "producer-consumer" chain has the following sequence: the producer sells electrical energy to a wholesale market entity, which then sells it to the final consumer. The network organization provides the delivery of energy from the seller to the buyer. The coordination of the technological process of generation, transmission and consumption of electric energy is carried out by the subjects of operational dispatch services.

In this regard, special attention to legal relations in this area is explained by the significant specificity of the industry. Opportunities for contractual cooperation between electric power industry entities are often limited by mandatory prescriptions of legislation. At the same time, it appears that the effective functioning of the industry is based on a combination of administrative law and civil law regulation methods [7, p.410]. We believe that the most important components of the solution to the problem of determining the optimal model of relations in the electric power industry are finding a certain balance in the application of these methods.

Referring to the provisions of the Civil Code of the Russian Federation related to the transfer of electrical energy, it is worth paying attention to the fact that they are essentially aimed at regulating the relations of the retail market. In this regard, we consider the basic contractual construction, reflected in §6 ch. 30 of the Civil Code of the Russian Federation, such as an energy supply contract. In the structure of contractual relations of the industry in question, this agreement acts as the main agreement on the basis of which electricity is sold.

According to paragraph 1 of article 539 of the Civil Code of the Russian Federation, an energy supply agreement is recognized as an agreement when one party (the energy supplying organization) assumes the obligation to transfer energy to the other party (subscriber (consumer)) via the connected network, while the subscriber (consumer) receives oneself the duty to pay for the ¬ taken energy. In addition, the subscriber is obliged to comply with the contractual mode of its consumption, to ensure the safety of operation of the energy networks under his jurisdiction and the operability of the devices and equipment used by him that are related to the terms of the contract.

An analysis of the state of knowledge of the research topic suggests that an energy supply contract in the scientific literature qualifies as a type of sales contract. This is based on a number of qualifying features inherent to it, to which the civilist scientist, the doctor of law, professor V.V. Vitryansky. This is the specificity of the subject of this contract - electrical energy and the method of fulfilling the obligation caused by this specificity - the transfer of energy to the subscriber through the connected network [5, p.40].

In addition, a separate type of contract of sale and purchase of energy supply is assigned in accordance with clause 5 of Art. 454 of the Civil Code. However, in accordance with the provisions of the Federal Law of March 26, 2003 No. 35-ФЗ "On Electric Power Industry" and the Basic Provisions for the Operation of Retail Electricity Markets, approved by the Decree of the Government of the Russian Federation of 04.05.2012 No. 442, these contracts should be considered as independent tools for regulating the turnover of electric power. energy in retail markets. They differ in the scope of rights and obligations of the parties. Thus, under the purchase and sale (supply) agreement, the guaranteeing supplier undertakes to supply (supply) electric energy to the buyer. As for the energy supply contract, in this case, this obligation is complemented by one more: the supplier assumes the settlement of relations connected with the operational dispatch management and transmission of electrical energy. In relation to the contract of sale, the buyer has the right to independently regulate relations in the operational dispatch management and the provision of services for the transmission of energy over the networks by concluding the necessary contracts. The question of the relationship of these contracts allowed paragraph 4 of Art. 539 of the Civil Code of the Russian Federation, which establishes the subsidiary application of the norms of the Code to the relationship of the supply of electrical energy.

Of course, the formation of the optimal structure of contractual relations depends largely on the peculiarities of its legislative regulation. However, to date, there are gaps and inconsistencies in the regulations governing relations in the power industry. This is due to the fact, for example, that the concepts of "supply" and "purchase and sale" are often used as equivalent. However, such a statement of the question is not always correct and is inconsistent with previously adopted legislative acts (including the Civil Code of the Russian Federation), which leads to difficulty in applying law. Therefore, one should distinguish between the energy supply contract and the supply contract (purchase and sale). If we talk about the first, then the object of legal relations is energy (electric, thermal), which is transferred to the consumer only through the attached network, while in the supply contract there are other resources and other goods, the transfer of which to the buyer (consumer) through the connected network is only one of the possible ways of fulfillment of obligations. For example, oil or petroleum products can be delivered to the buyer in tanks, and gas - in cylinders. Such relationships will be governed by the supply or sale contract.

It is important to understand that an energy supply contract, being a separate type of sales contract, cannot be recognized as a kind of supply contract. This can be explained by the fact that the qualifying feature of the latter is not the special properties of the product, whereas the unique specifics of the product - energy as properties of matter - to do a certain work - serve as a basis for separating the energy supply contract into a separate type of sales contract.

Thus, the power supply agreement covers only those legal relations that are formed when consumers are supplied via the connected network with electrical or thermal energy. As for the other contracts, the subject of which is the supply

of consumers through the attached network with gas, oil and petroleum products, water and other goods, they are not formally related to power supply contracts.

Another criterion that allows determining the scope of the energy supply contract is the subject composition of the relations regulated by it: the person consuming energy (consumer, subscriber) acts as an obligatory participant of such legal relations (clause 1 of Article 539 of the Civil Code).

The power supply contract is subject to conclusion in simple written form. However, it is necessary to take into account the fact of who acts as a subscriber. Indeed, according to the law "On Electric Power Industry", both individuals who purchase electrical energy for their own (household) needs and legal entities that purchase electricity for production can act as energy consumers. In each case, the goals of energy use affect the specifics of the legal regulation of these relations. If a natural person acts as a subscriber and energy is used by him for domestic purposes, the legislator allows for a simplified procedure for entering into an energy supply contract. So according to paragraph 1 of article 540 of the Civil Code for the recognition of the contract concluded, the first actual connection of the subscriber in the prescribed manner to the connected network is sufficient. In this case, the power supply agreement in accordance with Article 428 of the Civil Code of the Russian Federation belongs to the connection agreements and is considered to be concluded for an indefinite period.

According to paragraph 2 of article 539 of the Civil Code of the Russian Federation, a prerequisite for concluding an energy supply contract if the subscriber is a legal entity is the presence of an energy-receiving device connected to the networks of the power supply organization, as well as the possibility of accounting for energy consumption. Otherwise, the subscriber is deprived of the opportunity to exercise his right to conclude an agreement with the energy supplying organization, despite the obligation of the latter to enter into an agreement with anyone who applies to it (Article 426 of the Civil Code).

When concluding an energy supply contract, the consumer agrees with the supplier on the subject of the contract (quantity and quality of energy), on the procedure for compensating the cost of deviations of the actual energy consumption from the contractual volume, on the accounting for consumed energy, on the category of reliability of electricity supply to consumers, on the emergency and technological armor, etc.

Energy as an object of an energy supply contract predetermines the peculiarities of its acceptance by the number on the part of the subscriber. There is a strong relationship between the processes of production and energy consumption at any given point in time, which allows us to speak about the continuity of technological processes. Therefore, the amount of actually received energy can be determined solely by the indicators of metering devices [6, p.50]. At the same time, the power supply contract may provide for the subscriber's right to change the amount of energy received by him, subject to reimbursement of expenses incurred by the power supplying organization in connection with ensuring the supply of energy not in the stipulated amount (clause 2 of Article 541 of the Civil Code).

In addition, proper fulfillment of the obligation by the energy supplying organization for energy quality implies that the subscriber is able to receive electricity continuously by maintaining voltage and current in the network, regardless of the amount of energy actually received by the subscriber.

In case of violation by the power supplying organization of the requirements for energy quality, the subscriber has the right to demand compensation for actual damage (Art. 547 of the Civil Code of the Russian Federation). In addition, he retains the right to refuse to pay for such energy. At the same time, taking into account the actual use by the subscriber of the specified energy (although not meeting the requirements for its quality), in order to avoid its unjust enrichment, clause 2 of art. 542 GK gave the power supplying organization, which provided poor-quality energy, the right to demand from the subscriber a refund of the cost that he had unreasonably saved due to the use of this energy.

Particular attention should be paid to the provisions of paragraph 2 and paragraph 3 of article 546 of the Civil Code of the Russian Federation governing the actions of the energy supplying organization in connection with a break in the supply, termination or restriction of the energy supply. These points provide that a break in the supply, termination or limitation of the supply of energy can take place only by agreement of the parties. The exceptions are the following cases:

- if the unsatisfactory condition of the subscriber's energy installations is threatened by an accident or creates a threat to the life or safety of citizens. These circumstances must be certified by the state energy supervision authority;

- the need to take urgent measures to prevent or eliminate the accident in the system of the energy supplying organization itself, subject to immediate notification of the subscriber;

- in case of violation by the subscriber of obligations to pay for energy.

The power supplying organization is obliged to compensate the damage caused to the consumer if it allowed a break in the supply or the cessation or restriction of the supply of energy in violation of the established procedure. In such cases, the actions of the energy supplying organization should be regarded as improper fulfillment of its obligations under the energy supply contract, which entails liability, established by Art. 547 of the Civil Code.

Summing up, we note that the specificity of the subject of the energy supply contract distinguishes it from the subject of obligations arising from other types of sales contracts and consists of the following:

1) the transfer of goods to the consumer is carried out by supplying energy through the connected network to the power plant of this consumer (subscriber);

2) additional obligations are assigned to the subscriber in connection with the use of such a product as energy: to ensure compliance with the mode of its consumption, safety of operation of the energy networks under its authority and the operability of the corresponding instruments and equipment used by him;

3) the power supplying organization is vested with additional rights to monitor the technical condition of the subscriber's power supply, its instruments and equipment;

4) the legal regulation of an energy supply contract is not exhausted by the norms contained in the Civil Code of the Russian Federation. The special regulations governing the supply of electric energy include the Federal Law of March 26, 2003 No. 35-ФЗ "On Electric Power Industry", as well as the Basic Provisions for the Operation of Retail Electricity Markets, approved by the Government of the Russian Federation of May 4, 2012 No. 442 .

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中俄科技合作的几个方面: 法律方面
SOME FACETS OF THE SCIENTIFIC AND TECHNICAL COOPERATION BETWEEN RUSSIA AND CHINA: LEGAL ASPECT[1]

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注解。法律视角中的文章从回顾和现代性的角度, 涵盖了中俄科技合作的一些方面。两国在互利条件下发展STC的客观需要是以此为基础的。起点是1992年政府间协定: 科学和技术合作以及军事技术合作。作者侧重于指定领域的问题和合作前景。作者考虑了可实现合作的一些例子。该研究采用了科学知识的方法: 一般科学辩证法, 历史辩证法, 比较法律分析法, 从经济学的角度考虑法律。同时, 作者从过程和现象的主观 – 客观分配及其相互关联性出发。新颖性在于 "通过" 方法, 从回顾和现代性的角度来影响正在研究的问题。似乎过去几年的积压和其他情况和因素 (不同层面的积极联系等) 为STC领域的进展奠定了基础, 并且其发展前景被认为是相当成功的。
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Annotation. *The article in the legal perspective covers from the perspective of retrospectives and modernity, some facets of the scientific and technical cooperation between Russia and China. The objective need of the two countries to develop the STC on mutually beneficial conditions was taken as a basis. The starting point is the 1992 Intergovernmental Agreements: on scientific and technical cooperation and on military technical cooperation. The author focuses on problem issues and prospects for cooperation in the designated area. The author considers some examples of realizable cooperation. The study used such methods of scientific knowledge as: general scientific dialectic, historical, comparative legal analysis, the law is also considered from the standpoint of economics. At the same time, the author proceeds from the subjective-objective assignment of processes and phenomena, and their* <u>*interconnectedness*</u>*. The novelty consists in the "through" approach, affecting the*

issue being studied in retrospect and from the perspective of modernity. It seems that a significant backlog of past years and other circumstances and factors (active links at different levels, etc.) create a basis for progress in the field of the STC and the prospects for its development are seen to be quite successful.

Keywords: *BRICS, scientific cooperation, Russia, China, military cooperation, innovation policy, innovation, implementation, technoparks, RAS*

Scientific and technical cooperation (STC) has always been one of the most important components of bilateral relations between Russia and China. At present, for the further development of science, a comprehensive and global approach to the solution of new tasks is needed, which cannot be implemented without the cooperation of states. Considering the relations of China and Russia in the field of the STC, it can be argued that the Russian Federation, unlike its Western partners, gave and gives China the opportunity to master new technologies, primarily military, at relatively low prices [17, p.60]. This fact is quite important, because sooner or later, before any country there is a need to solve the dilemma: continue to depend on the import of technology or accelerate the development of its own science [2, pp. 170-191].

Cooperation between Russia and China in the field of science and technology, enshrined in the intergovernmental agreement on scientific and technical cooperation (1992) (URL: http://www.conventions.ru/view_base.php?id=18018 (appeal date: 01.02 .2019)), implemented through the bilateral Subcommission on scientific and technical cooperation in the areas of fundamental and applied research, including the creation of new technologies with proper observance of national legal norms (Art. 3 and 4).

In recent years, such cooperation has been expanding, acquiring the nature of multi-planning. If the Chinese side is interested in gaining access to the results of fundamental and applied research conducted and conducted in Russia, the latter's actions are aimed not only at a worthy presence in the Chinese market of high technology products, but also at organizing full-cycle research projects (from scratch to creating the latest productions) instead of similar works solving the problems of separate cycles.

At present, military technical cooperation (MTC) of Russia and China is based on the provisions of the intergovernmental Agreement on MTC (1992). and the Memorandum of Understanding of the PTS (1992) [12], as well as the Agreement on Cooperation between the Ministries of Defense of the two countries [4]. As goals, the above documents declare both the receipt of the results of scientific research and the fight against the challenges and threats in the form of terrorism, separatism, banditry, extremism and drug trafficking arising on Eurasian territory. An important role in the activation of military-technical cooperation between our

countries recently was played by the recent contracts for the supply to the PRC of multi-purpose Su-35S and S-400 air defense systems [8].

According to the provisions of Art. 9 of the intergovernmental agreement on the STC of 1992. Any scientific and technical information obtained as a result of cooperation, not being industrial property and not subject to disclosure, any of the parties to the agreement may transfer to third countries with the formal consent of the other party or Based on the rules of the organizations of the Russian Federation and the People's Republic of China participating in cooperation.

In 1999, in order to streamline innovation and technology cooperation in the development of the provisions of this article. 9 of the STC Agreement (1992), its application was signed - an intergovernmental Protocol on the protection and distribution of intellectual property rights created or transferred in the process of implementing the STC of the Russian Federation and the PRC [1. P. 126].

However, this Protocol still does not resolve one of the most important issues - the issue of protection of intellectual property rights, since it does not establish the responsibility of violators of these rights. There are no provisions on liability in subsequent agreements (Memorandums of Understanding on cooperation in the field of innovation from 03.11.2000 and 06.11.2007) [1. P. 126], which emphasizes the focus of both parties on such forms of scientific interaction that are able to ensure the rapid implementation of the innovations obtained in the course of R & D into production and at the same time get their decent commerce.

Domestic technologies were introduced in China by the International Risk Investment Company and the Russian-Chinese consortium Center for Science and High Technologies (established in 1995). The result of their activity is projects for the production of modern wall coverings, granulated polymers, etc.

The legal basis for the implementation of Russian-Chinese relations for the next twenty years was the Treaty on Good-Neighborhood, Friendship and Cooperation (2001) signed by the leaders of the Russian Federation and the People's Republic of China (Rossiyskaya Gazeta. No. 134 of July 17, 2001 URL: http: //docs.cntd .ru / document / 901792686) in all major areas and directions. This treaty, replacing the Soviet-Chinese Treaty of Friendship, Alliance and Mutual Assistance (1950), secured the commitment of its parties to develop equal partnership and strategic cooperation on a long-term basis, including in the field of military and military-technical cooperation (eg, Articles 7, 12, 16, etc.), and other (listed and other) areas, parties of mutual interest, promoting the development of their cross-border and interregional cooperation and the creation of the necessary favorable conditions for this, as well as in various fields, including information, the right and protection of intellectual property in accordance with national legislation and international treaties are the Russian Federation and the PRC (Art. 16 of the Treaty of 2001).

In China, decisions on science and technology policy are based on the speech of Deng Xiaoping at the National Science Conference in 1978, which outlined his theory of technical progress (TTG), the ideological basis of which was the theses that determined the vector of the formation of innovation policy in China, the essence of which is that the control system of science and technology should lead to the release of productive forces, the most important productive forces are science and technologies, and the scientific and technical specialists and scientists in this system are representatives of Avitel working-class meat, which requires labor remuneration [17]. These ideas were then consistently developed in the documents of the CPC Central Committee and the State Council of the PRC (for example, the "Medium and Long-Term Strategic Plan for the Development of Science and Technology and the Enhancement of the National Innovative Potential" (2006), etc. [18; 6, p.40-44].

In practice, the parties began to create innovative structures in 2000, establishing a Russian-Chinese demonstration base on the results of the development of new and high technologies by the industry (Yantai, Shandong Province), whose main task is to promote China and third countries, mainly high-tech developments of the Russian Federation. For these purposes, Russia offered one hundred thirty promising technologies, fifty of which received a request from China. To date, four joint ventures are planned to be established on the territory of the base, and the interest of other industrial centers of the PRC is growing in its experience.

In 2001, the Russian Federation and the People's Republic of China established the STC Park (City of Juzhou, Zhejiang Province), intended for the introduction of developments in industrial chemistry. In order to develop with Russia, the STC from the Chinese side (Ministry of Science and Gosplan PRC) approved the merger of two Harbin zones (the development of new and high technologies and technical and economic development) and it was proposed to establish an office of the united zone in Novosibirsk, the Russian-Chinese technology park (a joint business incubator) with the attraction of investment and financial participation of the Chinese side in high-tech projects of the Russian Federation.

In 2002, the Russian-Chinese STC Program [9] included seventy-nine projects of applied and fundamental joint research in such areas as: bio-and resource-saving technologies; chemistry and petrochemistry; atomic physics and high-energy physics, etc. In the course of these works, concrete results of great scientific and economic importance were obtained.

In the development of the provisions of the intergovernmental agreement on the STC (1992) on the willingness of the parties to contribute to the development of R&D projects, create joint enterprises on their basis, and to this end encourage direct communication between research centers (enterprises, organizations) to implement and joint development of the obtained results (Art. 5) by 2009, various

scientific organizations of China and many institutes of the Russian Academy of Sciences (RAS) carried out the STC on the basis of direct contracts. For example:

- The Chinese Academy of Engineering Physics established a joint industrial company, Sichuan Mianyang LIER, with the Institute of Problems of Chemical Physics of the Russian Academy of Sciences with the aim of applying high-tech technological works to create chemical methods for the protection of plants, products made of polymeric materials, organic intermediate materials under production conditions products,

- the "Great Wall of China" corporation and the Institute of High Temperatures of the Russian Academy of Sciences established the Tigol joint venture for the production of equipment for applying coatings from advanced materials (titanium nitride and others);

- The Institute of Chemical Metallurgy of the Academy of Sciences of China and the Institute of Metallurgy of the Ural Branch of the Russian Academy of Sciences have established a joint venture for the production of anti-corrosion coatings using powder technology;

- The Institute of Atmospheric Physics of the Academy of Sciences of China and the Institute of Atmospheric Physics of the Russian Academy of Sciences carry out joint research to overcome the problems of atmospheric pollution in large industrial centers of the Russian Federation and the People's Republic of China, etc. [eleven].

Recently, the establishment of joint ventures of Chinese participants with participants from other countries has been carried out in all spheres of life where at least some efforts are made - from the development of science to the financing of projects requiring direct investment, etc., and these numerous joint ventures are actually turned into a kind of "business card" of China [3. Pp. 17-30]. A number of Russian-Chinese research centers have been opened as joint ventures, for example: the Joint Space Weather Center, which aims to conduct bilateral space research and is based on the Intergovernmental Agreement on Cooperation in the Study and Use of Outer Space for Peaceful Purposes (1992). [ten]; Center for the Study of Natural Resources, Ecology and Environmental Protection [5], etc.

The provisions of the STC agreement (1992) list (Article 5) various forms of interaction, from the exchange of scientific and technical information and specialists in the field of science and technology to the transfer of scientific and technical knowledge, experience and research; from the organization of scientific and scientific-technical events (seminars, symposia, conferences, exhibitions) to joint research centers, laboratories, research groups, etc. As an important aspect of the STC, the provisions are stated that are determined by the so-called "human factor", which consists not only in the traditional (above-mentioned) ways of interaction, but also in the need to improve the skills of personnel for occupying the STC at

different levels - from understand the nature of the tasks (scientific and practical) that they have to jointly solve on the basis of the available knowledge of specialists from both sides, to a good command of a foreign language in order to establish and ensure the and the success of communication.

In this regard, an interesting example is the implementation of the STC and the VTS by transferring to China the Russian side a license to manufacture the SU-27 fighter. Initially, the Chinese aviation industry objected to the import of foreign fighters, but after deciding on the possibility of installing the engine of the Russian Su-27 on the Ki-Thai fighter J-10, objections were dropped. For Russia, it was more desirable to sell ready-made aircraft to China, rather than a license to manufacture them. In the course of the negotiations between the parties, when China limited the volume of purchases of fighters to 48 pieces without transferring the license, Russia signed a contract for the transfer of technology, components and the provision of necessary technical support to China with a cost of $ 150 million in 1993, actually transferred licensed in 1996. Under the terms of the contract, the Russian side pledged to assist the Chinese side (Shenyang Aviation Company - SAC) to create a production line and assist in the release of two hundred Su-27 for 15 years, supplying Russian engines, radars, avionics and systems weapons Su-27 Chinese assembly received the index "project 11" and the name J-11.

After the Russian side supplied the Chinese SAC with a complete set of production drawings (1997), the SAC, commencing production of the first fighters in 1998, next year handed over to the Russian Air Force two aircraft for testing, which were successfully completed in 2000. As a result of the cooperation, the base version of the J-11 practically had no differences from the Su-27 SC. But, if the first J-11 series were separately equipped with a GPS monitor, which was installed on the windshield to the right of the indicator (HUD), then subsequent release aircraft were already equipped with these monitors by integrating them into a multifunction display.

The apparent success in assembling J-11 motivated the Chinese side to create an improved version of the latest issues using only national components with the name *J-11B,* as well as its double version - J-11BS [14].

In the period 2010-2016 STC was implemented by the scientific community through the organization and holding of exhibitions Expo 2010 [13. Pp. 19-26], of the First-Third Russian-Chinese EXPO, in the framework of which the Russian-Chinese round tables on the STC and technology transfer [7] took place, etc.

The new impulse of the STC of Russia and China was the signing by the chairmen of the RAS and the ANK (in the presence of the heads of state) of a new Cooperation Agreement (2018), which is an initiative of China aimed at strengthening scientific cooperation not only from China and Russia, but also from Asia, under the motto "One Belt - One Way", for which three directions were chosen

and formulated:

1) the development of transport systems and corridors, such as the Harbin-Vladivostok high-speed highway (Navy) project, which again received its continuation;

2) study of the deep-sea mineral and biological resources of the Pacific region (there are no specific projects yet), which requires modern equipment from research vessels and descent vehicles, to new diagnostic methods and devices;

3) the implementation of joint construction and operation of large research complexes of the MegaScience class, similar (by type) to the Nica complex (Dubna, RF) under construction with the participation of the People's Republic of China. For this project, the direction of laser technology was chosen as a promising area (construction of a laser with a cord power of radiation was started in Shanghai, there is a similar project in Russia).

Both sides are in favor of active scientific exchange at the level of academies and emphasize the need for regular contacts between academic institutions [15].

It is worth noting in this regard that such cooperation has taken place and is taking place. So, the author of the article, for example, in 2015 at the invitation of prof. Fan Yongming, Director of the BRICS Research Center at the Fudan University Development Institute (Shanghai, China) (Center for BRICS Studies of the Development Institute, Fudan University) took part in a scientific and practical roundtable on "Labour Relations and Private Law in BRICS countries "(" Labor relations and private law within the BRICS countries '"), held at the Center on October 27, 2015 (BRICS Information Sharing & Exchanging Platform. URL: http://www.brics-info.org/labour- relations-and-private-law-within-the-brics-countries / (appeal date: 02.02.2019)).

Thus, it appears that the STC of Russia and China has a solid legal basis and a significant backlog of past years, has an extensive organizational structure and active links at various levels, and creates the basis for progress in the field of MTC. For these reasons, the development of the STC of Russia and China in the future seems to be very successful.

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法律作为医学科技进步的框架：中俄经验
LAW AS A FRAMEWORK OF SCIENTIFIC AND TECHNOLOGICAL PROGRESS IN MEDICINE: THE EXPERIENCE OF CHINA AND RUSSIA[1]

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注解。本文从法律角度和现代的角度介绍了俄罗斯和中国生物医学技术领域合作的一些方面。基础是两国人口对捐助材料的客观需求。作者着重研究了医疗器官移植法律规制中存在的问题。注意力集中在国际法律来源的研究上，在国家立法框架内规定了对所研究的法律关系进行监管的基本原则。

该研究采用了科学知识的方法：一般科学辩证法，历史辩证法，比较法律分析法。同时，作者从过程和现象的主观 – 客观分配及其相互联系开始。结论是，目前俄罗斯移植立法并不完全符合该领域的法律关系，这决定了在这一领域形成新的法律环境的必要性，中国立法者可以充分利用这一方向。   。

关键词：生物医学领域的合作，俄罗斯，中国，移植学，同意推定，捐赠，世界卫生组织，等待名单，器官和（或）组织分布的信息系统。

Annotation. *The article covers some aspects of cooperation in the field of biomedical technologies in Russia and China in the legal perspective and from the modern point of view. The basis is the objective need of the population of two countries for donor material. The author focuses on the problems of the legal regulation of medical organ transplantation. The attention is focused on the study of international legal sources, enshrining the basic principles of regulation of the studied legal relations in the framework of national legislation.*

The study used such methods of scientific knowledge as: general scientific dialectic, historical, comparative legal analysis. At the same time, the author proceeds from the subjective-objective assignment of processes and phenomena, and their interconnection. It is concluded that the current legislation on the transplantation in Russia does not fully correspond to the legal relations in this area, which

determines the need for the formation of a new legal environment in this area and the Chinese legislator can fully be used in this direction.

Keywords: cooperation in the field of biomedicine, Russia, China, transplantology, presumption of consent, donorship, World Health Organization, waiting list, information system for the distribution of organs and (or) tissues.

Scientific and technical progress in the XX - XXI centuries. made organ transplantation, which is the removal (explantation) of an organ from a donor and its transplantation (implantation) into a recipient's organism [13] one of the strategically important and high-tech methods of treatment. Transplantology incorporates a significant number of bioethical problems that require not only legal but also moral comprehension [9].

In this regard, in the conditions of rapid development of biomedical technologies, a catastrophic shortage of donor material and high economic costs of maintaining patients' lives due to extracorporeal detoxification methods, rational legislative regulation of problematic issues in the field of transplantation becomes necessary.

It seems that the domestic legislator, in the search for an effective legal model for the regulation of controversial issues, designed to best ensure a balance between human rights and at the same time address the problem of the lack of donor agencies, should study the aspects of legal regulation in the field of transplantation in a comparative legal context, as various national legal systems are actively engaged in similar issues.

In the denoted course, in our opinion, the greatest interest is the study of the experience of the country, which is developing in the east at an extremely fast pace - China. So, firstly, modern economic realities, caused by the sanctions policy of Western Europe and the United States with respect to Russia, cause a reorientation of our country's foreign policy towards the East [26], where China acquires the status of a strategic partner. Secondly, the basis of the international legal basis for such cooperation between the two countries has already been laid.

At the bilateral level of cooperation between the two countries, the central document is the "Agreement between the Government of the Russian Federation and the Government of the People's Republic of China on scientific and technical cooperation" (concluded in Beijing on 12/18/1992) [20]. According to the provisions of this agreement, cooperation between the two countries in the field of science and technology should be strengthened in the long term outlook on the basis of the principles of equality and mutual benefit.

In 2012, a Memorandum of Understanding was signed between the Ministry of Education and Science of the Russian Federation and the Ministry of Science and Technology of the People's Republic of China on cooperation in the implementation of joint projects in priority areas of science, technology and technology

[14]. The named memorandum was prepared in accordance with the decisions and recommendations of the XV meeting of the Russian-Chinese subcommittee on scientific and technical cooperation, in which the parties expressed their intention to conduct a selection of joint research projects in a number of priority areas of science development, including *nanosystems and materials, life sciences (art.2).*

The considered set of program-strategic documents, in our opinion, lays the foundation for scientific cooperation between the two countries in the field of bio-medicine.

The first international legally binding document in the field of transplanta-tion, which most substantively regulates this field of activity, is the Convention on Human Rights and Biomedicine, adopted in 1997 by the Council of Europe (hereinafter - the Oviedo Convention) [11]. The conditions of the convention were supplemented by a number of Additional Protocols, designed to detail its condi-tions. So, in 2002, the Additional Protocol was adopted regarding the transplanta-tion of organs and tissues of human origin (hereinafter - the Additional Protocol) [8]. The parties that have ratified the Oviedo Convention are obliged to provide adequate legal protection for the implementation of the rights and principles set forth in the document, but Russia and the PRC are not among those. At the same time, these documents are of paramount importance, since their conditions on do-nation and transplantation (eg, conditions on donor and recipient rights, etc.) were implemented by the legislation of those states that have not ratified these legal documents [7].

The documents adopted by the World Health Organization (WHO), the World Medical Association (WMA) and the International Transplantation Society, which have recommendatory power, but are widely used by States in the implementa-tion of law-making activities and in the law enforcement practice of courts [3] are of significant legal importance. For example, in the case of "Sergey Denisov vs Russia" [5], the European Court of Human Rights in one of the paragraphs of its Resolution refers to the WHO resolution.

Currently, among the most important documents are the WHO Guidelines on Transplantation of Human Cells, Tissues and Organs, which are periodically up-dated to reflect advances in medical science. Their version is now in force, approved at the 63rd World Health Assembly in May 2010 (Resolution WHA63.22 [2]).

Let us now turn to the national legal regulation of the studied legal relations in the Russian Federation and the People's Republic of China. The regulatory framework governing relations developing over the donation and transplantation of human organs and tissues appeared in Russia only in 1992, and before that, the instruments of legal regulation were extremely imperfect and fragmentary, which sharply slowed down the pace of development of this branch of medicine [17].

Today in Russia, the field of human organ (tissues) donation and their trans-

plantation is regulated by a number of legislative acts, among which, first of all, the RF Law of 22.12.1992 No. 4180-1 "On the Transplantation of Human Organs and (or) Human Tissues" should be highlighted [10], which during its more than twenty-year history almost did not undergo significant changes, although the regulatory framework, directly or indirectly affecting the issues of transplantology, has undergone significant changes. Thus, the Federal Law of November 21, 2011 No. 323-FL "On the basis of health protection of citizens in the Russian Federation" [25] was adopted, in which a special article appeared on the donation of organs and (or) human tissues (Art. 47) .

Attention is drawn to the fact that Art. 8 of the Law on Transplantation establishes the principle of *"presumption of consent"* for the removal of organs and (or) tissues from a corpse. At the same time, Federal Law No. 8-FL of January 12, 1996 "On Burial and Funeral Business" [24] effectively establishes the *"presumption of disagreement"*.

Thus, there is a legal collision between the two regulatory legal acts, which contributes to the fact that among medical institutions that collect transplants for transplantation, there is no consensus regarding the legality of the removal of organs and tissues belonging to deceased people. Regarding the mechanism for overcoming the current situation, the legal doctrine offers a dual approach. Thus, one group of lawyers (for example, M.N. Maleina [12]) considers it necessary to formalise the presumption of disagreement on the seizure of a person's organs after the death of his organs in the Law on Transplantation, while supporters of a different, opposite position believe that an attempt to establish the presumption disagreement is an untimely step (eg, A.N. Golovistikova [23]).

Here it is also necessary to refer to the regulatory acts developed by the relevant ministry, which regulate a number of fundamentally important aspects of transplantology. In particular, organs for transplantation are distributed among patients who are listed in the so-called waiting lists of transplantation of a corpse organ and (or) tissue, which is administered by a doctor of a medical organization that performs transplantation in accordance with the rules of waiting list approved by the Ministry of Health of the Russian Federation October 31, 2012 № 567n "On approval of the procedure for providing medical care on the "surgery (transplantation of organs and (or) human tissues)" profile[19].

In addition, Resolution of the Government of the Russian Federation of September 20, 2012 No. 950 [21] approved the Rules for determining the moment of death of a person, including the criteria and procedure for determining the death of a person, which is the key point in the removal of human organs (tissues) from a corpse. And the Order of the Ministry of Health of Russia dated June 8, 2016 No. 355n approved the Procedure for registering human donor organs and tissues, organ and tissue donors, patients (recipients), medical documentation forms and

statistical reporting forms to account for human donor organs and tissues, organ donors and tissues, patients (recipients) and the order of their filling [15].

In Russia, there is no national system for the distribution of donor organs. In part, these functions are performed by the only subdivision in Russia in this form - the Moscow Coordinating Center of Organ Donation (MCCOD). The visiting team of MCCOD is constantly located on the basis of SBHI named after. S.P. Botkin and works around the clock [18]. At the same time, the criteria for obtaining an organ include the patient's waiting time and medical indications of compatibility with the donor organ, in particular, blood type, immunological characteristics, etc.

In this regard, it is obvious that the problem of presumption of consent to the removal of organs for the purpose of their further transplantation in Russia does not find a clear solution in the doctrine or in practice. In order to modernize general regulations in the field of healthcare, a new draft law "On Transplantation of Human Organs and/or Tissues", prepared by the relevant ministry, was repeatedly submitted to the State Duma of the Federal Assembly of the Russian Federation. The adoption of the law has not yet taken place, but this issue has not been removed from the agenda of the State Duma of the Federal Assembly of the Russian Federation.

In China, the beginning of the legal regulation of the field of transplantation was laid down by the adoption of the Interim Rules on the use of the body or organs of executed criminals in 1984 (*Interim Rules on Using the Body or Organs of Executed Criminals, 1984*), which, against the background of the discovery of the effect of the drug "cyclosparin-A", suppressing the rejection of alien organs, led to the widespread practice of trafficking in human organs taken from executed prisoners for the purpose of their subsequent transplantation. Since the 1984 Rules remained the only legislative act in the field under study for two decades, local authorities gradually began to work out local acts, for example, *"Regulations on Human Cadaver Donation"* or *"Regulations on Human Organ Donation for Transplant"* [1]. This practice continued until the publication of the *"Interim Provisions on the Administration of Clinical Applications for Transplant Technology, 2006"* by the Ministry of Health in 2006. A year later, the State Council issued the *"Regulations on Human Organ Transplant, 2007 [4]"*, which prohibits organ trafficking and the removal of human organs without its prior written consent.

The rules of 2007 have the highest legal force in relation to all the above normative legal acts regulating the investigated sphere of legal relations in different volumes.

In addition, in order to combat transplant tourism in China, the Ministry of Health also prepared and issued a notification in July 2007, which, in accordance with the Istanbul Declaration on Transplant Tourism and Organ Trade, 2008 [22] establishes the principle of priority in obtaining organs for Chinese citizens in

view of the global shortage of donor organs.

A similar reform of legislation in the field of transplantation in China with the aim of implementing into it the main international principles and standards was carried out under pressure from international governmental and nongovernmental organizations (eg, WHO, WMA, International Committee of the Red Cross, etc.) that strongly condemned the practice of Chinese doctors of organ seizing of prisoners sentenced to death by criminal courts for their subsequent transplantation.

It should also be noted that, in contrast to Russia, in the PRC, the national information system has become operational for the distribution of donor organs. The legal basis for this was laid in Art. 6 of the 2007 Rules, however, for a long time this regulation was declarative in nature. Practical implementation of art. 6 became possible only after the entry into force on September 1, 2013 of the Provisions on Human Organ Procurement and Allocation. The 2013 regulation states that a record of each donor organ in a country should be entered into a single "China Organ Transplant Response Systems - COTRS [16]) for equitable distribution of donor organs among recipients [6] .

The legislator establishes a strict ban on the transplantation of human organs and/or tissues bypassing the COTRS information system [27], a violation entails revocation of a physician's license and is subject to criminal liability in accordance with Amendment VIII to the Criminal Law of the PRC [28].

Based on the research done, it can be concluded that the imperfections and collisions in the legal environment governing the donation and transplantation of human organs and tissues in Russia are extremely significant and should be eliminated. In our opinion, to solve the disadvantages of the mechanism for regulating relations in the field of transplantology is possible only through the development and adoption of a new law that meets international standards. In this direction, we can fully use the Chinese experience, some aspects of which are outlined in this work.

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专业再培训专家资产水物的生态修复
PROFESSIONAL RETRAINING OF SPECIALISTS ASSETSSUCH ECOLOGICAL REHABILITATION OF WATER OBJECTS

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抽象。 该文件考虑到俄罗斯联邦城市规划法的额外要求，处理专家的专业培训问题。 在水体生态修复专家再培训过程中，采用了我国和国外远近国家设施的最佳生产经验。
关键词：继续教育，水，环境康复。

Annootation. The paper deals with the issues of professional training of specialists taking into account the additional requirements of the Urban planning Code of the Russian Federation. In the process of retraining of specialists for ecological rehabilitation of water bodies, the best production experience of work at the facilities of our country and countries of near and far abroad is used.

Keywords: continuing education, water, environmental rehabilitation.

According to the current town-Planning Code of the Russian Federation [11], carrying out engineering penalties, development of project documentation, construction, reconstruction and capital repairs of objects of ecological rehabilitation and arrangement of water objects, can carry out the organizations of all forms of ownership which are members of the relevant Association of the self-regulating organizations (ASRO) in the field of construction.

In 2017, in the system of self-regulation in the field of construction, there was a radical reform based on increasing the responsibility of both the members of the ASRO and their specialists for the work they performed at the objects of environmental rehabilitation and arrangement of water bodies.

Since July 1, 2017, Russia has introduced [11] the national register of specialists (LDCs) in the field of construction, which contains information about highly qualified staff members.

Each member of ESRO in the field of construction (ecological rehabilitation of water objects), reconstruction and capital repairs of capital construction facilities with 01.07.2017 [9]must be in the state at the principal place of work of at least two specialists whose information is included in the LDCs.

A specialist of a construction organization may be [2] an individual (General Director, Director, Manager, head), who is entitled to perform labor functions on the organization of work on the construction site under an employment contract concluded with a legal entity or an individual entrepreneur. The organizer of the construction industry can be [1] a specialist (chief engineer, chief engineer of the project, head of construction, project Manager), information about which are included in the LDCs in the field of construction - Association of all - Russian non – governmental non-profit organization-all-Russian industry employers ' Association "National Association of self-regulatory organizations based on the membership of persons engaged in construction-Nostroy". They are notified of their entry into LDCs, with a specialist identification number, for example, P-16-147629, where 16 is the number of the region in which they work. Similarly, the information system of LDCs in the field of engineering research and architectural design has been formed [10].

The creation of LDC professionals has several objectives. First, there is a resource that combines information about high-class specialists of the industry, which will allow customers to evaluate the experience and competence of persons engaged in the work. Today, these data are available respectively on the websites of Nostra – www.nostroy.ru and ENGINEERS – www.nopriz.ru. Secondly their personal responsibility to ensure the quality and safety of their work.

Synchronization of the unified register of ASRO and LDC members will allow to see the real picture of the availability of specialists for ecological rehabilitation of water bodies for each ASRO.

Specialists must have [1,2,11] in the direction of training higher education (engineer, master, specialist) or non-core higher education plus additional professional education in the direction of "construction" (professional retraining in the direction of "construction" profile "water Supply and sanitation").

The following additional professional responsibilities have been introduced to professionals included in LDCs in the field of construction (environmental rehabilitation of water bodies)::

- organization of incoming control of the received project of ecological rehabilitation of the water body;

- implementation of operational planning, coordination, organization and con-

duct of operational quality control of the work performed during the environmental rehabilitation of the water body;

- acceptance of the completed types and separate stages of work in the implementation of environmental rehabilitation of water bodies, elements, structures and parts of the objects of capital construction, engineering networks, their sites with the right to sign the relevant documents;

- signing of the following documents:

a) acts of acceptance of ecological rehabilitation of water bodies and objects of ecological rehabilitation;

b) confirming compliance of ecological rehabilitation of the water body and their ecological rehabilitation with the requirements of technical regulations and codes of practice;

C) confirming compliance of parameters of ecological rehabilitation of water body and object of ecological rehabilitation to the project, including requirements of energy efficiency and requirements of equipment of object with metering devices of the used energy resources;

g) confirming compliance with the environmental rehabilitation of a water facility technical requirements for connection to the networks engineering and technical support.

For the account of requirements of radical reform of system of self-regulation in the course of professional retraining of specialists of the profile "water Supply and water disposal" [5] staff of chair of water supply and water disposal (VIV) of the Kazan state architectural and construction University (kgasu), in earlier developed program of professional training of specialists (the decision of Presidium of the Russian Academy of natural Sciences considering relevance, scientific and educational importance of the professional development program were selected and presented at the international Frankfully book exhibition FRANKFURTER BUCHMESSE [3]. By the decision of the latter, it was included in the special catalog "FRANKFURTER BUCHMESSE 2017" and awarded the "Gold" Medal of the salon), the curriculum and work programs of the majors made additions and changes that take into account additional professional duties of a specialist in the field of construction of water bodies and objects of environmental rehabilitation [6,11].

Professional retraining of specialists for environmental rehabilitation and arrangement of water bodies is carried out under the program "professional retraining of specialists in the field of water management", which was selected and presented at the V Moscow international Salon of education 2018 by the decision of the Presidium of the Russian Academy of natural Sciences, taking into account the relevance, scientific and pedagogical importance. This program is included in the catalog of the V Moscow international salon of education 2018 (18-21 April 2018), was awarded the "gold" Medal Salon [7].

This made it possible to take into account the increasing requirements for their training [11], which impose on them additional professional duties listed above, in accordance with the qualification standards of the ASRO, based on professional standards [1,2], approved by the state [11].

According to the concluded agreements of kgasu, both with legal entities and directly specialists with higher education in other specialties, but working in the field of construction and expressed a desire to undergo professional retraining in the profile of "water Supply and sanitation" were trained in 802 hour program. Students of professional retraining completed the curriculum in full (settlement and graphic and course work, passed tests and exams in the disciplines provided by the curriculum, developed and publicly defended at the meetings of the state certification Commission final certification work. The decision Of the state certification Commission issued them a diploma of professional retraining in the profile "water Supply and sanitation", which provides the right to introduce professional activities for environmental rehabilitation and arrangement of water bodies.

Classes at the courses of professional retraining of specialists in the profile of "water Supply and sanitation" are held in laboratories and offices, specially prepared by the staff of the Department of VIV kgasu together with leading experts of domestic and foreign organizations [3,4]. Conducted classes at the courses of professional retraining of specialists take into account the best production experience of engineering surveys, implementation of architectural and construction design, the introduction of works in the implementation of construction, reconstruction and overhaul of environmental rehabilitation of water bodies, both in our country and in the countries of near and far abroad [6].

In the 2014-2015 academic year, 11 specialists in the profile of water supply and sanitation were retrained, and in the 2016-2017 academic year – 9 specialists of the Volga Federal district (Republic of Bashkortostan, Mari-El and Tatarstan).

Obtained both basic and additional professional knowledge, skills and abilities in the process of mastering the program of professional retraining of specialists in the profile of "water Supply and sanitation", in full, allowed to form in demand in the modern labor market competent specialist for the implementation of environmental rehabilitation and arrangement of water bodies with the knowledge to perform both basic and additional professional duties specified in the Federal law №372 FZ [11]. In the end, will solve the problem of providing members of ASRO specialists carrying out environmental rehabilitation and improvement of water bodies [8], meeting the requirements of Builders and Noprize Russia in terms of level of education and to enable them to the appropriate LDC in the construction sector.

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研究"积分微积分"专题的技术大学学生的系统性困难
METHODICAL DIFFICULTIES OF STUDENTS OF TECHNICAL UNIVERSITY WHEN STUDYING THE TOPIC "INTEGRAL CALCULUS"

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注解。在现代条件下，教育活动的主要结果不仅是知识的获得，还包括独立思考的能力，分析和寻找问题解决方案的能力。

数学培养了构建数据，创建情境的数学模型，分析和解释结果的能力。数学教学的目的是形成基础知识，技能和能力，确保学生在高等教育系统中对数学课程和相关学科的坚定和有意识的掌握。

积分微积分是数学分析的一部分，其中研究积分，它们的性质，计算方法和应用。这部分最成功地培养了学生的创造性和工程思维倾向，但同时也给学生带来了很大的困难。在高等教育初期阶段工作的教师的主要任务是为学生提供各种有效适应大学教育环境条件的方法。本文基于技术学院数学教学的教学经验，将有助于系统化"积分微积分"部分的一些主题，这些主题是可访问和可视的，并克服了这些困难。

关键词：数学教学方法，积分微积分，技术学院，学生。

Annotation. *In modern conditions, the main result of educational activities is not only the acquisition of knowledge, but also the ability to think independently, the ability to analyze and search for solutions to the problem.*

Mathematics develops the ability to structure data, create a mathematical model of the situation, analyze and interpret the results. The purpose of teaching mathematics is the formation of fundamental knowledge, skills and abilities that ensure the firm and conscious mastery of students in mathematics courses and related disciplines in the system of higher education.

Integral calculus is a section of mathematical analysis in which integrals, their properties, calculation methods and applications are studied. This section

most successfully develops in the student a tendency towards creative as well as engineering thinking, but at the same time it causes great difficulties for the student. The main task of teachers working at the initial stage of education in higher education is to offer students all sorts of ways to effectively adapt to the conditions of the educational environment of the university. This article, based on the pedagogical experience of teaching mathematics in a technical college, will help to systematize some topics in the "Integral calculus" section that is accessible and visual and overcome these difficulties.

Keywords*: methods of teaching mathematics, integral calculus, technical college, student.*

The first difficulty a person faces when trying to teach him to think mathematically is that he needs to learn a more direct view of things, he needs to learn to think more specifically and directionally.

The aim of our research is to study the pedagogical experience of teaching higher mathematics and modeling the process of students' mathematical education during the period of their first year at a technical university using the example of the Stankin Moscow State University.

We formulate the general problems of learning [1]:

• discrepancy between the increase in the volume of educational information and the factor of limited learning time;

• intensification of the educational process;

• the problem of the formation and enhancement of the student's cognitive interests;

• the problem of holistic personality formation.

But as a result of our research, we also identified the following problems:

• the problem of the dominant algorithmic thinking;

• student learning formalism;

• interdisciplinary uncoordinated educational process;

• lack of sufficient motivation to obtain new knowledge;

• inconsistency of the didactic goals of higher technical education with the goals formulated by the student on the basis of common sense (student experience).

An important problem in the teaching of mathematics is the search for ways to improve the learning process and enhance the cognitive activity of students. The solution of this problem involves the strengthening of the ideological aspect of education, the improvement of methods for implementing the applied and practical orientation of teaching mathematics.

To solve these problems, as well as to facilitate the process of adaptation at the university and to simplify the learning process, in many universities, in particu-

lar, in MSTU "Stankin", an electronic educational environment has been created, which contains materials on subjects in electronic form: work programs of disciplines, lecture notes, guidelines for students, electronic testing and much more, something that allows you to simplify the student's independent work process. At the same time, in the process of classroom work, the teacher must find tricks that will improve the perception of this or that information. At the university, the learning process is distinguished by a more conscious approach to future knowledge (a pragmatic motive), but learning itself, apart from the skills acquired in secondary school, requires the development of the quality of introspection, self-identification of the changing environment. Approaching the process of learning as a system that organizes thinking, memory, attention, we select the solution of problems formulated in any form [2].

Cognitive activity in the process of solving problems in the university environment has very broad boundaries: from collecting information about equipment and conducting an experiment to theoretical and philosophical generalizations of the results in abstract and technical sciences. Consequently, motivated activity is associated with the acquisition, organization and use of knowledge. Solving problems in mathematics has one of the most important advantages - the ability to simulate the process of thinking, to formalize a solution method, to have an act of an experiment in the form of a solution presented by the subject himself. Considering the process of finding the solution of a certain mathematical problem by students, one can find that the complexity consists not only in the lack of knowledge, but in the inability to extract and apply them [3, p. 206]

Using the example of the topic "Integral calculus", we will try to analyze the approach to the systematization of knowledge. Integration of functions is an excellent basis for the development of creative activity through independent work.

After completing the study of various methods of integration, the student is often not able to understand which method is used in which case. To systematize the methods of integration, students are invited to find differences in solving the following examples:

1. $\int \dfrac{dx}{x+1}$;

2. $\int \dfrac{dx}{x^2+1}$;

3. $\int \dfrac{xdx}{x+1}$;

4. $\int \dfrac{xdx}{x^2+1}$;

5. $\int \dfrac{x^2dx}{x^2+1}$;

6. $\int \dfrac{x^2dx}{x+1}$.

At first glance, with inattentive consideration, students say that these examples differ little and do not look very difficult. But in the process of solving a student has to remember not only the table of integrals (Example 2), but also apply the methods studied earlier: differential properties (Example 1), summing up the differential sign (Example 4), integrating irregular rational fractions (Examples 3, 5, 6).

Here we will take a closer look at the solution of Example 3. It can often be noted that students solve this problem in various ways:

Method 1. Selection of the whole and fractional part

$$\int \frac{xdx}{x+1} = \int \frac{(x+1-1)dx}{x+1} = \int \left(1 - \frac{1}{x+1}\right)dx = x - \ln|x+1| + C ;$$

But sometimes we see that a student does a variable change:

Method 2

$$\int \frac{xdx}{x+1} = \begin{vmatrix} x+1=t \\ x=t-1 \\ dx=dt \end{vmatrix} = \int \frac{t-1}{t}dt = \int \left(1 - \frac{1}{t}\right)dt = t - \ln|t| + C = x+1 - \ln|x+1| + C$$

.

The second method, though cumbersome, still requires the involvement of more complex mechanisms of thinking: here you need to correctly introduce a replacement, and go back to the original variable.

In the following lesson, the following can be added to these examples to establish the differences [4]:

7. $\int \dfrac{dx}{\sqrt{x+1}}$;

8. $\int \dfrac{dx}{\sqrt{x^2+1}}$;

9. $\int \dfrac{xdx}{\sqrt{x^2+1}}$;

10. $\int \dfrac{dx}{x\sqrt{x^2+1}}$.

If the first six integrals may not cause special problems, but only help structure the integration methods, help to feel the differences in the application of approaches to the solution, then integrals 7 through 10 already have as their goal the choice of the optimal solution, especially since students most often have fear of irrationality. And if integrals 7 and 8 are still quite simple (although there is a problem when the student made huge transformations, during which he came to integrals of type 7 and 8, and he cannot figure out what to do next), then integrals 9 and 10 require the involvement of many thought mechanisms.

Let us dwell on example 10. As is known, there are several ways to solve this example, and here the student is offered a choice.

Method 1. Substitution $x = \operatorname{tg} t$, in this case, using the trigonometric formula

$$1 + \operatorname{tg}^2 t = \dfrac{1}{\cos^2 t}, \text{we get that } x^2 = \operatorname{tg}^2 t, 1 + x^2 = 1 + \operatorname{tg}^2 t = \dfrac{1}{\cos^2 t},$$

from where $\sqrt{1 + x^2} = \dfrac{1}{\cos t}$, $dx = \dfrac{dt}{\cos^2 t}$. As a result, we have:

$$\int \dfrac{dx}{x\sqrt{x^2+1}} = \int \dfrac{\dfrac{dt}{\cos^2 t}}{\operatorname{tg} t \cdot \dfrac{1}{\cos t}} = \int \dfrac{dt}{\sin t},$$ the obtained integral can be

solved with the help of a universal trigonometric substitution. The whole described method is very laborious, double replacement is necessary, it is difficult to return to the original variable without knowing the relevant formulas.

Method 2. Substitution $1 + x^2 = t^2$. Then $x = \sqrt{t^2 - 1}$, $dx = \dfrac{tdt}{\sqrt{t^2 - 1}}$.

As a result, we have:

$$\int \frac{dx}{x\sqrt{x^2+1}} = \int \frac{\dfrac{tdt}{\sqrt{t^2-1}}}{\sqrt{t^2-1}\cdot t} = \int \frac{dt}{t^2-1}.$$ Using such a replacement, we

obtained a table integral, the solution turned out to be shorter, but nevertheless, we need to return to the original variable, and this can also be difficult.

Method 3. Removing from the sign of the root x and making the sign of the differential $\dfrac{1}{x^2}$.

As a result, we have:

$$\int \frac{dx}{x\sqrt{x^2+1}} = \int \frac{dx}{x\cdot x\sqrt{1+\left(\dfrac{1}{x}\right)^2}} = -\int \frac{d\left(\dfrac{1}{x}\right)}{\sqrt{1+\left(\dfrac{1}{x}\right)^2}}.$$ Making a re-

placement $\dfrac{1}{x} = t$,

we will come to integral 8. Problems can arise at the stage of transformations.

If we give an opportunity to solve this example by all means, to examine in more detail all the problems arising in the process of solving this problem, we can avoid difficulties in the future.

Here is another example. $\int \dfrac{2x-3}{x^2+4x-5}dx$.

We propose to solve it to the student in different ways [5].

Method 1. We expand the denominator into factors:

$$x^2+4x-5=0$$
$$x_1=-5;\ x_2=1$$
$$x^2+4x-5=(x+5)(x-1).$$

$$\frac{2x-3}{x^2+4x-5} = \frac{2x-3}{(x+5)(x-1)} = \frac{A_1}{x+5} + \frac{A_2}{x-1} = \frac{A_1(x-1)+A_2(x+5)}{(x+5)(x-1)}.$$

Equate the numerators of the left and right fractions, we get

$$2x-3 = A_1(x-1)+A_2(x+5).$$

With $x=1$ $-1=6A_2$ $\Rightarrow$ $A_2 = -\dfrac{1}{6}$.

With $x=-5$ $-13=-6A_1$ $\Rightarrow$ $A_1 = \dfrac{13}{6}$.

I. e. $\dfrac{2x-3}{x^2+4x-5} = \dfrac{\dfrac{13}{6}}{x+5} + \dfrac{-\dfrac{1}{6}}{x-1}$.

Let us return to the integral:

$$\int \frac{2x-3}{x^2+4x-5}dx = \int\left(\frac{\dfrac{13}{6}}{x+5}+\frac{-\dfrac{1}{6}}{x-1}\right)dx = \frac{13}{6}\int\frac{dx}{x+5} - \frac{1}{6}\int\frac{dx}{x-1} =$$

$$= \frac{13}{6}\ln|x+5| - \frac{1}{6}\ln|x-1| + C.$$

Method 2. Select the derivative of the denominator in the numerator.

$$\int\frac{2x-3}{x^2+4x-5}dx = \int\frac{(2x+4)-7}{x^2+4x-5}dx = \int\frac{2x+4}{x^2+4x-5}dx - \int\frac{7}{x^2+4x-5}dx =$$

$$= \int\frac{d(x^2+4x-5)}{x^2+4x-5} - \int\frac{7}{(x^2+4x+4)-9}dx = \ln|x^2+4x-5| - \int\frac{7}{(x+2)^2-9}d(x+2) =$$

$$= \ln|x^2+4x-5| - \frac{7}{6}\ln\left|\frac{x+2-3}{x+2+3}\right| + C = \ln|x^2+4x-5| - \frac{7}{6}\ln\left|\frac{x-1}{x+5}\right| + C.$$

Note that in the process of solving in any of the ways we come in the process of transformations to integrals of type 1-6.

By offering the student a choice of one of the ways, we develop not only mathematical thinking, but also the creativity necessary for life in general. The essence of these examples is for the student to see before the eyes a functional system of actions, to be able to indicate the sequence of their implementation, to train the

mental and speech formulations. Thus, the organization of the sequence of actions and the structure of the result is formed. Research skills obtained in the course of mathematical analysis, have a positive impact on the nature of the entire educational activity of the student.

Thus, we see that in establishing the difference between integrals of type 1-6, the student can avoid difficulties in solving examples of type 7-10, and also find new ways to solve the problems posed.

As a result of the use of the described systematization of integration methods, the mathematical literacy of students and the quality of the formation of logical thinking are significantly improved. The practical implementation of these methods allows you to bring up a higher-quality specialist.

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跳高运动员高素质运动学特征分析
ANALYSIS OF KINEMATIC CHARACTERISTICS
OF HIPPING EXERCISES OF HIGH QUALIFICATION ATHLETES

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注解。 本文提出了跳远运动员跳高运动员运动学特性的分析。 整体跳远跑与选定练习的比较生物力学分析。 显示在这些练习和整体长跳起飞中进行动作时建立动作节奏的异同。 提供在不同时期的训练跳投中使用练习的建议。

关键词：跳远，运动节奏，偏转时的步长和频率。

Annotation. *This paper presents an analysis of kinematic characteristics of jumping exercises long jumpers high qualification. Comparative biomechanical analysis of holistic long jump run and selected exercises. Shows the similarities and differences in building the rhythm of movements when performing movements in these exercises and holistic long jump takeoff. Provides recommendations to use exercises in different periods of training jumper.*

Keywords: *long jump, rhythm of movements, length and frequency of steps when a deflection.*

Relevance. It is known that the result in the long jump is largely determined by the average speed that the jumper develops during the run. This confirms the close correlation between the speed of the takeoff and the result, which fluctuates at the level of 0.83-0.94 [2]. At the same time it is important to get exactly on the repulsion bar, reaching the maximum speed for a given athlete. Often, athletes lose the competition, not showing the exact hit on the bar of repulsion. This may be due to the protrusion of the repulsion bar or, conversely, the athlete pushes off without accessing it over considerable distances. This leads to a reduction in the result, which is measured from the push-off bar to the landing site [3].

Biomechanical analysis of the run in long jumps indicates that the running speed depends on the ratio of length and frequency of steps. In long jumps, the stride length increases towards the end of the takeoff run, but is reduced at the last

step, which allows the jumper to specify the flight path that determines the longest jump length [1]. To search for a compromise between the need to achieve maximum speed in the run-up and an accurate hit on the push-off bar, jumpers work out a certain rhythm of run-up over the years, using various exercises. Consider this problem in terms of the training process.

The purpose of the study was to conduct a comparative analysis of the kinematic parameters of the run in long jumpers when performing model exercises, often used in training athletes of this sport.

Methodology and organization of research. The study involved 34 highly qualified athletes - Candidates for the Master of Sports and the Master of Sports, specializing in long jumps.

In the present study, biomechanical analysis of kinematic parameters was performed during a run in long jumps in the following exercises:

1. Performing a long jump with a full run, from step 21;

2. A full run with repulsion from the 21st step;

3. Long jump with an average takeoff from 11 steps;

4. Long jump with a short run, with 8 steps.

In the first case, the run was performed with the setting to achieve maximum speed during repulsion. The second option is associated with the demonstration of the full run-up run with imitation of repulsion, but without accented execution of the flight phase of the jump. The third variant models a jump with an average run-up, and the fourth - with a short run-up eight steps. Athletes consistently performed each exercise in a training session after warm-up in a competitive mode.

In each attempt, the run speed was measured in the last six steps of the run, the last three steps of the run and the final speed of the run. At the same time, using electronic pairs located at the edges of the runway, the length was also recorded and the step frequency was calculated on the same run segments.

The results of the study.

When performing a competitive jump in length, the speed increases evenly: at the last 6 steps, it is equal to 9.32 ± 0.22 m/s, at the last three steps - 9.73 ± 0.30 m/s, reaching a maximum value of 10 , 12 ± 0.10 m/s at the last step (line 1, table 1). Similar dynamics of change

Table 1.

Indicators of running speed in long jump and jump exercises in m/s

Exer.	On the last 6 steps	On the last 3 steps	On the penultimate step	On the last step	Average speed
1	9,32±0,22	9,73±0,30	9,83±0,11	10,12±0,10	7,90±0.18
2	9,28±0,16	9,54±0,28	9,30±0,19	9,97±0,09	8,18±0.21
3	8,62±0,34	9,25±0,39	9,23±0,18	9,83±0,11	7,65±0.41
4	7,71±0,50	8,52±0,13	8,57±0,11	9,18±0,28	7,25±0.42

speed is typical for the long jump with a short run. However, when performing a jump from a short run, the athletes perform a jump with a lower speed set, which is 7.71 ± 0.50 m/s in the last 6 steps, and then increase to 9.18 ± 0.28 m/s in the last step.

When performing a full run when imitating a long jump, with accented repulsion (option exercise 2), the jumper's speed first increases from 9.28 ± 0.16 m/s in the last six steps to 9.54 ± 0.28 m/s on 3 last steps. Then the speed of the jumper decreases to 9.30 ± 0.19 m/s in the penultimate step, reaching maximum values when performing repulsion - 9.97 ± 0.09 m/s. Probably, such a dynamic of speed is connected with the preparation of the jumper for repulsion and is not optimal for achieving the maximum length of the jump.

The jump from the average takeoff is accompanied by a minimum drop in speed at the penultimate step, comparable to the error in determining its magnitude, and during a run from the short run, the speed gradually increases and reaches its maximum value at the moment of repulsion (Table 1, line 4).

Comparison of the dynamics of speed with changes in the length and frequency of steps at the appropriate moments allows us to identify the causes of the decrease in speed on individual segments of the run. From the materials of Table 2, it can be seen that in none of the options for the run-up run the maximum step length is reached, and a comparison of this indicator in the last 6 and 3 steps indicates certain differences. When performing a long jump with a full run, the length of the steps is almost preserved, and the frequency increases during the last three steps of the run (line 1 of table 2). A slightly different picture when performing a full takeoff run with repulsion, when the step length indicators slightly fall and the frequency increases in the same way as a full jump.

Table 2.

The ratio of the length and pace of run steps in long jump and jump exercises

Control	Step length, m			Step tempo, st/s		
	Max.	On last 6 steps	On last 3 steps	Max.	On last 6 steps	On last 3 steps
1	2,37±0,02	2,28±0,02	2,28±0,04	4,37±0,07	4,09±0,12	4,27±0,16
2	2,33±0,01	2,25±0,02	2,23±0,05	4,55±0,04	4,11±0,14	4,26±0,16
3	2,18±0,05	2,12±0,02	2,15±0,02	4,65±0,06	4,11±0,15	4,36±0,18
4	2,16±0,02	2,01±0,05	2,12±0,04	4,20±0,12	3,76±0,12	3,96±0,15

When performing a jump from the average takeoff, the step length on the last six steps increases slightly from 2.12 ± 0.02 to 2.15 ± 0.02 m, as does the frequency of the steps from 4.11 ± 0.15 to 4.36 ± 0 , 18 st/s in the last three steps of the run, similar to a long jump with a full run, reaching a maximum value by the moment of repulsion. In long jumps with a short run, the stride length on the indicated segments also increases with a slight increase in the frequency of movements from 3.76 ± 0.12 to 3.96 ± 0.15 n/s in the last three steps. Those. the main difference is that when performing a competitive jump in length, the increase in speed is achieved by increasing the frequency of movements in the last three steps of the run while maintaining a certain step length (line 1, table 2). In other competitive exercises, the structure of the movements changes, the step length either decreases on the selected segments as the frequency of sleep movements increases during the last 3 steps of the run, or the step length decreases with a similar trend of movement frequency change.

4Of greatest interest is the analysis of the length of steps at the penultimate step of the run and during repulsion, the measurement results of which are presented in Table 3. It turned out that when performing a jump (option 1) the length of the last step is 2.39 ± 0.02 m and exceeds the length of the penultimate step equal to 2.35 ± 0.04 m. The frequency of the run, when performing the last step, reaches a maximum value and is equal to 4.57 ± 0.07 st/s, exceeding this figure when performing the penultimate last step of 4.14 ± 0.05 st/s. A similar ratio is observed when performing a jump from a short run up: 2.16 ± 0.02 m versus 2.15 ± 0.02 m for the length of steps, and the frequency of steps increases when the last step is performed from 3.92 ± 0.05 n / s up to 4.20 ± 0.12 st/s.

The ratio of the length and pace of the last two steps of the run during long jump and jump exercises

Exercises	Step length, m		Frequency steps, st/s	
	Penultimate	Last	Penultimate	Last
1	2,37±0,15	2,21±0,16	4,14±0,05	4,57±0,07
2	2,35±0,04	2,39±0,02	3,92±0,06	3,99±0,09
3	2,18±0,05	2,13±0,03	4,32±0,07	4,65±0,06
4	2,15±0,02	2,16±0,02	3,92±0,05	4,20±0,12

When you perform option 2, the length of the last step is reduced to 2.21 ± 0.16 m compared to the length of the penultimate step, which amounts to 2.37 ± 0.15 m. And the frequency of steps in similar periods is, respectively, 3.99 ± 0.09 against 3.92 ± 0.06 st/s. With the eleven-step long jump, the length of the last step also decreases, and the frequency, on the contrary, is higher when the last step is performed (Table 1).

It is interesting to note that performing the eleven-step long jump is accompanied by higher rates of movement frequency (line 3, table 3) than with a full run (line 1, table 3). And during the eight-step run jump, these indicators have a slightly smaller value, 4.20 ± 0.12 st/s, but also exceed this figure when pushing off from a full run, keeping the same frequency of steps when performing the penultimate last step (line 4, table 3). Thus, it turns out that the frequency of movements is higher when performing the last step of the run in all the conditions studied, which contributes to the formation of the desired rhythm of movements in this part of the run. The main differences relate to the change in the ratio of the length of steps when performing a take-off run and jumping from eleven steps. The closest in structure to the ratio of the length and frequency of steps is observed when performing jumps in the run in eight steps.

The analysis of the ratio of the length and frequency of steps during the run in long jumps and jump exercises allows us to relate the changes that occur to the speed indicators. Based on the obtained changes in the kinematic differences performed by the jumpers in the movements being studied, it can be summarized as follows. A long jump with a full run is different from a take-off run with the dynamics of the increase in run speed. In the take-off run in the penultimate step, there is a slight decrease in speed, which occurs due to a decrease in the length of steps in the last three steps of the run and a simultaneous increase in the movement frequency indices.

When performing a long jump with an average run-up, the average length of the last three steps increases compared with the average length of the last 6 steps,

but their size is less than when performing a jump with a full run. Therefore, the jumper seeks to compensate for this at the expense of higher rates of frequency of movements performed in this part of the run. However, the athlete manages to score less speed than during the run. In relation to the dynamics of changes in the length of the steps and the frequency of the movements performed, this exercise is the closest in kinematic structure to the kinematics of the long jump with a full run.

Finally, the main differences in the kinematics of a jump from a short and full run up are that the athlete does not reach the required length and frequency of steps and performs movements at a much lower speed of movement.

Comparing the data presented with previous studies, it should be noted that to the presented differences in the kinematics of the long jump with a full run and jump exercises, you should add different dynamics of the speed increment at the end of the run of the athlete. According to previously published data, the angle of inclination of the speed curve for a jump in length with a full run-up is 25º, for performing a take-off run - 37º, for a jump from an average run-up - 44º, for a jump from a short run - 45º.

Thus, the presented data indicate various options for constructing the rhythm of movements when performing the analyzed jumping exercises. The ideal option seems to be when athletes quickly start a run, with maintaining a constant increase in speed in the middle of the run and increase the frequency of movements while maintaining close to the maximum step length. Performing a long jump with a short run-up does not allow the athlete to achieve the values of the step length and frequency of movements characteristic of a long jump with a full run. From this point of view, these exercises can be used only in the preparatory period of the annual cycle; in the competitive period, these exercises are simply inexpedient.

Running repulsion with repulsion has its advantages, because it allows you to perform steps of considerable magnitude and demonstrate high rates of movement frequency, but the ratio of the length of the last steps of the run has a different dynamics and does not allow you to perform movements with the maximum frequency at the last steps of the run, which can contribute to creating the wrong rhythm of movements when doing repulsion.

The long jump from the average takeoff has the closest structure to the kinematics of movements to the long jumps from the full run, but the dynamics of the increase in the speed of the runway differ significantly from the performance of the long jump from the full run.

Conclusion Analysis of the dynamics of change in speed and comparison of this indicator with changes in the length and frequency of steps during the execution of various jumping exercises allows us to conclude the following:

• a long jump from a short run does not allow the athlete to reach the values of the stride length and frequency of movements characteristic of a long jump from a

full run, but can be used in the preparatory period to form the basis of the correct rhythm of jumper movements;

• The long jump from the average takeoff has a similar rhythm for performing movements with the long jumps performed from the full run, but the indicators of the achieved speed at the moment of pushing away are much lower than during the long jump from the full run. This allows us to recommend this exercise for training in the preparatory period and partly during the pre-competitive micro cycles of the long jumper training;

• running of the take-off run allows to achieve significant speed at the last step of push-off in the jump and contributes to the achievement of maximum results, it is recommended as a means of training in the pre-competition training period;

• an increase in the speed of pushing away is achieved by a jumper mainly due to an increase in the frequency of steps at the last step of pushing away and requires the inclusion in the training of athletes of exercises contributing to an increase in this indicator.

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从中国语文课堂语言文化立场教授俄语成语的方法
METHOD OF TEACHING RUSSIAN IDIOMS FROM LINGUISTIC-CULTURAL POSITIONS IN CHINESE CLASSROOM

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注解。　本文从中国观众文化文化的角度探讨了俄语词汇单元的教学问题，并提出了与俄语词汇单元翻译成汉语的等效程度相关的各种教学方式。

关键词：成语；短语单位（PU），俄语作为外语，文化语言学，文化语言能力；学习方式。

Annotation. *This article discusses the problem of teaching Russian phraseological units from the standpoint of cultural culture in Chinese audience and suggests various ways of teaching related to the degree of equivalence of the translation of Russian phraseological units into Chinese.*

Keywords: *idiom; phraseological unit (PU), Russian as a foreign language, cultural linguistics, cultural linguistic competence; ways of learning.*

Idiom as the fruit of labor and intelligence of each nation is the quintessence of language and the treasury of culture. Recently, phraseology has been intensively introduced into the practice of teaching Russian as a foreign language (RFL) in China, since the study of Russian phraseology makes it possible for Chinese students to immerse themselves in a foreign national culture, to become familiar with customs and traditions, beliefs and traditions, myths and legends, and Finally, to the peculiarities of the national picture of the world, reflected and fixed in this language. [1, p.132]. In this regard, the problem of teaching Russian phraseological units in classes on RFL is highly relevant, because the study of Russian phraseological units contributes to the formation of not only linguistic and communicative, but also cultural studies of students.

Idiom are the most indicative of the ethnocultural units and are the cultural heritage of a particular people. By virtue of this, the study of the phraseology of a language allows for a deeper understanding of the culture of the speaker of the given language. The Chinese scholar Liu Yunhun wrote: "A significant part of the phraseology of the Russian language, especially non-equivalent, is taken from the

Bible, Greek mythology, Russian history and Russian folklore" [8, p.115]. She also noted that an error in interpreting cultural facts is more serious than in a language, and therefore, when translating phraseological units, one should be aware of their national and cultural specificity.

Russian researcher V.V. Vorobjev understands the relationship between phraseology and culture: "The phraseological corpus of any national language is a unique source of knowledge about the culture of a people. In the deep connections of stable verbal complexes, messages about the world of a particular country are coded: about its geography, climate, mental state of the people, lifestyle at different times, etc. The cultural elements are drawn from the denotation, the phraseological unit (phraseological unit) lying in the figurative basis, and to describe it, it is necessary to decipher the metaphors, to find images, to relate words and phrases to cultural categories, to reflect on the cultural language and, of course, to describe cultural discourse" [3, p.31].

The study of the national-cultural identity of phraseological units is closely connected with the problems of studying human consciousness, perception of the world and ways of understanding it, reflected in language. Every nation sees the world through the prism of its language and reflects it in national-specific images [6, p.211]. In this regard, the study of the phraseology of the Russian language can help Chinese students to get acquainted with the language picture of the world and the nature of the Russian people, which is very important in intercultural communication.

Acquaintance of Chinese students with Russian phraseological units is an important and necessary step in the development of Russian as a foreign language, and the study of Russian phraseological units has the following functions:
  - broadens the students'outlook;
  - gives knowledge of the culture of the language being studied;
  - develops linguistic and cultural competence;
  - facilitates the process of adaptation of another's culture;

In the process of studying Russian phraseological units, students inevitably encounter their translation. According to the degree of equivalence of the translation of Russian phraseological units into Chinese, the analyzed phraseological units can be divided into the following types: full equivalents (phraseological units in two languages have the same meaning, structural, grammatical and stylistic characteristics, as well as the internal form), partially equivalent (phraseological units, which in two languages have the same meaning, but different figurativeness) and nonequivalent (phraseological units that are of national identity, it is impossible to find the corresponding equivalent in another language) [2, p.137]. Each of these types requires a special way of learning, which we consider below.

We can cite quite a few examples of fully equivalent phraseological units both in Russian and in Chinese. Compare:

Russian *Better to see once than hear a hundred times*; Chinese 百闻不如一见 (literally: its better to see with your own eyes than to listen from other people a hundred times);

Russian *Misfortune never comes alone*; Chinese 祸不单行 (literally: troubles never come alone);

Russian *Add fuel to the fire*; Chinese 火上浇油 (literally: add oil to the fire);

Russian *Strike while the iron is hot*; Chinese 趁热打铁 (literally: strike while the iron is hot).

Such idioms to understand Chinese students easier. As a result of the unity of the real world and the commonality of human thinking, different nations can have the same understanding of objective reality in similar social and work practices, which is reflected in the language picture of the world. In this regard, in Chinese and Russian languages, there are many phraseological units with similar meanings that correspond to each other.

Partly equivalent are those phraseological units that have the same meaning in two languages, but different images that underlie the rethinking of basic expressions, for example:

Russian *To fear wolves - not to go to the forest*; Chinese 不入虎穴，焉得虎子 (literally: without getting into the tiger's lair, you will not catch the tiger cub);

Russian *Kill two birds with one stone*; Chinese 一箭双雕 (literally : one arrow to kill a pair of eagles);

Russian *Cowardly like a hare*; Chinese. 胆小如鼠 (literally : funky like a mouse);

Russian *Cast pearls before swine*; Chinese 对牛弹琴 (literally : play for cow on lute).

The examples show that the people of the two countries sometimes perceive the environment differently, since from ancient times they lived in different settings, the cultures of the two states developed in different ways, they have different beliefs, traditions and customs, history and mentality. Let's give an example of biblical phraseological paper *to throw beads in front of pigs*. 对牛弹琴 (lit.: play for the cow on the lute); the image of a pig in European and Russian cultures personifies a dirty, stupid, dull animal, which, as we see in this phraseologism, can not understand that beads are a precious treasure. In Chinese idiom, this image is "replaced" by a cow symbolizing dullness and simplicity, which is unable to enjoy beautiful music.

In the process of teaching such phraseological units, a comparative method is often used. The presentation of Russian phraseology in comparison with Chinese is the linguistic basis of the teaching methodology of Russian phraseology [1, p.133], since foreign students often think in their native language and compare Russian language material with it.

The group of non-equivalent phraseological units includes such phraseological units that vividly express the national color. For example,

The seventh water on kissel;
They don't go to Tula with their samovar;
Not all Maslenitsa for a cat, there will be Lent;
How mamai passed.

Such idioms can not find the appropriate translation in Chinese, and in the learning process they are difficult for Chinese students. One of the best ways to teach Chinese students without equivalent phraseological units is to use synonymous expressions, for example, *the seventh water on kissel*, we can find a Chinese synonymous expression. 八竿子打不着的亲戚 (literally : eight sticks do not get relatives; figurative meaning: a very distant relative). Although this method can help Chinese students more easily understand the meaning of this phraseological unit, but with this translation, Russian phraseological units lose their national identity and Chinese students do not acquire knowledge of Russian culture.

Another way to learn to use non-equivalent phraseological units is to explain semantics. In this case, the RFL teacher, in order to achieve an understanding of the meaning of the phraseological unit as a whole, explains to the students the meaning of its individual component words, reflecting national and cultural specifics. So, for example, familiarizing Chinese students with Russian FE *in Tula with their samovar do not go,* we can explain the meaning of the word *Tula: Tula is a large industrial city that is known for producing metal everyday objects (mainly samovars).* And in this way, Chinese students can immediately understand what is being said. The method of explaining semantics will not only help Chinese students understand the meaning of non-equivalent phraseological units, but at the same time preserve the national specificity of Russian culture, reflected in these phraseological units.

So, during the training of Chinese students in Russian phraseological units, the RFL teacher must choose the optimal way of teaching in order to convey both the meaning and cultural information of the phraseological unit. The method of teaching Russian phraseological units from the linguistic-cultural positions in the Chinese audience is of great importance for the formation of the linguistic and cultural competence of Chinese students and the competence of intercultural communication.

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利用互动技术教授外语写作技巧
THE USE OF INTERACTIVE TECHNOLOGIES
IN TEACHING FOREIGN LANGUAGE WRITING SKILLS

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注解。　本文讨论了在学习过程中使用新教育技术的必要性，即在外语课程中学习书面语言过程中引入交互技术的可行性。　作者提供了学习外语写作的互动练习的例子。　重点放在旨在形成现代学生的拼写技巧和书面语言技能的练习上。
关键词：外语写作，互动方式，互动技术，互动练习。

Annotation. *The article discusses the need to use new educational technologies in the learning process, namely the feasibility of introducing interactive technologies in the process of learning written language in foreign language classes. The authors provide examples of interactive exercises for learning foreign language writing. Emphasis is placed on exercises aimed at the formation of spelling skills and written speech skills in modern students.*

Keywords: foreign language writing, interactive approach, interactive technologies, interactive exercises.

Currently, significant changes are being made in the methods and approaches of teaching a foreign language at school, which is directly related to the introduction of the main provisions of the latest generation of Federal State Educational Standards (FSES). Thus, the main goal of the modern FSES is the implementation of the system-activity approach, which implies a variety of organizational forms, consideration of the individual characteristics of students, the use of interactive technologies in the process of learning a foreign language in order to improve the quality of education. The interactive approach to learning is a modification of the activity approach, the foundations of which were still laid in the works of S. L. Rubinshtein, A. N. Leont'ev, P. Ya. Galperin, and others. [6] Among the leading signs of interactive interaction in a foreign language class are polylogue, dialogue, mental activity, sense-making, active exchange of opinions, freedom of choice, situation of success, optimism of evaluation, reflection, etc. Thus, the interactive

approach to learning and teaching has a number of the following advantages:

1) it does not allow one participant to dominate the educational process over others;

2) it gives everyone the opportunity to equally speak in class, exchange ideas, come to common conclusions;

3) it is able to interest and motivate students for a long time to learn English, as it includes various forms of work and excludes uniform tasks;

4) it contributes to the formation of tolerance among students;

5) it stimulates to express his opinion with arguments;

6) it helps students to become more confident, not to be afraid to use means of a foreign language (FL) to express their own thoughts.

According to the FSES of the basic general education [5], the main practical goal of teaching FL is the formation of foreign language communicative competence, one of the components of which is the formation of communicative skills in written speech as the form of speech activity. In practice, teaching with the use of interactive technologies in a foreign language classroom is more often realized while teaching oral speech than speech writing. According to L.P. Tarnaeva, this tendency can be explained as follows: "The main specific condition for writing is the absence of direct contact between the participants of communication" [7]. Consequently, the very act of receiving and transmitting information is distanced in space, and therefore in time. Learning writing in a foreign language through the use of interactive exercises requires a modern teacher to have a creative approach, innovative thinking and a new look at the educational process. The analysis of educational and methodical literature shows that not enough attention is paid to learning foreign language writing on the basis of interactive technologies.

In order to correctly and clearly state your thoughts on a piece of paper, you must have spelling skills, the ability to build compositionally and correctly write out the desired message, as well as the ability to choose adequate lexical and grammatical means. Due to the fact that the quality of the generated written text in a foreign language is directly related to the level of formation of certain skills and abilities, interactive written exercises can be divided into two groups:

1) aimed at the formation of spelling skills;

2) aimed at the formation of written speech skills.

Interactive technologies such as running dictations, informational inequality, joint writing projects, creating interactive surveys, brainstorming, "chain writing", mingling ("Brownian motion") can be effectively used in foreign language lessons of teaching writing, exchange of e-mails, etc. The variety of forms and types of work in the listed technologies enriches the content of the lesson, accelerates its pace, motivates students to share their knowledge and experience [6]. Interactive technologies can be used to develop spelling skills as well as speech productive

skills.

Let us consider some examples of interactive tasks for the formation of students' spelling skills, which we use in the 6th grade while teaching foreign language speech writing. One of these tasks can be called "Write on my back". We divide students into several teams. The very first student stands in front of the board, the others behind him in order. The teacher dictates the word, the students write only one letter of this word on each other's back with a finger in order to make up the whole word. So, the second student writes the second letter of the word on the back of the first student and so on. Every student standing in front of the board writes the letter on it that was written by another classmate on his back. Then this pupil goes to the end of the line and the next one does the same procedure until there is the whole word written on the board.

Another similar task is "Where's the logic?". The task is to guess all the hidden words according to the pictures and symbols shown on the slide of the presentation. Class can be divided into 2 or 3 groups. The winner is the team which writes down all the words quickly and correctly.

As one of the interactive tasks for the formation of written speech skills, students can be asked to divide into teams and look through the pictures shown on the slide. Their task will be to arrange the images in chronological order and then each team member writes one sentence according to the pictures so that there is a completed story written by the whole group. Then you can share stories and play them by role. This exercise can be done in another way: you can give the beginning of the story to one team and the end to another, so both teams will have different stories that can be played in the next lesson.

For the simultaneous formation of spelling skills and foreign language writing skills, you can play the game "Field of wanders". The game will require one host - a teacher, 2-3 teams, handouts. The game is best carried out as a consolidation of the learned lexical material and its further use in writing. On the board, the teacher records the hidden word within the framework of the topic being studied. Each letter of the word is covered with a white sheet of paper. The teacher reads out either the definition of the word in English, or asks a question, the answer to which will be the given word - everything depends on the level of preparedness of your students. The teams then try to guess the word by spelling it. After all the words are guessed, students can use them to write a short story or make up sentences.

Thus, learning a foreign language with the use of interactive technologies creates a cumulative effect that helps students to master their knowledge of a foreign language and to form their teamwork skills, communicative competence, responsibility for decisions, cognitive activity and tolerance [2]. Interactive exercises not only improve and develop students' communication skills, but also increase the speed of learning and enhance pupils' motivation in learning a foreign language.

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存在未来男人的问题
PROBLEMS OF THE EXISTENCE OF A MAN OF THE FUTURE

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注解。 文章分析了后人的形成及其存在的替代方法。
关键词：后人类，超人主义，进化，技术奇点，纳米技术，超意识
Annotation. The article analyzes the formation of the posthuman and the alternative to his existence.

Keywords: posthuman, transhumanism, evolution, technological singularity, nanotechnology, hyperconsciousness

In less than a decade, cyberspace has become not only an environment in which interpersonal interactions take place, semantic contexts are set for a huge mass of people defining their behavioral culture, but has become one of the main bases in the life activity of both humanity as a whole and an individual person. Modern information technologies have changed not only the nature of a person's work, his social connections, the nature of social communications and the social relations themselves, they have changed and continue to change the person himself.

The analysis of this unique situation in its own way, when radical reformatting of the anthropological, sociocultural and even ontological foundations of modern human life is taking place, is an actual research topic located at the junction of ontology, philosophical anthropology and social philosophy.

The main goal of the article is to trace the transformation of a person's ideas about himself and the idea of a person of the future in the conditions of the development of information and communication sphere. Humanity as a species, for the first time, faced such a serious challenge that casts doubt on the very existence of man. What will this postman be? And who is he at all? Will he have something from the person, or will it be a new "product" of the technogenic sphere?

The idea of development is the basis and explanatory principle of the fundamental posthuman notions: a person is not the crown of earthly intelligent life, but only the initial stage of its further development; the qualitative development of earthly intelligent life is possible only on the basis of the development of scientific

and technical knowledge and skills; leaving in the past the known limitations of people, people must constantly evolve.

The earliest, rudimentary form of ideas about a person's fundamental change should be considered ideas about the afterlife - as it seems to be innate to a person, dimly present in him already in the initial phases of primitive consciousness. There is hardly a more influential factor in a person's life than an awareness of one's own mortality. The knowledge of death permeates human nature and underlies the whole diversity of human culture. Death exists only for the living, not only as an end, but also as a constant ultimate self-test of life, suggesting its completion, integrity in any act, any deed or act. Man's disagreement with the naturalness of death and the desire for immortality is reflected in the most ancient beliefs. After the physical death of a person, some radically different form of existence awaits, and he himself does not in any way create it, its presence and character do not depend on the person. But almost at the same time, also at the stage of deep archaic, ideas arise that the afterlife fate may be different, and there are certain actions of a person by which he can influence this fate. So a cult arises. However, the cult practice does not transform the human being, suggesting only certain acts of the believing consciousness.

But the most thorough, reference model of transformative anthropological practice on a religious basis are the spiritual practices of various religions. It is not clear whether such a transformation is possible apriori, but, nevertheless, spiritual practices arise in all major world religions. In the structure of religious transformative practices and beliefs, there is a combination, conjugation of one's own human activity and the actions of external, divine forces [1, 13].

The most vividly the scientific and philosophical idea that man is only an intermediate link on the way from animal to superman was developed in his works at the end of the 19th century by the German philosopher Friedrich Nietzsche. For example, in his work "Thus Spoke Zarathustra" he writes: "Man is something that must surpass ... What is a monkey in relation to man? Ridiculous or painful shame. And the same must be a man for a superman: a laughing stock or a painful disgrace. " Without belittling the importance of man, Nietzsche postulates a whole worldview, according to which all human efforts should be directed towards preparing the world and the man himself for the arrival of the unshackled morality and truly free superman. "Man," he writes, "is an arrow of longing thrown on the other side" [3, 18]. The arrow is thrown, but whether it will reach the target or not - one cannot say for sure in advance. Therefore, man as a process, as uncertainty, as tension between two extreme levels, is a creature that is fundamentally subject to risk. Human risk, in contrast to the risk that other species, in particular, animals, plants, etc., are exposed to, is very special: no other natural creature is in danger of losing its species quality, no one can voluntarily change its fundamental identity.

The man in the anthropological picture described by Nietzsche is at risk of ceasing to be human.

Nietzsche, however, did not mention technology in this context. He believed that man must evolve into perfect form himself, using self-development.

This, however, did not prevent the "superhuman" aspect of Nietzscheanism from turning into a new technocratic form - transhumanism in the 20th century.

The term "transhumanism" was borrowed from Julian Huxley, one of the founders of this trend, but he talked about "understanding the new possibilities of human nature," in which a person remains a human being. Modern transhumanists consider "evolutionary humanism" as a process aimed at overcoming human nature and transition to a qualitatively new state. Project-utopian thinking comes to the scene, which is a motley picture where all sorts of ideas such as "human reform", "changing human nature", "eugenic human cultivation", "body restructuring", etc. are richly represented.

It is in the modern era that, for the first time in the history of man, it becomes technically feasible for him to fully transform himself, his nature, and constitution. On this frontier, it is necessary to raise anew almost all the basic questions of anthropology: about the existence of "nature" and the possibility of "determining" man, about personality, about individual and species identity, about value and ethical foundations of human existence, about limits of admissibility of transformations. Today, it is mainly the transformation itself that is being discussed, its details, the image of a person that will be achieved during the change, as well as the immediate immediate consequences of these events that will develop in the era of technological singularity. According to Kurzweil, the technological singularity may begin as early as 2045 due to the emergence of powerful artificial intelligence and active cyborgization of people, that is, the replacement of parts of the human body with artificial, but more efficient counterparts.

Technological singularity is a predetermined point in the future, when the evolution of the human mind as a result of the development of nanotechnology, biotechnology, artificial intelligence and cognitive sciences accelerates to such an extent that further changes will lead to the emergence of the mind with a much higher level of performance and a new quality of thinking.

From the standpoint of a cybernetic approach to evolution according to V. Turchin [4], a similar period can be characterized as a metasystem transition or a transition from a locally distributed consciousness to a networked integrated supermind.

The purpose of highlighting the "historical stages of the development of posthuman notions" is to link posthuman issues to well-known general historical concepts that provide a common historical vision of the posthuman. The leading futurologist and philosopher Max More, who in 1990 developed his own doc-

trine "Principles of extropianism" and outlined the ways of human transition to post-human existence, played a leading role in the development of the postman. In 1992, together with Tom Morrow, he created the Institute of Extropy, which discussed the neo-Darwinian futurological projects proposed as the "ideology of the future." As Mor writes, "when technology allows us to overcome ourselves in psychological, genetic and neurological aspects, we, as transhumans, can transform ourselves into posthumans - creatures of unprecedented physical, intellectual and psychological abilities, self-programmed, potentially immortal, unlimited individuals." [5].

People may turn out to be completely artificial creatures (based on artificial intelligence) or the result of a large number of changes and improvements in human or transhuman biology (the transition from human to posthuman). Some post-people may even find it useful for themselves to give up their own bodies and live as information structures in giant super-fast computer networks.

One of the most promising and least fantastic areas for transforming the foundations of human nature is digital virtualization of both man and the whole space of his existence, as a result of which a separate type of postman is formed - HomoVirtualis. HomoVirtualis is a naming convention for the emerging special human species that is actively involved in the virtual reality space, where it implements individually and culturally significant behavioral strategies. The emergence of HomoVirtualis is technologically based on the "computer revolution" of the second half of the 20th century, as a result of which it became possible for man to create a new space of his own existence - computer virtual reality. Virtual computer reality, as defined by V.V. Bychkova and N.B. Mankovskaya is a "special space-time continuum created using computer graphics and sound effects and fully realized in the psyche of the subject" [6, 369]. At the same time, a person within its framework has the ability to partially or fully realize his own subjectivity through acts of simulation activity, transforming the space of virtual reality. There is a process of formation of a new type of consciousness, which is no longer a subject-individual, but a postclassical hyperconsciousness.

The anthropological dimension of the existence of HomoVirtualis clearly demonstrates the degree of its transformation and the difference from the "traditional" person. First, the dematerialization of a person, which turns into an information digital unit, losing its corporeality and traditional forms of representation, draws attention to itself. Secondly, the virtual-digital avatarization is replacing the material and physical constancy. Thirdly, computer reality gives HomoVirtualis many superhuman abilities.

As a result, a "virtual person", on the one hand, can fully realize his superhuman aspirations within the framework of existence in the virtual space, on the other hand, he loses his anthropological identity, turning into an information-digital

plurality of avatars. In this regard, we can agree with PS. Gurevich, who believes that in the XXI century, there is a rapid deantropologization of man [7].

Such a paradigm shift, implying a kind of invasion of "non-human" entities into the originally human world, will require a revision of many modern norms, practices and foundations - political, ethical, philosophical.

But the "superman" that is emerging today, is a movement from higher organic, complex forms to lower, elementary, mechanical. Modern technological civilization creates a person complex in its external manifestations, as complex as the machines with which it works, and the simplified inner world.

In general, the creation of a computer program that is equal to, so to speak, the human consciousness, is highly utopian. Not in the sense that a program could model any individual human functions — some of them, these programs are already being performed more perfectly than a person already — but in the sense that consciousness has resources that are inaccessible in principle information technology. This, in fact, is the main stumbling block in the creation of the cyborg-superman.

Cyborgs and post people, built on the basis of modern scientific technologies, will always be lower than man in the sense of his higher spiritual abilities - creativity, moral and moral consciousness, perception of beauty, faith, hope, love. Therefore, the "evolution" of man to posthumans - cyborgs, promoted by transhumanists, and in fact, replacing man with cyborgs will always not be human development, but human degeneration, the loss of divine gifts that cannot be modeled within information technologies.

To make the emergence of a posthuman singularity possible, many current and future people will have to pay a very expensive price. One can imagine how, in the name of a majestic posthuman future, posthumanists will justify the extinction of such humanistic ideals as individual freedom, self-realization, and personal and social morality.

After creating self-developing programs ("point of singularity"), it will be time to create robots that produce themselves. Robots will gradually learn to do any work and will inevitably crowd out a person subject to fatigue and imperfection in all areas. By virtue of their indefatigability and the exponential progress of their capabilities, these artificial creatures will eventually become more perfect than man. The audit of the legal basis of man-machine communication has already begun, and one example of this process is the European Parliament Resolution of February 16, 2017. Its authors attempted to establish such ethical and legal norms for the coexistence of humans and high-tech robots created using artificial intelligence technologies that would not suppress the development of innovations. So, robots with which we may soon be neighbors, will a priori "do good" (everything is in the interests of people) and practice the principle "do no harm". And a person will be granted the right "independently" and "voluntarily" to make decisions about the conditions of interaction with machines [8].

On this way to the new world of smart machines, the task of loading consciousness should be solved, i.e. creating a complete model of the human brain, and transferring the human consciousness into the machine by "scanning" it.

"You can vouch for - a person will disappear, as the face drawn on the coastal sand disappears," wrote M. Foucault. But what will be the world without a person? What is he replacing? J. Deleuze in the appendix "On the Death of a Man and on the Superman" to his book on Foucault gives this answer. "Forces in man enter into relations with external forces: with the power of silicon taking revenge on carbon, with the forces of genetic components taking revenge on the body, with the power of agrammatics taking revenge over the signifier ... As Foucault would say, superman is something much smaller than the disappearance of existing people, and much more than a change in the concept: this is the coming of a new form, not God and not man, and one can hope that it will not be worse than the previous two "[9, 98]. And if it gets worse?

The appearance of the first post-people will also automatically divide people according to an unprecedented principle and will create a huge conflict potential in the social, economic and political spheres. In other words, it will give rise to unpredictable scales of inequality, as well as confusion in the sphere of law: what rights does a person have, and what rights does a postman have? Is a posthuman a human and so on.

The consequences of this artificially created inequality will be unprecedented, because previously, despite all the differences, people were united by one important fact - they were a single type of Homo Sapiens. Now humanity is divided into two (or even more) species.

In fact, it will destroy the entire social system that currently exists in many countries and is based on a certain philosophical foundation - for example, on the concept of natural law (all people are born equal in rights and from birth are endowed with certain rights), which simply loses all meaning first postman. How can such ideas be postulated if people are divided into several types and will not share common human nature?

At a time when a man got out of the inequality that reigned throughout most of his previous history, he risks finding himself in an even more unjust world than ever before - all thanks to biotechnologies and transhumanists, no matter how good their intentions are, says F Fukuyama [10, 185].

Summing up, it is obvious that disputes about the essence of program personalities will not subside in the near future, it remains only to "independently" choose their own strategy of interaction with potential neighbors and fellow citizens. One way or another, humanity can retain its subjectivity, even by sharing it with different personalities of non-human nature. But will we be able to maintain humanity?

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在线请愿的类型作为特定的书信文本
GENRE OF ONLINE PETITION
AS A SPECIFIC EPISTOLARY TEXT

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注解。 本文讨论了在线请愿作为多范式书信体的各种特征。
关键词: 范式，在线请愿，大众传媒。
Annotation. *The article discusses the features of online petitions as varieties of polyparadigmatic epistolary texts.*
Keywords: *paradigm, online petition, mass media communication.*

Today, speaking of the paradigm in linguistics, we should agree that most of the specialists represent it as a way of posing the problem and its solutions. And since in a linguistic society, due to the difficulty of the object of study, it is difficult to solve all problems in one way, then "linguistics itself is by definition polyparadigmatic". [7].

Differentiating the abstract and methodological interpretation of the term "paradigm", some linguists use the concept of a "disciplinary matrix", relating it to a particular model of statement about the problem and their solutions, that is, methodological principles [1].

The epistemological meaning of the key term should be based on the understanding of the ontological essence of the object itself - language - as a complex phenomenon, which cannot be interpreted unambiguously. In this regard, in the opinion of the majority of reputable foreign and domestic scientists (N. F. Alefirenko, P. Bourdieu, G. Wagner, V. 3. Demyankov, E. S. Kubryakova, V. A. Maslov, G.P. Melnikov, G. Rikkert, Yu.S. Stepanov, M.J. Tagaev, V.N. Teliya, T.N. Khomutov, and others), it can be argued that in modern times In the meticulous study of language, a polyparadigmatic approach prevails, "methodological plural-

ism" [2], suggesting an integrative and interdisciplinary method for solving a set of issues related to the study of the "changing type of language" [6]. The use of different methodological principles in the analysis of linguistic facts that complement each other is advisable when systematically and comprehensively considering language as a means of communication, representing cognition, knowledge, action, code of civilization and culture. As a result, there is a multidimensional, multi-vector "addition" of the problem field of study, which opens up significant prospects for scientific research.

"The polyparadigmatic approach presupposes in no way the systematic nature of the experimental paradigms, but the coherence of the results obtained with the support of different paradigms. The integrity of experimental paradigms in the polyparadigmatic scenario is implied by us not in the sense of the Hegelian logic of identity ("the principle of dialectical negation"), but also as the "unity of diversity" (G. Rickert). Otherwise, various paradigms are in the polyparadigmatic scenario not in the antithetical relationship ("either-or"), but in the heterothetical ("as, thus,") "[4].

In the vein of paradigm, genre studies are considered to be promising (M. M. Bakhtin, V. V. Dementyev, K. A. Dolinin, V. A. Salimovsky, K. F. Sedov, M. Yu. Fedosyuk, T. V. Shmeleva and others), in particular, a multi-aspect study of epistemological texts (N. I. Belunova, N. Yu. Busorlina, N. A. Kovaleva, L. V. Nizhnikova, E. V. Polyakova, etc.).

According to this concept, an epistolary is interpreted as a complex, multi-purpose stylistic figure represented in discourses of various kinds due to the properties of clichiness, reproducibility, polyfunctionality and polycodularity [3]. Directly polydiscourse type of epistolary, which forms its ontological essence, establishes equally as its demand in different areas of interpersonal and public communication in synchrony and diachrony, and gives the opportunity to talk about the specifics of the epistolary genre in the polyparadigmatic dimension.

The polyparadigm of epistolaria is studied in 2 nuances:

1) ontological (as well as the quality of this genre and the expression of its ontological essence, considered in the context of other data: polydiscursivity, poly-and full functionality, polycodularity, clichiness, reproducibility of textual modification);

2) epistemological (from the point of view of the metodologicheskoy design, allowing the study of this single genre adequate - single - method).

Epistolary is characterized by researchers and as well as the material used, and as an independent subject of interdisciplinary research in the humanities in general and linguistics in particular.

As an example, showing the rationale and rationality of using the polyparadigmatic alignment in genre studies, consider the texts of online petitions relating to

electronic media communication, performed using information transfer in digital form (A. B. Bushuev, T. G. Dobrosklonskaya, L. R. Duskaeva, V. I. Karasik, V. B. Kashkin, etc.). According to the correct remark of M. McLuhan, electronic communication resources form a "galaxy of communications," which replaced the period of writing (the Guttenberg era) [5].

Online petition is a form of electronic epistolary text that has received extensive advancement in the field of today's mass media communication due to the availability of web generation and distribution, timeliness and efficiency in achieving results, saving effort, time and material costs. Thus, the creators of Change.org's "global open platform" summarize the fact that "over one hundred million people from 196 countries" decided to use their online services. Our own importance in popularizing the electronic petition genre, which is manifested in the expansion of a set of certain Internet services, is, in our opinion, an activity aspect typical of the consciousness of a part of citizens of the contemporary Russian community to the understanding of the world order, which can be regarded as an expression social initiative and active citizenship.

Special Internet services, problem-specific sample surveys, discussions in groups of social networks and in the framework of Internet forums provide an opportunity to create an online message to representatives of regional or state authorities online. An individual or collective reflection, which is associated with the comprehension of an everyday social problem, is considered to be a predominantly collective reflection. The goal is to express a request / requirement to eliminate this problem using a directly formulated solution, collecting signatures in support of the proposed initiative, promoting the petition and publicizing the results.

Texts of online petitions represent a complex genre, requiring, respectively, a comprehensive study.

Firstly, these texts demonstrate the correlation between the genre epistolary canon, thus, without exception, all the basic statements of the theory of epistolary are applicable to their consideration [3].

Secondly, in the communicative process, the figures of the creators and signatories of the petition are of particular importance in explaining the need for studying online petitions in the nuance of the concept of a language personality.

For an epistolary-media linguistic personality participating in an interactive dialogue on acute social problems, it is common for them to understand their belonging to a team of like-minded people. Such a social commonality of the creators of the petition and the signatories seems to be an important regulator of self-awareness and social action, based on the individual identity of the participants in the interaction, since the positioning of the individual as the author of an open online petition requires the manifestation of courage, integrity, determination, persistence. According to our research, in the analyzed texts the model of the self-

presentation of the creators from the first person of the plural number dominates.

Suppose that demonstrating the precedent of group authorship of online petitions enhances the influential potential of the text and encourages the recipient to reciprocal influence: "We, students of institutions and colleges, leaders and activists of student institutions, representatives of youth organizations, and, moreover, Active and not indifferent citizens of the Russian Federation, we appeal to you (presidential aide) with a wish to stop a gross violation of the rights of students of the Pavlovsk Agricultural College (Altai Territory). Negative, with the purpose of the educational concept of the state, the fact of impunity of extortion of money from students with impunity is founded in this institution. "

Important participants in the discourse development of online petitions are represented by such participants of the communicative event as signatories seeking to leave a comment on the website of the event: "I don't want children to die" (Natalia Kanenva. Only RemEkoStroy needs to be tested в (Lyubov Zelenina. Petrovsk), "I don't want another tragedy" (Natalia Andreeva, Moscow), etc.

Thirdly, the substantive focus of the petitions, the marking of communicants primarily from the point of view of their social status make it possible to establish the circumstance of the social importance of text-based online petitions and the probability of their study from the standpoint of the concept of social communication and sociolinguistics. , media linguistics, social and political linguistics, legal studies, discourse analysis, semiotics.

So, as of January 1, 2019, one of the sites recorded 558 calls, the distribution of which in thematic groups was as follows: social sphere - 93 topics, human rights - 56, legislation - 78, culture - 42, foreign policy - 53, corruption - 32, education - 50, ecology - 28, political science - 36, health care - 25, rights of livestock - 28, rights of car owners - 31, housing and utilities -24, science - 3, defense - 6 , medicine - 33.

In the description of the type of addressee of online petitions, social status dominates: authors turn to representatives of regional or state authorities. According to our observations, the number of appeals to officials of the highest echelon of power prevails (personally V. V. Putin, D. A. Medvedev, S. K. Shoigu, and others, as well as collective petitions to the Ministry of Education, Culture, and Health and so forth). The authors even address their proposals for solving regional problems in some cases to representatives of state services. As a rule, regional officials are approached with requirements affecting the improvement of the activities of housing, utilities, construction, road repair organizations.

Epistolary communication, carried out with the help of online texts, is characterized by a special technique. The task of the author's communicative work is to publicly discuss the social problem, form a condition for social resonance, and also stimulate the authorities to act (initiate the law, punish the perpetrators, etc.),

and not receive a reply letter peculiarly traditional correspondence. This task is reflected in the formulation of concrete conditions: "We call upon this petition: From the Government of the Russian Federation: to introduce a draft law against domestic violence; From the State Duma: put the law on reading and adopt; From the Ministry of Internal Affairs: to form a special unit for counteracting domestic violence, to introduce a system of protection instructions. "

Fourth, the special importance of the electronic-media communication channel, through which petitions are formed and promoted, makes it possible to explore the texts under consideration from the standpoint of the concept of electronic mass communication, virtual discourse.

A standard online service for providing petition formation and promotion services requires user authorization and contains such structural elements as creating a petition, viewing petitions, poisk, addressee, petition header, addressee, and also information about the number of signatories and their comments of the latter with an indication of the signing of the petition. At the request of the co-creator of the petition, his name can be reflected on the site of the service, and information on participation in the action - in social networks, for example, Face-book. Some sites notify their users about the coverage of the petition problem in the media (with the e-mail address and comments from readers). The formation of "feedback" is promoted by the presence of such active settings as complaining, saying thank you for not being indifferent. Authorized users receive regular email notifications from the site's news feed.

Fifthly, the implementation of the imperative design of the creator and the accompanying strategies of thinking, argumentation makes the study of online petitions from the perspective of the concept of speech influence, psycho- linguistics, pragmalinguistics sound.

The interaction of people with the help of online petitions is not an information exchange procedure, it is the formation of some kind of community that participants can experience in the form of a unified view of the situation, its emotional acceptance / rejection, etc. As a rule, It is certified (in particular, by pointing out data and statistical information) with the aim of convincing potential signatories and recipients: "In the Russian Federation 40% of all serious offenses are committed in the family ... Only in 2017, 8,700 women died from criminal offenses, 10,298 suffered serious damage to health. According to official data in 2017 - 46 thousand minors were victims of violent crimes. About 2 thousand died, 3,6 thousand were injured. Half of these crimes were committed at home. According to official data of the Ministry of Internal Affairs of the Russian Federation as of December 2017, police records cost 212.7 thousand family debaters "(from the address of Alena Popova (Moscow) to the Government of the Russian Federation" No domestic violence ": July 20 In 2017, the petition collected 132,877 signatures).

We consider it necessary to study the texts of online petitions in the plane of functional lexicology, stylistics, text science, the theory of speech genres, rhetoric, culture of speech.

At the genetic level, online petitions go back to the genre of petitions. In the broad-formal and functional-pragmatic relationship, this kind of epistolary text echoes, on the one hand, the genres of open correspondences, correspondences in defense, pro-correspondent correspondences, correspondences in the editorial board, etc., which have been operating for a long time in newspaper and magazine journalism, on the other hand, with numerous varieties of official correspondence - petitions, petitions, statements, declarations, claims, offers, reclamations, guarantees, notices, requests, etc. The presence of journalistic and business qualities in the stylistic organization of online petitions of syncretism creates a "public special order" for this text view.

The study of the language organization of the texts of online petitions shows the specific degree of possession of a verbal civilization by addressees. The latter is necessary to achieve an impact on the target (government representatives) and mass (network users, potential signatories) audience. Most of the texts under consideration do not contain errors, which indicates the specific degree of literacy of their developers and the professionalism of the site creators. We add that in the texts under consideration (first of all, online petitions of journalistic orientation) there are elements of verbal imagery, indicating the authors' desire to build their textual activity rhetorically competently. Let us give an example of the use in the texts of online petitions of the stylistic resources of the language: "Russia was sentenced to the fate of becoming a world outcast - the world's nuclear dump for the civilized world. The world's largest repository for the disposal of highly active long-lived nuclear waste will be built in the center of Russia, near Krasnoyarsk. For the good of others, our land will be poisoned for several million years ... Nuclear burdens will soon be brought to Russia from all continents of the world, even from Africa ... "(referring to Vladimir Putin about banning the construction of a nuclear repository near Krasnoyarsk).

Thus, in connection with the clearly manifested regional tendency of the texts under consideration, the area of issues studied in the framework of regional linguistics and regional discourse studies becomes important in the course of their analysis.

An analysis of the subject groups of online petitions revealed an extensive "geography" of the authors and signatories, a large range of acute social problems that are relevant for both the regions and the country as a whole. Let us give examples of the following petitions: "Free meals at school", "Return summer time to Altai Territory!", "Stop the construction in front of the windows of houses", "Cry of the soul of parents of disabled people !!!" "Save the Children's Art School No. 14 in

the city of Novosibirsk", "On the crimes of the head of Saratov Grischenko O.V.", "Save water on the planet and stop fires in Transbaikalia", "Creating a shelter for animals in Orenburg", "Stop the massacre animals in Sevastopol "," An open letter on the residence of illegal immigrants in the basements of Khimki's houses "," Stop the deputies of Tuleyev collapsing Kuzbass medicine! "and so on.

Thus, the material used in research practice in the field of genre studies (in particular, epistolary) confirmed the feasibility and effectiveness of the use of a polyparadigmatic approach in modern linguistic studies, involving the analysis of a linguistic phenomenon in the nuance of different paradigms (approaches relevant to different linguistic disciplines), in different ways and learning techniques.

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民族认同，心理安全和原型
ETNIC IDENTITY, PSYCHOLOGICAL SECURITY AND ARCHETYPES

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Annotation. *Solving the problem of psychological security for a modern person is closely related to the appeal to the collective unconscious, which activates natural socio-psychological and cultural mechanisms that contribute to maintaining the security of society through strengthening ethnic identity.*
Key words: *psychological security, ethnic identity, archetype.*

Since the realities of the modern world are full of wars, terrorist attacks, natural disasters and various crimes, and the news about them is instantly transmitted through media around the world, the sense of psychological security of the subject

is under serious threat. If we add to this the variety of difficulties that accompany the individual life path of the subject, we will see that there are much more dangers. This puts the problem of psychological security among the key problems of the modern world. "The individual way of resolving the dilemma between safety and the insecurity of life is closely connected with referring to the collective unconscious, namely to archetypes, which in the individual symbolism reflect the primary models of human behavior in universal life situations."

Violation of the psychological security situation activates behavioral constructs corresponding to the images of the collective unconscious, and the person turns to the experience of the ancestors. This circumstance requires in the process of analyzing the interrelation of psychological security with the corresponding archetypical constructs of applying the archetypical approach, from the point of view of which archetypes are considered as universal models of understanding typical social situations and structural schemes of building social interactions corresponding to these situations.

In this regard, it should be noted that a number of studies are based on the idea of differentiating archetypes into universal, of universal significance and ethnocultural, formed within different ethnic cultures and are an unconscious marker of ethnic identity. At the same time, the archetypes are inherent in the very structure of the human psyche, they give a powerful charge of psychic energy, which is difficult to resist, cause a strong affect. In addition, "a person is not able to accomplish individuation, bypassing ethnicity. ... Man is only a tool of this ethnic individuation, its moment, its gap. " Thus, people are different among themselves, like ethnic groups, but at the same time people are not self-sufficient, because they need a couple to continue the race, there is no solid balance between someone else and their own, there is no initiation as an institution of birth and death, there is no own myth. This biological, psychological, sociocultural dependence and insufficiency of the subject fills the ethnos: it can give a couple for marriage, a space of communication and mental development, and initiation, and a myth. A.I. Dontsov, E. B. Perelygina and co-authors note: «Being expressed in the fairy-tale, the mythological ideas work as an efficient instrument of personal identification and socialization, making it possible for the individual to predict effectively the results of social interactions, to build the figurative picture of the world through activating the processes, which overlap the behaviour of fairy-tale characters in real life»[1].

Archetypes in their ethnic dimension appear as "ethnic constants", i.e. "Logically inexplicable, accepted in the ethnic picture of the world for the axiom blocks", on the basis of which the ethnos builds new pictures of the world, provid-

ing adaptation and creation of a safe picture of the worldview at a certain stage of its existence, being an archetypal tool for ordering and stabilizing experience from the outside world. In the continuum of psychological security, the most significant is the idea of the source of good, the localization of the source of evil, and the activity forms of the victory of good over evil. Despite the endless variability of archetypes, in terms of the problems of psychological security, the archetypical source of good reveals itself in the content of the archetypes of the Father, Mother, Hero, House, "we" and the "archetype of conformity".

The Father's archetype is associated with the unconsciously conditioned male element, symbolically embodied in the images of governance, support and protection, reliability and protection. The archetype of the Hero, which embodies humanistic values, ideas of protection against threats and dangers, is the quintessence of cultural expectations. It should be noted that this image is multi-layered: it can be both anthropomorphic and zoomorphic, combine various social roles and functions related to management, help, courage, activity, strength, and deliverance from danger, to make the connection between the upper and lower world symbolically realizing continuity, security and stability of existence. «Condition of security lays the foundation for an individual's comprehension and evaluation of the world surrounding»[2].

The House archetype as a security archetype reflects the sociocultural space of a person's life, mastered and protected. At the same time, the archetype of the House can be viewed in the cosmological aspect, as the cosmos, the universe, nature, and in the socio-psychological aspect, when the society and the inner spiritual world of man, his "co-existence" with Others, etc., are the home. One way or another, the House archetype implies the presence of reliable landmarks that help a person in life. «In contrast to anxiety caused by loss of direction positive environment image yields an important feeling of emotional comfort and establishes harmony between an individual and outer world»[3].

The House archetype can be projected not only onto a person's own dwelling, but also to personify the historical territory of the ethnos, the country and even the ethnos as "its own" space, traditional, safe, protected from adverse influences, in which the moment of uncertainty, unpredictability, uncertainty is minimized. «Scholars concerned in environment impact on human beings admit the significance of physical surrounding for sense of place development, a person's identification with a certain place". In China, the concept of well-being is indicated by a hieroglyph, the literal translation of which is "a woman under the roof". This hi-

[2] Dontsov A.I., Zinchenko Y.P., Zotova O.Y. Notions of Security as a Component of Students Attitudes towards Money // Procedia - Social and Behavioral Sciences 86 (2013) 98 – 103. P. 99. doi: 10.1016/j.sbspro.2013.08.532

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eroglyph can be considered the visual embodiment of security in Chinese culture. Also, the House archetype correlates with the matrices of intergroup relations that are entrenched in the collective unconscious and are related to the interval of such archetypal values as "self" - "alien" / "we" - "they", which mark the link between personal continuity and its recognition by other members of ethnic groups.

A special role in understanding the phenomenon of security is played by the archetypes "we" and "the archetype of conformity," which, in turn, are closely related to the archetype "they". The action of these archetypes is associated with the subconscious emotional-evaluative attitude of the individual to the representatives of his and other ethnic groups, the differentiation of ethnic identity based on the opposition of one group to another. According to Z. Bauman, the dichotomy of "we" and "they" also makes sense only in opposition to each other, since "We" as a whole unity arises in opposition to other cohesive groups with their own norms and values. "There is no such "we" that would not be opposed by any "they", just like the opposite... The process of assimilation and the process of isolation are mutually opposite, but at the same time they interact, are in various combinations." Consequently, the activation of the ethnic "we" archetype, caused by the need for security, inevitably activates the "they" archetype. The interval between these archetypical constructs often becomes a source of ethnic confrontations and conflicts. The cause of ethnic conflicts can be considered too individualized "I", which acquires a frustrating role and leads to activation of the "we" archetype, which, in turn, activates the "they" archetype, understood as a source of danger. The dichotomy "they and we" will claim the images associated with the heroic and dramatic events of the history of the ethnic group, actualizes the fundamental archetypes of ethnic culture, which constitute the space of ethnic identity.

As a special archetypical construct, the archetype of "conformity" can be distinguished as the conditions for the acceptance of the subject by the social community. The archetype of "conformity" appears as an internal unconscious need for self-organization, self-restriction of individualistic tendencies, the need for acceptance by an ethnos. This archetype is realized as a necessary condition for the continuity of identity, the formation of a sense of ethnic "we". The archetype of conformity can be viewed as an unconscious need for ethnic identity.

The action of the "conformity" archetype reflects an attempt to fill in the lack of security in the most accessible way by striving to belong to a certain social group, strengthening one's position in it and feeling one's identity with it. This explains the relevance of archaic elements contained in the structure of the collective unconscious as a protective phenomenon. However, the protective function of archetypes is organically combined with the need of culture for evolutionary development. Thanks to the action of archetypes, "history as it were reserves for itself the possibility of return actions". Thus, the actualization of archetypical symbols

and images, especially in crisis periods of history, acts as a natural mechanism of culture, which contributes to the maintenance of the social and psychological security of society.

A bundle of ethnic identity is one of the cornerstones of the psychological security of a person, launching the mechanism of the subject's belonging to certain values, cultural traditions, the foundations of the history of an ethnos, creates a basis for sustaining perception of oneself as a member of an ethnic group, especially in the period of difficult and extreme periods situations. Otherwise, if the principle of interaction is violated, contradictions in the formation of identity parameters are amplified and mainly negative social effects are achieved, which not only do not contribute to psychological security, but only reinforce existing threats. Thus, archetypes are those basic ethnohistorical, ethno-psychological and ethno-cultural constructions, on which the phenomenon of ethnic identity is based and psychological safety is strengthened.

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根据自信和主观幸福的严重程度，对各种团体和机构的信任特征
FEATURES OF TRUST TO VARIOUS GROUPS AND INSTITUTIONS DEPENDING ON THE SEVERITY OF SELF-CONFIDENCE AND SUBJECTIVE WELL-BEING

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注解。　根据自信和主观幸福的严重程度，揭示了俄罗斯对各种团体和机构的信心。　总共有2514人接受了访谈，根据自信心和主观幸福感的严重程度进行了分组。　显示了所选受访者群体中对社会机构和亲属（亲属，父母，朋友等）的信任程度的差异。
关键词：主观幸福/痛苦，信任。

Annotation. *Depending on the severity of self-confidence and subjective well-being, features of Russian confidence in various groups and institutions are revealed. In total, 2514 people were interviewed, who were divided into groups depending on the severity of self-confidence and subjective well-being. The differences in the level of trust to social institutions and relatives (relatives, parents, friends, etc.) in the selected groups of respondents are shown.*

Keywords: *subjective well-being / distress, trust.*

Introduction

In modern psychological research, trust is described in formats of social and economic behavior. In modern society, the creation and modification of the amplitude of diagnostic methods, which reveal the inclination and level of trust of various social groups, becomes an urgent task.

The categorical "trust-distrust" pair has a significant informative scientific potential, but the level of its theoretical research seems to be one-sided. A number of serious works deal with distrust and a decline in the level of social trust. The content of the concept of trust remains insufficiently disclosed, in particular, the psychology of trust. Of particular importance is the development of trust and subjective well-being as components of the psychological security of modern society. «The confidence factor is a strong component in psychological interaction. In interpersonal relationships the role of an individual's trust in a partner's honesty and trustworthiness is great; sincerity and human decency in a social group are important factors for the security of intragroup interaction»[1].

For an adequate modern socio-economic situation and the level of development of scientific knowledge of the study of trust and subjective well-being as the basis of the psychological security of modern society, it is necessary to identify the relationship: the trust of individuals at personal, interpersonal and intergroup levels; social conditionality of the formation of the subjective well-being of the individual; sustainable development of the social environment; the effectiveness of strategies to overcome situations containing a threat to the psychological security of the person and their implementation in behavioral models.

Objective: depending on the severity of the level of self-confidence and subjective well-being, to identify the degree of trust to groups and institutions

Research methods:

1. "The scale of subjective well-being" in the adaptation of M.V. Sokolova. It is a variant of the Échelle pour l'évaluation subjective du Bien-être, developed in 1988 by A. Perrudet-Badoux, G. Mendelsohn, J. Chiche.

2. "Reflective questionnaire of the level of self-confidence", T.P. Skripkina.

3. A questionnaire designed to identify the degree of trust of an individual to groups and institutions, the reasons for the violation of this trust.

Sampling: The study was conducted in five districts of the Russian Federation: Central Federal District (Moscow), North Caucasus Federal District (Republic of Dagestan), Crimean Federal District (Republic of Crimea), Volga Federal District (Republic of Tatarstan), Ural Federal District (Sverdlovsk region). The research sample of each region was representative and reflected the general population — the population structure of the region by gender, age, level of education, and type

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[1]Dontsov A.I., Perelygina E.B. Interpersonal confidence as a factor in the prevention of disorganized interaction// Psychology in Russia: State of the Art. The official journal of the Russian Psychological Society/ Volume 7. Issue 1. 2014. P. 40-49. P. 41. doi:10.11621/pir.2014.0105.

of settlement. A total of 2514 people were interviewed.

The data collected was subjected to qualitative and quantitative processing. Data processing and analysis were performed using SPSS 20.0.

Results

All participants in an empirical study based on the method of M.V. Sokolova and ETC. Skripkina was divided into groups depending on the severity of self-confidence and subjective well-being, as a result of which 4 groups of respondents were singled out, which included 578 people from the total number of respondents.

Group 1 of respondents is characterized by a high level of trust in themselves and subjective well-being.

Group 2 - is characterized by a low level of self-confidence and subjective well-being.

Group 3 - respondents with a low level of trust in themselves and subjective problems.

Group 4 - respondents with a high level of trust in themselves and subjectively unfavorable.
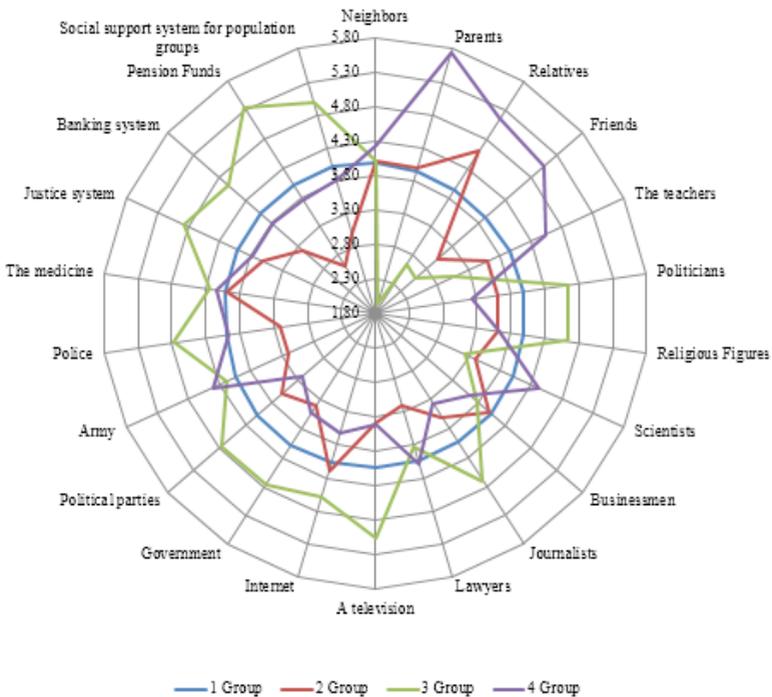
Figure 1 - *The degree of confidence in groups and institutions of the respondents*

According to the results of the questionnaire, designed to identify the degree of trust of an individual to groups and institutions, the scores obtained for each considered scale were deposited on the respective radii of the scheme. Interpretation was carried out depending on the number of answers on 22 scales. The study resulted in the following differences in the selected groups (Fig.1).

In group 1 of respondents all indicators are within the normal range, this group equally trusts all groups, institutions, relatives and friends. Trust for them is the background condition for their existence. It should be noted that the results are approximately in the same range (M = 4.00; SD = 0.04) with a very small variation. In this case, the indicators obtained can be viewed to a greater degree as "readiness for trust". Thus, according to Skripkina, "such a state of readiness is associated with the inter-value subjective attitude of interacting subjects in relation to each other and to themselves."

Group 2 of respondents demonstrates an uneven schedule, which may indicate conflicting trends. The combination of a low level of self-confidence with a high degree of trust in politicians, television, the pension fund and other social institutions indicates a shift of responsibility to others, which causes irresponsibility. According to V.A. Perovsky, if a person trusts another more than himself, then he loses authenticity, for such a position there is a risk of self-suas.

The third group of respondents is characterized by a low level of trust in themselves, with the highest values of trust in the entire sample for all social institutions, which creates fertile ground for manipulating the consciousness of this group of respondents, submission to authorities.

In group 4, there is a significant distortion of trust from social institutions towards relatives, relatives, parents and relatives, which, combined with a high level of trust in themselves, provides a picture of critical perception of incoming information, skepticism of social institutions, perception of themselves and their families as autonomous and sovereign subjects of life and activity. That is, we are witnessing a transition from institutional to interpersonal relations.

The typology revealed the main differences in the degree of confidence of respondents to groups and institutions. Identification of individual-typological features allows you to detect peculiar syndromes of individual consciousness related to the degree of severity of subjective well-being and level of trust. The built empirical typology can serve as the basis for diagnosing the individual psychological characteristics of various groups of the population, increasing the competence of Russians regarding their own well-being, greater flexibility in coping with stressful situations and everyday problems, developing an optimal balance of trust in the world and self, and building their own strategies prosperous life.

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奥伦堡 – 十八世纪的城市要塞，«亚洲的钥匙和大门»
ORENBURG – A CITY-FORTRESS OF THE XVIII CENTURY, «THE KEYS AND THE GATE TO ASIA»

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注解。 文章探讨了堡垒城市建设的历史，奥伦堡边界线的主要据点，俄罗斯与中亚的政治和贸易关系中心。 前哨的军事战略性质为堡垒建设期间俄罗斯城市规划艺术的特殊性留下了印记。 这座城市的Menovoy i Gostinyy dvor成为俄亚贸易的主要中心。 从最初的步骤开始，边境小镇的建筑和文化外观以欧洲和亚洲特色相结合为特征。

关键词：奥伦堡探险，边界线，堡垒城市，城镇规划，建筑，奥伦堡，Gostiny Dvor，Menovoy dvor，中亚。

Annotation. *The article discusses the history of the construction of the fortress city, the main stronghold of the Orenburg border line, the center of political and trade relations between Russia and Central Asia. The military strategic nature of the outpost left an imprint on the peculiarities of Russian town-planning art during the construction of the fortress. The Menovoy Dvor and Gostinyy Dvor of the city became the main centers of the Russian-Asian trade. From the very first steps, the architectural and cultural appearance of the border town was characterized by a combination of European and Asian features.*

Keywords*: Orenburg Expedition, border line, fortress city, town planning, architecture, Orenburg, Gostiny Dvor, Menovoy Dvor, Central Asia.*

Peter the Great cut a "Window to Europe" and dreamed of building a fortress city, which was supposed to be a "key and gate" to Asia, but according to the historian P.I. Rychkov, a sudden death prevented him from fulfilling this plan [8, p. 4-5]. The successor-empresses were to continue his work: his niece Anna Ioannovna and daughter Elizabeth Petrovna.

The question of how to protect the Russian lands from the raids of the Kirghiz-Kaysaks (Kazakhs), wandering behind Yayik, became acute in the 1730s, when they themselves began to need protection from the Dzungars and asked for protection and patronage from Russia. But in order to expand trade relations with Central

Asia and the countries of the East, to protect trade routes and border settlements from attacks and looting of steppe nomads, it was necessary to build a border line with the main fortress city. The expediency of such construction among many, surrounded by Empress Anna Ivanovna, was doubtful: the semi-desert South Ural steppe seemed to be a wild land, unsuitable for the Russian population [5, p. 42].

The empress managed to convince the supporter of reforms and the associate of Peter the Great, the chief secretary of the Senate I.K. Kirilov, who argued that "it is necessary to strengthen the south-eastern borders of the state, to build a "great fortress city" and make it the main stronghold of the region" [11, p. 10]. In his opinion, the new city should become the organizing center, the base of Russia's trade not only with the Kirghiz-Kaysak nomads and the khanates of Central Asia, but even with India.

Ivan Kirillovich Kirilov, appointed head of the Orenburg expedition, laid in 1735 a fortress in the mouth of the River Or' with four bastions and two gates, and in two weeks - the city of Orenburg. How important was attached to the planned city, says the fact that even before its construction, the Empress Anna Ivanovna gave the city a "Privilege" for all sorts of rights and privileges in order to attract migrants. The privilege provided for: exemption from state taxes for three years, free provision of urban land "for yards, storerooms, barns, benches", interest-free cash loans for a period of 10 years for housing, aid for construction materials from the treasury, permission for duty-free trade in the first three years since the founding of the city [5, p. 42].

Vasiliy Nikitich Tatishchev, one of the most prominent scientific and political figures of the 18th century, was appointed to the position of the deceased Kirilov as head of the Orenburg Commission (a former expedition). He visited the mouth of the River Or', at the site of the proposed construction of the fortress and did not approve it: the place is low, flooded, barren and treeless, far from the center of Russia. Tatishchev personally examined the new site for the construction of the city, about 160 km downstream of the Yaik River in the area of the Krasnaya Gora tract, and sent his project to the Senate [3, p. 15]. Soon a decree was issued on transferring Orenburg to a new place, and the fortress founded by Kirilov was renamed Orsk. Orenburg was founded for the second time in 1741 at the Red Mountain.

Ivan Ivanovich Neplyuev became the last chief of the Orenburg Commission. He chose the third place for the construction of Orenburg - not far from the confluence of the Sakmara River into Yaik, where the Bordskaya krepost' was founded by I.K. Kirilov. In 1743, the construction team, arrived from Samara, laid Orenburg here. The location for the city was extremely successful: on the right, elevated bank of the Ural River, not far from the confluence of the Sakmara River, the neighborhood abounds with building stone; fertile lands attracted here the ag-

ricultural population; the routes of communication with the center of Russia were secured from the attack of the Bashkirs and the Kirghiz-Kaisaks.

The triple establishment of Orenburg in different, far from each other places is an unprecedented fact in Russian history [12]. It was founded as a fortress city, having "two functional purposes: to serve as a stronghold of serf lines created by Yaik, Samara and Sakmara and to be the center of trade and political communication with the peoples of Central Asia and Kazakhstan" [4, p. 5].

Orenburg entered the history of Russian architecture as a vivid example of Russian town planning of the eighteenth century. It is the largest fortress city built in Russia. The length of the city was 1,444 meters, and its width - 1,216 meters. Neither before nor after such large cities-fortresses were built in Russia. And this is the main feature of Orenburg, which distinguishes it from other new Russian cities of the 18th century [12].

According to the doctor of architecture N. L. Krasheninnikova, Orenburg can be considered "after St. Petersburg the second exemplary city of the new Peter's formation" [6]. First, they built complex fortifications and at the same time planned streets, squares, churches and large urban complexes on the ground. The plan of Orenburg is called "the standard of the Russian regular city of the XVIII century" [6]. Straight streets were gradually built up with residential, administrative and public buildings. The quarters, located along the main axial streets, were intended for government buildings, houses of officials, officers and Cossack officers. The western side of the city was assigned to civilians.

It was required in the shortest possible time to provide housing and working premises for the administrative apparatus and the military garrison stationed there. The buildings were built strictly along the "red line" of the streets and were connected by typical fences with entrance gates and wickets. The houses were mostly single-storey, most often wooden.

The Orenburg fortress was built with minor deviations from the intended plan. To ensure better defenses, the western wall was moved away from the slope, so that the approaches to the city were well shot through. The eastern wall was moved for the sake of symmetry. As a result, the fortress turned from a round one - as it was planned according to a plan - into an oval [5, p. 48]. Work on the construction of a military fortress led engineer Major General von Shtokman, was named after one of the bastions of the fortress. The Galofeev bastion also bore the name of one of the main builders of the fortress.

The fortifications consisted of a moat, a rampart, 11 polygons and 10 bastions (Uspenskiy, Neplyuyevskiy, Nikol'skiy, Shtokmanskiy, Galafeyevskiy, Gubernskiy, Voskresenskiy, Proviantskiy, Berdskiy, Torgovyy) had 11 polygons. On the banks of the Urals, 2 semi-bastions were built: Nagornyy i Preobrazhenskiy to protect the city of Orenburg from the Ural River [4, p. 24]. The star-like layout

of the bastions of the Orenburg fortress was carried out according to the rules of military fortification. All life there was subject to a rigid military charter and was in no way connected with the daily economic life of the city.

Four gates led to the city. In the southwestern part there were the Yaitsk Gates (popularly known as the Vodyanye Gate), in the west - the Sakmara (later - Cher-norechenskiye), in the north - the Samara (later renamed the Bordskiye, and then - the Sakmar), from the east - Orsk. All of them were made of stone and had a vaulted shape.

According to the testimony of P. I. Rychkov [8], an eyewitness to what is happening, the city developed unusually fast. The special Office of Buildings, established by the Government back in 1740, helped build the city. The first Orenburg architect of the Building Office was Leutgold. From 1746 Johann-Werner Müller starts working [3, p. 36]. "The office had a huge free labor force in the form of "criminals", who were referred there from different places, of which there were up to 3,000 people" [1, p. 6].

A year later, the city gained the status of a provincial center, and I. I. Neplyuev became the first governor, since the Orenburg province was formed as part of the Russian Empire. By 1746, in Orenburg, there were already 840 yards, four churches, there were breech rooms, pharmacies, a powder cellar, shops, the first gostinyy i menovoy dvor with 44 and 131 shops, respectively. The architecture of the city, which stood on the border of Europe and Asia, fit the eastern and European elements of folk architecture. By the beginning of the 50s of the XVIII century, Orenburg was mostly built up, only the north-western part remained free. By 1760, there were 2866 houses in the fortress, which by the standards of the 18th century was quite a lot.

The military character of the fortress city left an imprint on its appearance. In the Orenburg appeared stone buildings "of the military department: regimental barracks, gauptvakhta, tseykhgauz, artillery yard, hospital and pharmacy, engineering team house, kordegardiya, and civilian stone buildings: governor's house, provincial office, post office, office yard, magistracy, salt control building" [1, p. 7].

The outward appearance of Orenburg of the 18th century had its own peculiar features that distinguish it from other cities of the Petrine era. Such a feature is the location of the administrative center not in the geometric center of the city, but on the periphery of the fortress, on the high, picturesque bank of the river [12]. It is here that the representative main state buildings of the houses of high-ranking officials appear, by which the historian P. I. Rychkov, a witness of the city under construction, was much admired.

About the two-story building of **the provincial office**, he wrote that "hardly anywhere else in other provinces there will be the best for such, of course, clerical, institutions" [9, p. 352]. **The governor's house**, which consisted of 2 outbuildings

with 20 chambers while he, if he could have completed the whole according to the plan and facade, "had to be between the best buildings in the imperial residences" [9, p. 352].

Orenburg fortress was built from 1743 to 1760. Since Orenburg, from its foundation, began to play an important role in trade with Central Asia and the East, along with the laying of the fortifications began the construction of shopping centers: Menovoy dvor beyond the Urals, 3 km south-west of the city, for summer bargaining with nomads, and Gostiny Dvor - inside Orenburg for winter bargaining. At first, the shops were wooden and small, then in 1748–1754, thanks to an increase in trade turnover, Neplyuev replaced them with new stone [2, p. 162]. In appearance they resembled a fortress.

The Menovoy Dvor - a place for him on the left bank of the Yaik, "in sight of the city", was not chosen by chance, since in the summer Yaik was blocking the way to Orenburg to trade caravans from Central Asia, therefore trade and exchange transactions were carried out outside the city. It was a huge market and hostelry. The original complex of the Menovoy dvor was destroyed by the spring flood of the river in 1749. The construction of the new Menovoy dvor was accelerated by the decision of the Senate "On the construction of a stone courtyard and customs beyond Yaik" (1751) and completed in 1758.

This is how the unique structure of the 18th century appeared: a square citadel measuring approximately 420 x 420 meters with walls and bastions at the corners. From the four bastions they kept guard of the courtyard of the cannon and a special garrison of soldiers. On the inside, 148 barns and 344 benches adjoined the high brick walls of the Menevoy dvor. Two entrance gates led to the Menevoy dvor: the northern, European, facing Orenburg, and the southern, Asian - from the Kazakh steppe. Over the gate, respectively, were arranged border customs and guardhouse.

In the middle of the Menovoy dvor, there was a small courtyard, the so-called "Asian" with 98 benches and 8 barns, two barns at each corner of the yard [2, p. 163]. Here only Asian goods were traded. "This courtyard has its own Russian and Asian gates, which lead to the warehouse. A small Orthodox Church of Saints Zakhariya i Yelisaveta, captivating the eyes with the graceful simplicity of its architecture, rises above it" [7, p. 129].

On the western side of the Menovoy dvor there was a so-called Menovinskaya mosque, built at public expense for Muslims arriving with caravans, "so that they could worship the Most High without obstacles" [7, p. 129]. The mosque was a stone one-story building, square at the base, with a dome and two 3-tier minarets flanking the entrance. At the mosque, a Muslim school was opened for children of the Kirghiz-Kaisach nobility. In Orenburg itself, the first cathedral mosque will appear at the beginning of the XIX century.

P. I. Rychkov proudly stated about the Menovoy dvor that there is hardly any

"such a great building for merchants" within the entire state [9, p. 354]. The Meno-voy dvor played an important role in Russia's trade with the countries of Central Asia and the peoples who inhabited the southeastern border regions. Bargaining began annually in June and lasted until October. By this time, came caravans from Khiva and Bukhara. In addition, goods came from India, Russia, Kazakhstan and other countries. Trade turnover reached hundreds of millions of rubles.

Gostiny Dvor was located in the city center and was a citadel with high stone walls, deaf to the street. The length of the complex is 222 meters and width - 200 meters. Inside the one-story building, there were 150 benches and barns that belonged to the most famous merchants of Orenburg. The doors and windows of the shops went out into the courtyard, and arches and sheds allowed trading in any weather. In the center of the courtyard was customs [2, p. 163].

The ensemble of Gostiny Dvor was decorated with two architectural domi-nants: the Blagoveshchenskaya Church and the bell tower. The eastern buildings stood on the main Bolshaya (Gubernskaya) Street, from which the gate with the Blagoveshchenskaya Church led into the courtyard, there were other exit gates on the opposite side of the courtyard and above them was the dome-shaped bell tower. The Blagoveshchenskaya Church, like the whole complex of the Gostiny Dvor, was built by the architect I.-V. Muller

Knowing the dream of Peter the Great "to open the gates to noon Asia", Neplyu-uev did much to make Orenburg the center of Russian-Asian trade. As Neplyuev himself wrote, "noble bargaining in Orenburg had a beginning" [11, p. 23-24]. Asian merchants: Khivans, Bukharians, Sarts and other "steppe peoples" began to arrive in Orenburg in large quantities, despite all the difficulties of the way and the dangers of moving across the Kyrgyz steppes [2, p. 165]. Not only goods were brought here, but also gold in coins and bullion. The exchange trade of cattle near Orenburg, which covered not only dozens, but also hundreds of thousands of heads of various cattle, was especially successful.

Since 1752, I.I. Neplyuev achieved that bargaining in Orenburg was declared a fair, that is, it was possible to sell their goods both wholesale and retail. Kirghiz-kaysak allowed duty-free trade in livestock and other goods. To produce menovoy bargaining on the Orenburg border line with any goods was allowed only in Oren-burg, in other places - only bargaining on bread and hay. This allowed Orenburg to become the largest center of trade with Central Asia [2, p. 164].

I. I. Neplyuev was one of the most prominent in the state temple builders. By 1761, there were already nine Orthodox churches in Orenburg: the Preobrazhens-kiy and Vvedenskiy cathedrals, the churches of Blagoveshchenskaya, Nikol'skaya, Uspenskaya, Krestovozdvizhenskaya, Petropavlovskaya, Georgiyevskaya (in For-stadt), Saints Zakhariya and Yelizavety (on the Menovoy dvor).

Two main cathedrals - Preobrazhenskiy (summer) and Vvedenskiy (winter) -

were built immediately in stone and became the most significant works of baroque architecture and architectural dominants. "Both temples were clearly visible from the Ural River, as they stood on its high circle on the right bank and served as high-rise landmarks of the city from the Asian side. In addition, placed at a distance from each other, these cathedrals flanked the main city square, which was thus formed with their participation" [10, p. 29].

In 1775 on the central Gubernskaya Street was built the "Lutheran Confession church was built, although it was wooden, but on a stone foundation with a beautiful internal and external decoration, the service was already sent there" [9, p. 353].

By the end of the 18th century, Orenburg was still "a frontier town, to the east of which, across the Ural River, a steppe began with a semi-wild population under the rule of semi-independent Khans in relation to Russia. Owing to this frontier, as in a real fortress, the city gates were locked after penetrating the evening dawn, all night long until the morning dawn. The entire urban structure, not counting the suburbs, was inside the walls "[1, p. 3-4].

Orenburg several times was a provincial (1744-1781, 1797-1892, 1865-1917), regional (1781-1797), county town (1802-1865). The fortress status was maintained for more than a hundred years, its official abolition due to the loss of strategic importance took place in 1862. In fact, the fortifications and the commandant's office in Orenburg were destroyed in 1860, then part of the embankment surrounding Orenburg was razed and four city gates dismantled. The liquidation of the fortress gave a powerful impetus to the development of the city.

For its centuries-old history, the fortress city Orenburg played a major political role, as a military and administrative center of the region, as an outpost of the colonial policy of the Russian government in the East and as a center for the development of diplomatic and trade relations with the Central Asian khanates.

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胰腺炎腹膜炎的治疗和免疫修复的临床方面
CLINICAL ASPECTS OF THERAPY AND IMMUNOCORRECTION OF PANCREATOGENIC PERITONITIS

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注解。共检查和治疗了335例常见形式的胰腺腹膜炎患者。胰腺性腹膜炎的原因233例（69.6%）为出血性胰腺坏死，102例（30.4%） – 脂肪性。在术后早期使用经病理证明的外科手术策略与IT相结合，可以平衡休克的表现，将晚期并发症的数量从41.3%减少到13.5%，将术后死亡率降低到7.7%，这是酶性腹膜炎和患有肠源性感染和原发性化脓性腹膜炎的组中有18%，5%。在后一组中，与使用侵入性外科手术治疗传统综合征的患者组相比，死亡率降低了近3倍。细胞因子治疗可以消除SIRS，降低坏死性胰腺炎的感染并发症水平和晚期手术干预的次数。
关键词：腹膜炎，坏死性胰腺炎，强化治疗，免疫矫正。

Annotation. *A total of 335 patients with common forms of pancreatic peritonitis were examined and treated. The causes of pancreatic peritonitis in 233 (69.6%) patients were hemorrhagic pancreatic necrosis, in 102 (30.4%) - fatty. The use of pathogenetically justified surgical tactics in combination with IT in the early postoperative period allowed leveling the manifestations of shock, reducing the number of late complications from 41.3% to 13.5% and postoperative mortality to 7.7% in the group of patients with enzymatic peritonitis and to 18, 5% in the group with enterogenously infected and primary purulent peritonitis. In the latter group, mortality was reduced by almost 3 times compared with the group of patients treated traditionally syndromes using invasive surgical interventions. Cytokine therapy makes it possible to eliminate SIRS, reduce the level of infectious complications of necrotizing pancreatitis and the number of late surgical interventions.*

Keywords: *peritonitis, necrotizing pancreatitis, intensive therapy, immunocorrection.*

Introduction. Pancreatogenic peritonitis (PP) complicates the process of destructive pancreatitis (DP) at different stages of the disease and is one of the reasons for the progression of pancreatogenic shock, occurring in 14.8% of patients with mortality from 25 to 80% [2, 3, 6]. The basis of organ dysfunction in PP is the systemic inflammatory response syndrome (SIRS), caused by a massive release of inflammatory mediators into the systemic hemocirculation, and the leading components of which are spontaneous hyperventilation with hypoxia and arterial hypoxemia, as well as determinant cardio hemodynamic disorders hepatic and renal parenchyma, non-respiratory functions of the lungs, which are initiated by a high level of proteolysis and circulating biogenic amines in the initial the period of PP [4,5,9]. The causes of immunosuppression in DP are varied, but pancreatogenic toxins, impaired mechanisms of humoral regulation of immunity, and the emerging syndrome of compensatory anti-inflammatory response (CAPS) are directly involved in this. With systemic activation of pro-inflammatory cytokines (PICK), Due to transcendent stimulation of immunocompetent cells (ICC), many organs and tissues that are not involved in the infectious process [3,4,6,9] are targeted by PICK (IL-8, IL-2, IFN-γ, TNF-α). At the same time, the launch of SIRS induces feed-back regulation mechanisms based on the production of anti-inflammatory cytokines (IL-4, IL-10, IL-11, IL-13). Such an imbalance leads to the depletion of ICC and determines the development of pronounced secondary immunodeficiency, which in the post-shock period becomes the leading pathogenetic link in the development of DP and the progression of PP [4,8,9]. These mechanisms in combination with dehydration, toxemia and thrombohemorrhagic syndrome constitute the basis for the development and progression of respiratory distress syndrome (RDS) [1,2,6,8]. The most promising area of immunotherapy in the complex treatment of DP is cytokinetic replacement therapy [7]. For this purpose, the drug is used - roncoleukin (human IL-2), which belongs to the natural regulators of cell-cell interactions and has controlled effects on ICC, the leading of which is the activation of clonal proliferation and differentiation of T-lymphocytes, as well as apoptotic action [5,6]. The severity of the course of PP determines the necessity of anticipating the nature of the complex effect on the pathological process [2,3,5,6,8,9].

Purpose. To analyze the results of the pathogenetic treatment of patients with pancreatic peritonitis.

Material and methods. As part of an open, randomized controlled trial, 335 patients with common forms of PP were examined and treated. Among the causes of PP, 233 (69.6%) patients had hemorrhagic pancreatic necrosis, 102 (30.4%) - fatty. Three forms of PP were distinguished: enzymatic, enterogenically infected, and primary purulent peritonitis. The combination of SIRS with PP was considered a prognostic basis for the existence of pancreatogenic abdominal sepsis. The distribution of patients according to the forms of peritonitis is presented in table 1.

In the main group, complex intensive therapy (IT) was carried out using minimally invasive operational aids (MIOA), the whole arsenal of which we divided into abdominal, intracoronary, endovascular and systemically correcting. In the control group, traditional methods of treatment were used using open surgical methods. Substitution cytokine therapy was performed by the domestic immunomodulator (ImMD) - Roncoleukin. In 15 patients with primary purulent PP, the drug was administered intravenously in 400.0 ml of 0.9% NaCl solution with the addition of 4-5 ml of 10% albumin solution twice in 25,000 IU with an interval of 48 hours between infusions.

To determine the dynamics of the pathological process and the effectiveness of the treatment, the indicators of the enzyme pattern, the level of circulating immune complexes (CIC), the effective concentration of albumin, and the leukocyte index of intoxication were determined. Based on these indicators, the multiplicity and frequency of MIOA were determined. The main ICC subsets of CD3 +, CD4 +, CD8 +, CD16 +, CD20 + were determined by an immuno-cytochemical method using a set of monoclonal antibodies "DAKO" (Denmark), the phagocytic activity of neutrophils (FAN) and the level of serum immunoglobulins IgA, IgM, IgG were evaluated. The concentration of IL-2, IL-4, IL-8, IFN-γ, TNF-α was studied using the BIOSOURCE reagent kit (France) using the method of solid-phase ELISA. Early diagnosis and prognosis of the course of PP were based on dynamic integrated systems for objective assessment of the severity of patients' condition according to APACHE II clinical and laboratory indicators and modified systems, as well as on the detection of early direct and indirect signs of PP (ultrasound, dynamic laparoscopy).

Results. In the main group, a pathogenetic-based scheme of intensive therapy was used. *Antibacterial therapy* (ABT) was carried out in compliance with the following principles: antibacterial approaches (caval, selective aortic, endolymphatic, intestinal), multi-component chemotherapy, the choice of doses and the combination of drugs depending on the presence of post-antibiotic effect.

Infusion therapy to solve the following tasks: restoration of adequate tissue perfusion, correction of homeostatic disorders, decrease in the concentration of toxic substances and mediators of the septic cascade. The qualitative composition of the infusion program depended on the degree of hypovolemia, phase of DIC, blood albumin level, severity of RDS. With a pronounced BCC deficiency, combined with hypotension, plasma substitutes (dextrans, hydroxyethylamidones) were used. Albumin transfusion has advantages over artificial plasma substitutes with a decrease in albumin level of less than 25-30 g / l. It is desirable to exclude the use of dry plasma due to its imbalance and the possibility of exacerbation of DIC.

The distribution of patients in the main and control groups according to the forms of PP

Forms of peritonitis	The number of patients in groups					
	Main		Control		Total	
	abs.	%	abs.	%	abs.	%
Enzyme	102	60,4	83	50,0	185	55,3
Enterogenically infected	22	13,0	26	15,7	48	14,3
Primary purulent	15	26,6	57	34,3	102	30,4
TOTAL	169	100	166	100	335	100

Respiratory support is one of the main points in the treatment of PP; its adequacy and timeliness are extremely important. During laparoscopic manipulations, in addition to the main goal - evacuation of pancreatic exudate and elimination of absorption of myocardial depressive substances through the diaphragmatic peritoneum, the peritoneal receptor apparatus was blocked by local anesthetics. Along with the novocainic blockade of afferent branches of the celiac plexus, this is an obstacle to the spread of pathological receptor influences on the pulmonary pleural structures. On the other hand, the use of system-corrective MIOA in the complex treatment of toxemia and multiple organ failure (MOF), the early use of artificial ventilation of the lungs (AVL) with positive pressure exhalation valve to reduce the required level of $Pa0_2$, reduce pulmonary shunting and elimination of arterial hypoxemia allow, as a rule, to prevent the later phases of the development of RDS and other systemic disorders. The decision to transfer the patient on the AVL is difficult, but it is not necessary to bear in mind that the X-ray examination of the patient is ahead of the clinical manifestations of acute respiratory failure, and the functional incompetence of any organ exerts an additional load on the lungs, including and their gas exchange function. According to our data, mechanical ventilation is indicated with the combination of any degree of RDS with MOF (especially with encephalopathy, shock), a decrease in PaO_2/FiO_2 <200, with hemodynamic, gas ($Pa0_2$, $Sa0_2$) and biochemical monitoring.

Restoration of adequate tissue and organ perfusion was carried out using low molecular weight dextrans, heparin (10–20 thousand U/day intravenously), trental (10–20 ml/day), dopamine (0.5–3.0 mcg/kg/min.), dobutrex (2.5-5.0 mcg/kg/min.), which was pathogenetically focused on increasing peripheral extraction 0_2, regressing interstitial edema and increasing the number of functioning capillaries.

Nutritional support. The development of MOF syndrome in PP is usually accompanied by manifestations of hypermetabolism. In this situation, the energy needs coverage occurs due to the destruc- tion of one's own cellular structures (auto-

cannibalism), which aggravates organ dysfunction and endotoxicosis. The optimal daily calorie is 50-60 kcal / kg. The enteral route must account for up to 80% of the input calories. The inclusion of enteral nutrition (through a naso-intestinal probe) in the IT complex prevents translocation of microflora from the intestine, increases the functional activity of enterocytes and the protective properties of the mucous membrane, reducing the intensity of endotoxicosis and the risk of developing secondary infectious complications.

Correction of immune disorders. The main principle of immunocorrection for PP is the replenishment of the lack of immune defense and support for CAPS. In the acute period of the pathological process, substitution immunotherapy is indicated. In case of deficiency of cellular factors (T-system) - intravenous injection of leucoma suspension (3-4 doses of 300 ml). In case of insufficiency of factors of humoral immunity (B-system) - specific hyperimmune plasma (5-7 ml/kg, up to 10 doses per course). The use of leukes suspension or blood plasma of donors with increased titers of natural antibodies to the Re-glycopeptide (up to 1 l per course) corresponds to the same goals. Strengthening of the humoral link can also be achieved by using immunoglobulins for intravenous administration: intraglobin (Ig G - 2-5 ml/kg for 2-3 days), pentaglobin (Ig G and Ig M - 5 ml/kg/day thrice). The positive effect of these drugs is due to an increase in opsonization and phagocytosis, PICK inactivation, a decrease in the concentration of adhesion molecules, synergism with β-lactam antibiotics in ABT. But this therapy was carried out randomly and without control of the immunogram, this is especially true for the determination of immunoglobulin therapy. In the debut of the disease in the main and control groups, changes in the cellular immunity were manifested by a decrease in the percentage of the main fractions of T-lymphocytes CD3 + ($61.2 \pm 3.2\%$), CD4 + ($36.8 \pm 1.6\%$). The peripheral blood CD8 + content corresponded to the lower limit of the norm and was $27.9 \pm 2.1\%$. On the first day after surgery, indicators of cell-mediated immunity were characterized by a continuation of the decrease in the percentage of T-lymphocytes (CD3 + cells), as well as their subpopulations of T-helper / inducer (CD4 +), T-cytotoxic lymphocytes (CD8 +). There was a decrease in the FAN level and phagocytic number. The number of B-lymphocytes was reduced or increased in all the examined patients, which fully underlines the concept of "imbalance" of the immune system. A moderate increase in the level of IgA (4.8 ± 0.8 g/l) was found, and the IgM value was within the upper limit of normal and was 1.3 ± 0.3 g/l. No significant background difference in the cytokine profile between the main (n = 15) and control (n = 14) groups was revealed. These data indicate the presence of the phenomenon of "cytokine storm" in the peripheral blood in DP and primary purulent PP, which is one of the main pathogenesis of the development of purulent complications (PC) in DP. During treatment with ImMD, patients of the main group (n = 15) had significant changes in the cytokine status parameters (Table 2).

Table 2

Cytokine profile of patients with primary purulent peritonitis

Cytokines (pg / ml)	Patient groups		
	Main without ImMD (n=15)	Control (n=14)	Main with ImMD (n=15)
IL-8	220,3±17,3	197,63±6,4	15,99±6,21*
IL-4	65,97±4,84	60,01±2,04	11,44±4,8*
IL-2	23,01±7,6	21,12±4,2	57,31±5,7*
IFN-γ	37,65±7,16	35,43±6,21	8,17±2,52*
TNF-α	39,02±8,3	44,85±8,3	7,05±3,9*

* - the differences are significant ($p < 0.05$) compared with the main group before using ImMD.

A significant decrease in the level of PICK in peripheral blood was found. And the clearance of IL-2 (immunocytokine) showed a tendency to increase ($p < 0.05$) compared with the primary data. In terms of the immunogram against the background of ImMD treatment, there was a significant increase in the indices of CD3 +, CD4 +, CD8 + in comparison with the initial data. Moreover, in the main group, stabilization of the level of CD20 + (B-lymphocytes) was noted.

In the study of serum immunoglobulins of the classes IgA, IgM, IgG, there were no significant changes compared with the baseline data, which is associated with a short observation period limited to the early postoperative period. On the part of the phagocytic link of immunity, as compared with the control group, a clear tendency to an increase in the FAN and phagocytic numbers was revealed. The level of NK-cell indices (CD16 +) remained within the limits of normal fluctuations, which emphasizes the selectivity of the ImMD action only in the event of their depression. In the control group, cytokine regulation imbalance contributed to the development of an inadequate immune response, and excessive stimulation of the cell level against the background of increasing hypoxia and energy deficit of ICC led to the development of the phenomenon of "immunological paralysis" during the formation of parapancreatic infiltrate. At the same time frame from 7 days, infection progressed in parapancreatic fiber and PC DP. On day 14, severe immunosuppression developed. The concentration of CIC increased relative to baseline and amounted to 97.8 cu. There was a further decrease in the absolute number of lymphocytes, fractions of CD2 + and CD4 + against the background of a significant increase in CD8 + (36.7 ± 0.6). Such changes in the immune status correspond to the development of a stage of functional failure of the immune system and are rarely reversible. When using

ImMD, faster normalization of biochemical markers of DP (serum amylase, urine) was noted; endogenous intoxication syndrome was less pronounced and was stopped in a shorter time; reduced the number of complications of DP, including PC and related late surgical interventions.

Conclusion. The use of pathogenetically justified surgical tactics in combination with IT in the early postoperative period allowed leveling the MOF manifestations, reducing the number of late complications from 41.3% to 13.5% and postoperative lethalism to 7.7% in the group of patients with enzymatic peritonitis and up to 18.5% in the group with enterogenously infected and primary purulent peritonitis. In the latter group, mortality was reduced by almost 3 times compared with the group of patients who were treated traditionally syndromes using invasive surgical interventions. With DP and primary purulent PP, the content of pro-inflammatory cytokines in peripheral blood increases dramatically, which is the basis for the development of SIRS. In the absence of immunocorrection, further, in patients with DP, a deep immunodeficiency develops and PC progresses. The complex use of ImMD helps to balance the components of immune responses and levels the phenomenon of "cytokine storm", which is especially important in the early periods of DP existence. Immunocorrection in the complex treatment of DP makes it possible to normalize the indicators of enzymes - markers of DP, to stop the syndrome of endogenous intoxication earlier, to reduce the level of PC and the number of late surgical interventions associated with them.

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双面TAPP塑料
DOUBLE-SIDED TAPP PLASTIC

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Annotation*. The experience of surgical treatment of 93 patients with bilateral inguinal hernias is presented. I- group of 26 children with bilateral inguinal hernias. Performed bilateral laparoscopic herniorrhaphy. II - group 38 adults with bilateral oblique inguinal hernias. Made double-sided TAPP with separate polypropylene flaps. III group of 29 patients with bilateral direct inguinal hernias. Made TAPP single synthetic explants. Technical and methodological options for performing operations are discussed. Analyzed the complications and results. Based on personal experience, it is concluded that laparoscopic hernioplasty is the method of choice for surgical treatment of bilateral inguinal hernias in children and adults.*

Keywords*: inguinal hernia, TAPP plastic*

Introduction. Since the first reports on the use of the laparoscopic method in the surgical treatment of inguinal hernias (L.W. Popp, R.Ger and L.Schultz), more than fifteen years have passed. The evolution of this method of treatment was mainly technical. The characteristics of synthetic explants were discussed, new plastic materials were tested, accesses and tools for fixing the mesh were improved, the immediate and long-term results of treatment were compared using different techniques. With the accumulation of experience, tactical and organiza-

tional aspects were determined, contraindications for the use of transabdominal endoscopic hernioplasty [1,2]. According to the results of the 1st international conference "Modern methods of hernioplasty and abdominoplasty with the use of polymer implants" (Moscow, 2003), transabdominal preperitoneal hernioplasty (TAPP) is predominantly indicated for bilateral, bilateral combined and recurrent inguinal hernias. Approved by the method of choice transabdominal endoscopic surgery in children with pathology of the vaginal process of the peritoneum and bilateral inguinal hernia, the proportion of which reaches 15% [4]. An important advantage of abdominal endoscopic operations is the identification of asymptomatic bilateral inguinal and hernias of other sites in children and adults, and in 7% of children there are no clinical manifestations of bilateral inguinal hernia [4,11]. Laparoscopic hernioplasty (LHP) in bilateral inguinal hernias is preferred by many surgeons, especially emphasizing the possibility of performing simultaneous operations for hernias of other localizations [7,10,12]. Bilateral inguinal hernias in children are not a consequence of the destruction of the structures constituting the posterior wall of the inguinal canal. The reason for their existence is the pathology of the vaginal process of the peritoneum, which is corrected by herniosis without interfering on the elements of the spermatic cord. This allows us to consider laparoscopic hernioraphy (LHR) in children with a pathogenetically substantiated method for the treatment of bilateral inguinal hernias [4,8]. In adults, the most common variant of LHP is sequential plasty on the right and left according to J.D. Corbitt, which allows you to close the area of the formation of direct, oblique inguinal and femoral hernias mesh explant [1,2,3,5,9,12]. The use of TAPP in the treatment of bilateral inguinal hernias reduces the number of relapses to 0.1% and minimizes the level of postoperative complications [3,5,6,10,11,12].

J.Mc Kernan suggested using two mesh explants stitched together to correct bilateral inguinal hernia [9]. For the TAPP variant, plastic with a stitched synthetic flap for bilateral inguinal hernias acquired not a phased, but one-time character. The formation of various approaches and the implementation of transverse fascia prosthetics for bilateral inguinal hernias remains a pressing problem of herniology.

Material and methods. 93 patients with bilateral inguinal hernias were observed, of them 26 children and 67 adults. The age of boys varied from 2 to 14 years, men from 26 to 80 years. Bilateral inguinal hernia in children was only oblique, which amounted to 40.6%, in one case (3.8%) there was a combination with a recurrent inguinal hernia on the right after a previously performed K. Ger operation, in five cases with an umbilical hernia (19.2 %). All children completed bilateral LHR (Table. 1.).

Bilateral oblique inguinal hernia in adults was observed in 38 patients (59.4%), in one case (2.6%) there was a combination with recurrent inguinal hernia on the left after anterior inguinal access surgery with anterior wall of the inguinal canal,

in 2 cases with the umbilical hernia (5.3%), in one case with a femoral hernia on the left (2.6%). All patients underwent bilateral TAPP according to R. Fitzgibbons consistently. Umbilical hernias were eliminated "on care", plastic was performed with local tissues and an onlay mesh. The proportion of bilateral oblique inguinal hernia in the total population was 68.8%.

Bilateral direct inguinal hernia was observed in 29 patients, in combination with femoral hernias on the right in three (10.3%) and on the left in one patient (3.4%), which accounted for 31.2% of the total population. All men performed TAPP with a single net explant.

For plastic hernia gate used mesh polypropylene explants company "Linteks" (Russia). The mesh was fixed using a 5mm single-shot stapler, and peritonization of the 5mm explant herniostepler with spiral-shaped fixing elements produced by the PPP company used 3mm optics and the set of tools produced by the PPP company for operations in children.

Results and discussion. LHP for bilateral inguinal hernias is an operation performed by surgeons with sufficient experience in laparoscopic surgery in general and surgery for inguinal hernias in particular. The peculiarity of bilateral inguinal hernias in children is that direct inguinal and femoral hernias are caused by the presence of congenital defects of the transverse fascia of the anterior abdominal wall and the number of such observations does not exceed 0.3%, which makes it extremely rare for children to have this type of hernia. In our observations, direct and femoral hernias have not been seen in children. The task of the surgeon for oblique hernias in children is to divide the hernia sac (sealing the vaginal process of the peritoneum) from the posterior wall of the inguinal canal. Understanding this problem literally, supports the view that with a small hernia gate, it is enough to suture only the peritoneum without plasty of the internal ring of the inguinal canal. But this option, especially in the staple version, does not seem to be fully pathogenetic. It is possible with a narrow neck of the vaginal process of the peritoneum, which is more often with communicating dropsy of the testicular membranes, sealing the vaginal process with suture of the peritoneum is sufficient, but long-term results and timing of inguinal hernias on this side in adulthood are not always possible to analyze. We observed one early recurrence of the hernia on the right after stapler suturing of the neck of the hernia sac, and the bilateral localization of the hernia was detected only during repeated laparoscopic surgery. In principle, regardless of the size of the hernial ring with bilateral inguinal hernias in children, the "true" LHR was performed, initially from the left or the right did not matter. A hernial sac wall was dissected into a 5 mm perifocal mouth of the hernial sac to the area of the peritoneum segment covering the elements of the spermatic cord. After dissection of the peritoneum, a Z - shaped suture was applied to the neck of the hernial sac with atraumatic material. Then a medial suture of the

internal inguinal ring was inserted with the involvement of the upper and lower edges of the dissected peritoneum, the inguinal ligament, the transverse fascia and the internal oblique muscle of the abdomen. Nodes were tied intracorporeally. A similar procedure was performed from the contralateral side. In the presence of an umbilical hernia, an optical trocar was inserted through the umbilical ring; upon completion of the LHR, an umbilical defect under endovisual control according to Lexner (4 patients) and Spitz (1 patient) was performed on both sides. Intraoperative complications were noted. Patients were discharged the next day after surgery. Up to 4 days in the hospital, 3 patients were delayed, in whom in the postoperative period there was marked unexpressed scrotal edema, which regressed independently.

In the diagnosis and intraoperative evaluation of inguinal hernias in adults, Nyhus-Stoppa classification was used. With bilateral oblique inguinal hernias, the assessment of hernial protrusions was performed on each side. On the right, type I hernia - 3, Type II - 12, Type III - 4. Left type I hernia - 11, Type II - 5, Type III - 2 in one case in combination with femoral hernia, Type IY - 1 patient. This distinction is reflected in two methodological approaches. Stage performance of the operation depended on the size of the hernia. The operation began on the side of the larger hernial protrusion, on the side of the combined hernia, on the side of the recurrent hernia. The second feature was that with hernias of types III B and III BC, plastic surgery was performed with a single explant without isolating the spermatic cord. In these cases, the incision and the window in the prosthesis seems to be a weak point in terms of fixing the branches of the prosthesis. Both methodological approaches have a general justification - the initial execution of the operation on the side of greater complexity (time spent on one side), the possibility of the development of intraoperative complications and the associated predictive need to limit the intervention to only one side. In our observations, TAPP is completed on both sides. A single plastic explant was performed in 4 cases of III B on the right and in 2 patients of III BC on the left. Intraoperative bleeding complications - 3 cases, eliminated laparoscopically. In one patient, relaparoscopy was performed the day after the operation due to insufficient fixation of the prosthesis on the right. Hernial protrusion appeared when coughing 10 hours after the first operation. Repeated fixation of the explant on the right. With combined umbilical hernias (n = 2), the intervention was carried out at the end of the laparoscopic stage in an open version. The hernia defect plastic was performed according to the Spitz and the onlay plastic was performed with a mesh prosthesis. Fundamental mesh fixation was considered to be a uniform polypropylene thread, which is fundamental in the prevention of postoperative wound complications. In two cases, in the postoperative period, infiltrates in the area of trocar wounds were observed, regressed independently. Remote relapses in the observed patients were not detected.

29 TAPP operations were performed with bilateral direct inguinal hernias. A variant of plastics was used with a single mesh explant. From our point of view, such plastic to the maximum extent prevents displacement and folding of the mesh, provided adequate fixation. The most crucial moment is the cut of the explant. The width of the pre-vesicle bridge should not exceed 2 cm. The elderly and senile patients (n = 18) did not cut the explant for the spermatic cord. In young and middle-aged patients (n = 11), the cut of the mesh for the spermatic cord was always performed, and with type III AC, on the right, the cut was vertical (n = 1). The maximum number of fixing clips reached 20. The peritoneum above the inguinal areas was sutured sequentially with an atraumatic thread with a continuous suture. Unlike bilateral oblique inguinal hernia, when for some reason the operation can be limited to one side, with a direct bilateral inguinal hernia of TAPP, a single net explant should always be completed by closing the inguinal defects on both sides, this operation is inseparable. Intraoperative complications are represented by bleeding during the isolation of the spermatic cord (n = 4), stopped intraoperatively. In the postoperative period, dysuria, according to our estimates, associated with intraoperative trauma of the bladder and pre-bladder location of the mesh, was observed in 5 patients. Early recurrence in observed patients was not observed. The total number of complications in the operated patients was 19.4%, and only one complication was recognized as clinically significant, requiring a relaparoscopy to re-fix the explant (1.1%).

Conclusion. The past fifteen years marked the structuring of clear indications and the formation of an idea about the choice of operation method for bilateral inguinal hernias, thereby overshadowing the issues of feasibility and high cost of operations. Laparoscopic hernioplasty is the method of choice for bilateral inguinal hernias in children and adults, bilateral recurrent inguinal and femoral hernias, combined hernias. When bilateral inguinal hernia in children LHP is advisable to perform in the form of a "true" LHR, regardless of the size of the neck of the vaginal process of the peritoneum. Prosthetic transverse fascia LHP with bilateral oblique inguinal hernias should be performed in the form of TAPP separately - sequentially on both sides, with the options for the cut of the explant to be individualized. The method of selecting LHP in bilateral direct inguinal hernias is TAPP as a single net explant, the cut of which is standardized. Various LHP techniques using reticular explants that combine high efficacy and minimally invasiveness in the surgical treatment of bilateral inguinal hernias are accompanied by a minimum number of perioperative complications, and the pathogenetic validity of these operations can serve as a definite guarantee in the prevention of hernia recurrences. TAPD with bilateral inguinal hernias is the most promising in practical herniology and should be widely used in the surgical clinic.

Table 1.

Types of hernia	Children		Adults		Total	
	quantity					
	abs.	%	abs.	%	abs.	%
Bilateral oblique inguinal hernia *including: recurrent inguinal hernia	26	40,6	38	59,4	64	68,8
a) left	1	3,8	1	2,6	1	1,6
b) right					1	1,6
combined hernia:	5					
umbilical hernia			2	5,3	7	10,9
femoral hernia on the left		19,2	1	2,6	1	1,6
Bilateral straight inguinal hernia *including: combined femoral hernia			29	100	29	31,2
a) right			3	10,3	3	10,3
b) left			1	3,4	1	3,4
TOTAL :	26	27,9	67	72,1	93	100

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基于生物吸附法对石油污染土地进行生物修复
BIOREMEDIATION OF OIL-CONTAMINATED SOILS BASED ON THE APPLICATION OF THE BIOSORPTION METHOD

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注解。 该文章的作者开发了用于石油污染土地生物修复的生物吸附混合物。本文介绍了BSM（生物吸附混合物）在生物土地复垦阶段对石油污染土壤进行解毒和生物修复的比较效率的实验研究结果。
关键词：生物修复，土壤，石油析构，解毒，生物修复。

Annotation. *The authors of the article developed biosorption mixtures for bioremediation of oil-contaminated lands. The article presents the results of experimental studies of the comparative efficiency of BSM (biosorption mixtures) for detoxification and bioremediation of oil-contaminated soils at the stage of biological land reclamation.*

Keywords: *bioremediation, soil, oil destructors, detoxification, bioremediation.*

As a result of the activities of the Russian oil industry, more than 30 million barrels of oil pour onto the ground every year, which is seven times more than the result of the Deepwater Horizon disaster on the in 2010 [12].

The Samara region is characterized by the same problems as for any region of Russia with a developed petrochemical industry. More than 60 major accidents and about 20 thousand significant oil spills occur in the region annually. Disasters cause great damage to the environment and all living things. Every year the number of pipeline breakthroughs increases, significant accumulations of oil waste forms as a result of the activities of oil production and refining enterprises. According to the state statistical reporting on form 2 - TP (waste) from 3455 enterprises of the Samara region in 2006, 4147228.024 tons of waste were formed, of

which 773.737 tons of oils and waste liquid oil products (hazard class 2) [13].

All this results to the increasing negative impact of oil pollution on the environment [11,13,15,16].

Oil is known to be a multicomponent mixture consisting of various hydrocarbons with varying degrees of toxicity. Pollution by oil and oil products of soils leads to the death of soil biocenoses and soil degradation [1,19,20,26].

A theoretical analysis has shown that biodestructors that are promising for the solution of environmental problems associated with hydrocarbonic pollution of environment are biological technologies for the transformation of petroleum products. Among them, the most attention is drawn to the technology of bioremediation of oil-contaminated soils [14].

The very concept of remediation (from the English. Remediation - healing, remediation, rehabilitation) means the pollution removal and the multifunctionality of natural environments restoration in ways that are safe for ecosystems and humans [14]. Bioremediation of oil-polluted soils is a multistage biotechnological process, including physicochemical methods of pollutant detoxification, the use of organic and mineral additives, the use of biologics (V.V. Belkov, 1995).

For bioremediation of polluted lands, mainly evolutionary functions of microorganisms are used: their role in the biogeochemical circulation of substances in nature, in the processes of ecosystems self-purification, degradation of technogenic pollution, in the formation of soil humus, mineralization of annually formed mass of organic substances, natural biopolymers, etc. [1, 12].

Unlike most physical or chemical methods (for example, incineration, vitrification, extraction), biological methods allow mineralization of organic pollutants completely, processes take place under milder conditions and are distinguished by universality or selectivity [14]. In addition, biotechnological methods of soil restoration are becoming the most common due to relatively low costs in their implementation [1,2,8,11,12, 16,19,24].

Bioremediation uses natural mechanisms, living objects, and therefore it is the most environmentally friendly way in which biological material is incorporated into trophic food chains, the natural circulation of substances without generating waste [1,2,7,8].

So in the work (Gabriela Menta Alvimn, Patrícia Procópio Pontes, 2018), when assessing the bioremediation of clay acidic soils contaminated with diesel fuel, it was found that the addition of 5% sawdust was most useful for the microbial activity of microorganisms of biodegradable soil contaminants. The best result in the removal of diesel fuel from the soil was obtained in experiments with a combination of 5% sawdust and aeration (24.79 mg O2 1 kg of dry soil per day [22].

In a number of experiments, the possibility of increasing the rate of biodegradation was investigated (Harmsen, 2001, 2004). All ways to optimize the biore-

mediation process (bioreactor, temperature increase and forced aeration, addition of active fungi, the use of bacteria destructors, the use of agricultural waste and sewage sludge, additional vegetation, etc.) have a positive effect on the rate of degradation of the most bioavailable fraction of hydrocarbons [16-21] .

In the world, both single-component sorbents and multi-component sorbents are produced, consisting of natural raw materials (peat or its mixture with sapropel) and modifiers (salts of divalent metal and humic acids). A special group consists of biosorbents [5, 6]. Recently, natural sorbents are widely spread.

Use of natural sorbents as components of biosorption mixtures and soil ameliorants (dolomite flour, mineral components), as well as material carriers of biodestructors - straw, pine sawdust, localize pollution and prepare the soil for cleaning. The advantages of the sorbents proposed are that they are an organic part of the existing ecosystems and most closely comply with environmental requirements.

The use of sorbents is especially effective with biological activators. The biosorption method of hydrocarbon contamination eliminating consists in the use of multicomponent compositions: microorganisms immobilized on a sorbent + numerous prebiotic additives.

Development of new biosorption mixtures for soil bioremediation.

In the search for new effective solutions for the bioremediation of oil-polluted soils, we have developed and experimentally tested new biosorption mixtures (BSM) [4,5,6].

When conducting research, the " Crude petroleum. 3.2.1.2 GOST R51858 - 2002" (sour oil with medium density), and feeding grounds were used.

Oil in a mass concentration of 30 g / kg was added to the soil distributed into 11 containers, which corresponds to the average degree of soil contamination with oil and 50 g / kg, which corresponds to a high degree of soil contamination with oil, as in emergency oil spills (Figure 5). Control was the soil contaminated in the same mass ratio without the introduction of BSM. The added EM preparation - produced by the factory a mixture of effective microorganisms that improves the soil quality.

Composition of model mixtures:

BSM – **1** (test 1.1 (50 g/kg sour) and test 1.2 (30 g/kg sour)) – sorbent + vermiculite no add EM preparation;

BSM – **2** (test 2.1 (50 g/kg sour) and test 2.2 (30 g/kg sour)) – sorbent + vermiculite with addition EM preparation in dilution 50/50;

BSM – **3** (test 3.1 (50 g/kg sour) and test 3.2 (30 g/kg sour)) – sorbent + vermiculite with addition EM preparation in ratio 1/3;

BSM – **4** (test 4.1 (50 g/kg sour) and test 4.2 (30 g/kg sour)) – sorbent + vermiculite with addition EM preparation in ratio 1/3+ compost booster;

Control test with contaminated soil , no add BSM - (test 5.1 (50 g/kg sour) and 5.2 (30 g/kg sour).

Control - no add sour and no add BSM) (test 6).

Biotesting of soil samples was carried out by the seedling method, determining their phytotoxicity. The method is based on the reaction of the test object to the presence of pollutants in the soil. It allows to identify the toxic effects of certain substances (oil pollution). During the experiment, the germination, length of the above-ground and root systems were monitored.

The application of the biotesting method for watercress sprouts made it possible to compare the phytotoxicity of oil pollution at different stages of the experiment. The results of phytotoxicity tests in 1 month, 7 months, in 10 months and in 15 months after contamination of soil samples with oil are presented in Figure 1:
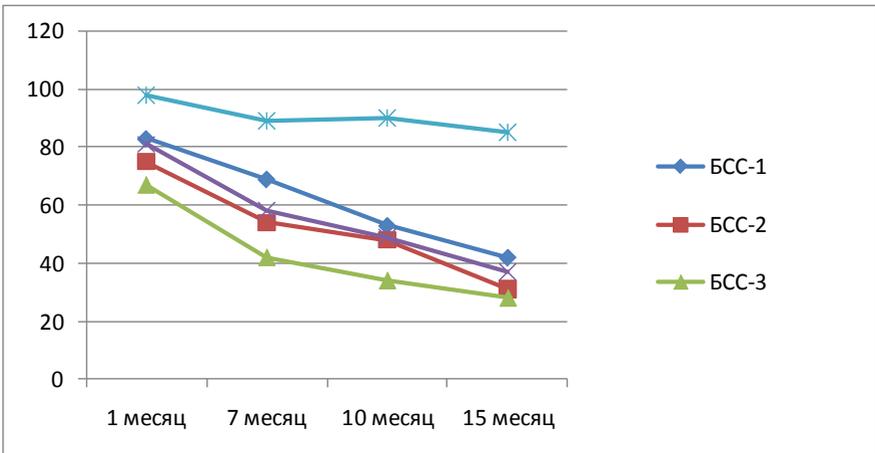
Figure 1 - *Comparative phytotoxicity of prototypes on cress-seedlings with a high degree of contamination of 50 g/kg.*

An analysis of the phytotoxicity of soil contaminated with oil using BSM and without applying BSM during different time periods showed that adding the BSM to experimental, oil-polluted soil samples influenced the decrease in soil toxicity compared to the experimental control contaminated soil samples without BSM (biosorption mixtures) .

Determination of catalase activity of test samples of oil-contaminated soils.

This method of determining soil catalase activity is based on taking into account the amount of unreacted part of hydrogen peroxide introduced into the soil.
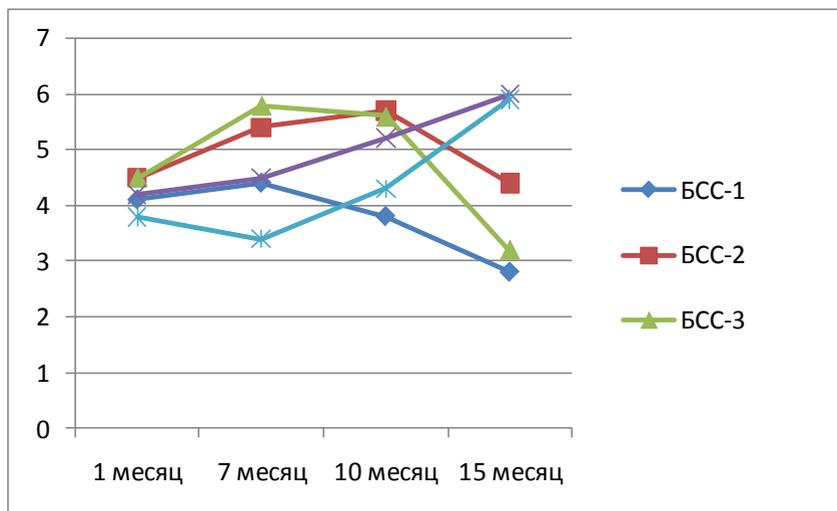
Figure 2 - *Comparative chart of the catalase activity of soil samples*
of an average contamination degree of 30 g/kg with the introduction
of the BSM and the control sample without the introduction of the BSM.

The difference between the amounts of peroxide introduced into the reaction medium and that detected after interaction with soil enzymes is equal to the amount of split peroxide and characterizes the activity of the catalase action of soil microorganisms. Catalase activity was expressed in milliliters of 0.1 N. $KMnO_4$ per 1 g of dry soil for 20 min.

Analysis of the catalase activity of prototypes of soils contaminated with oil (30 g / kg and 50 g / kg) during different periods of time from the grounding of the experience (15 months in total) showed that when making mixtures BSM-3, BSM-4 and BSM-% The highest rates of catalase activity were observed after 7 and 10 months, while in the control samples, on the contrary, there was a decrease in the catalase activity of soil microorganisms, which is probably due to the toxic inhibition of the soil samples without BSM by oil hydrocarbons (biosorption impurity) (Figure 2).

The results of studies on the determination of catalase activity showed that the introduction of BSMleads to an increase in enzymatic activity, which reflects the activation of the biodestructive activity of soil degradation microorganisms.

The results of studies of TMN (total microbial number) of test samples of soil contaminated with oil (30 g / kg and 50 g / kg) showed that in 6 months after initiation of experiments, the highest increase in TMN was observed - $17 \cdot 10^5$ total

coliform units CFU/g (sample 2.1 contaminated 50g / kg of oil with the introduction of BSM - 2), TMN - 18.5 · 10^5 CFU/g (sample 3.2 contaminated with 30g / kg of oil with the introduction of BSM - 3), TMN - 18.5·10^5 CFU/g (sample 4.1 contaminated 50g/kg of oil with the introduction of BSM - 4) and TMN - 16.7·10^5 CFU/g (sample 4.2 contaminated with 30 g/kg of oil with the introduction of BSM - 4) compared with the control without making mixtures of BSM, where is lowest indicators TMN - 7.4·10^5 CFU/g (sample 5.2 contaminated 50g/kg oil) and TMN - 9 ·10^5 CFU/g (sample 5.2 contaminated 30g / kg oil without making BSM).

The introduction of biosorption mixtures stimulated the activity of the oil destructive microorganisms, which was expressed in an increase of the catalase activity- 6.2 ml $KMnO_4$ / g / 20 min (experiment 3.1 application of BSM-3), 5.8 ml $KMnO_4$ / g / 20 min (experiment 3.2, introduction of BSM- 3) (after 7 months) compared with the control - 3.7 ml $KMnO_4$ / g / 20 min (test 5.1 without making the BSM), 3.4 ml $KMnO_4$ / g / 20 min (experiment 5.2 without making the BSM).

In our experiments with the use of biosorption mixtures, the number of destructor microorganisms (TMN) increased, which shows the stimulating effect of mixtures with sorbents and biological preparation "Baikal-EM-1" - BSM-2, BSM-3, BSM-4 and their effectiveness in the biological recovery of oil.

As a result of the experiments, it was found that biosorption complex mixtures of BSM-2; BSM-3 and BSM-4 proved to be the most effective for cleaning the soil. This allows recommending their introduction at the stage of biological reclamation, soil contaminated with oil products, or during the emergency oil spill response.

At a further stage of research, technological solutions were developed for the use of biosorption mixtures for the biological reclamation of oil-contaminated lands, waste neutralization and the methods for their application.

Conclusion. Based on the analysis of the work of domestic and foreign authors, biosorption mixtures were developed and experimental studies of their effectiveness in the bioremediation of oil-contaminated soils were carried out. The results of these studies and the developed biosorption mixtures can be recommended for use for effective cleaning and restoration of land contaminated by oil and oil products.

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解毒和恢复受污染土地的技术方法
TECHNOLOGICAL APPROACHES TO DETOXIFICATION AND BIOREMEDIATION OF OIL-POLLUTED LANDS

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注解。 在对现有的石油污染土地解毒和恢复技术的理论分析的基础上，本文作者开发了生物吸附复合物及其应用的技术方法。 本文介绍了实验证实的技术解决方案，用于生物吸附混合物（BSM）用于石油污染土壤的解毒和生物修复，并提出了在生物土地开垦阶段引入它们的方法。

关键词：技术，生物修复，土壤，生物吸附混合物，再培养。

Annotation. *Based on the theoretical analysis of existing technologies for detoxification and restoration of oil-polluted lands, the authors of the article developed biosorption complexes and technological approaches for their application. The article presents experimentally substantiated technological solutions for the use of biosorption mixtures (BSM) for detoxification and bioremediation of oil-contaminated soils and suggests methods for their introduction at the stage of biological land reclamation.*

Keywords*: technology, bioremediation, soil, biosorption mixtures, recultivation.*

In recent decades, the problem of soil pollution by oil and oil products has become increasingly serious in industrialized countries. High accident rate at oil-producing enterprises is accompanied by salvo emissions of oil and oil products into environment. But the largest oil emissions occur as a result of pipeline breakthroughs. It is calculated that, on average, with one pipeline damage, 2 tons of oil is thrown out, resulting in the unsuitability of 1000 m^2 of land [12.19]. All this leads to the increasing negative impact of oil pollution on the environment [11,13,15,16].

An analysis of the theoretical sources of Russian and foreign authors has shown that biodestructors that are promising for the environmental problems solution associated with contamination by petroleum hydrocarbons are biological technologies for the transformation of petroleum products. Among them, the most attention is drawn to technologies of oil-contaminated soils bioremediation [14]. Unlike most physical or chemical methods (for example, incineration, vitrification, extraction), biological methods allow mineralization of organic pollutants completely, processes take place under milder conditions and are distinguished by universality or selectivity [14]. In addition, biotechnological methods of soil restoration are becoming the most common due to relatively low costs in their implementation [1,2,8,11,12, 16,19,24]. Biological restoration uses natural mechanisms, living objects, and therefore it is the most environmentally friendly way in which biological material is incorporated into trophic food chains, the natural circulation of substances without waste generating [1,2].

Biodegradation (detoxification of contaminants by destructor microorganisms) is completed by their full mineralization or partial decomposition in both aerobic and anaerobic pathways. To speed up biodegradation, they resort to various methods of stimulating microorganisms and creating optimal conditions for their vital activity [7, 8].

In a number of works by domestic and foreign authors, the conditions for effective bioremediation of oil-contaminated soils were investigated. According to the researchers, the soil is a system in which several native (local) hydrocarbons biodestructors are always present (Schlegel, 1992, Zhao et al., 2017), which are activated as soon as the proper conditions appear (oxygen, vegetation).

As a result of numerous studies, it turned out that petroleum hydrocarbons (PH), including PAHs (polyaromatic hydrocarbons), are biodegradable, but their decomposition rate differs significantly (Sims and Overcash, 1983).

Several microorganisms types capable of biodegrading PH and PAH have been identified (Juhasz and Naidu, 2000, Kuppusamy et al., 2017). Ghosal et al. (2016) identified and described a large number of oil-decomposing microorganisms in combination with the appropriate conditions necessary for the degradation, including regulation of oxygen concentration, pH, temperature, availability of nutrients and improved bioavailability. In a number of experiments, it was found that the simultaneous use of all microorganisms in proper conditions can lead to enhanced petroleum hydrocarbons biodegradation (Zhao et al., 2017).

The petroleum hydrocarbons degradation under natural situation includes the sequential decomposition and occurs in a long time period , active recultivation is necessary, and creating the conditions to activate natural biodestructors, which reduces land reclamation and land restoration by orders of magnitude.

The activities of the first remediation level are aimed for activating soil mi-

croorganisms by the destruction of hydrocarbons. This includes loosening the soil, adding lime, gypsum, high doses of organic and mineral fertilizers, followed by tilling, creating a mulching surface from high-nutritional mixtures, planting oil-tolerant plants with increased standards, and also using compound ameliorates: NPK + manure; NPK + lime; NPK + lime + manure [1,2,7,8, 10,11,12,16,24].

The technologies with a periodic cycle showed the greatest efficiency in removing oil and oil products from soil: moistening - drainage - aeration. The rate of oil destruction can be increased by creating a neutral reaction in the soil, introducing water, nitrogen and phosphorus (C: N: P ratio should be 100: 10: 10), CaO [8,10].

Great attention is paid to the use of plants for the purification of soils contaminated with hydrocarbons (oil and petroleum products), considering the three most promising methods of cleaning with plants: phytodegradation, phyto evaporation, risodegradation [7,24]. The sowing of plants resistant to oil is very promising, as well as the use of effective strains of oil-oxidizing bacteria, algae. The introduction of green mass of siderats (meliotus, clover, rape) into contaminated soil activates the processes of oil microbiological decomposition, helps to restore the number of soil microorganisms, stimulates the activity of soil oxidoreductases involved into the oil destruction. Siderats have a high efficiency of action on the biological activity of the soil, enriching it with organic matter, nitrogenous compounds and other nutrients [8,10].

In a number of experiments, it was found that the simultaneous use of all microorganisms and proper conditions can lead to enhanced biodegradation of petroleum hydrocarbons (Zhao et al., 2017).

Natural degradation of petroleum hydrocarbons in natural conditions includes sequential decomposition and occurs in a sufficiently long period of time, while active recultivation is necessary, creating conditions for the activation of natural biodestructors, which reduces land reclamation and land restoration by orders of magnitude.

As components of biosorption mixtures of natural sorbents and soil ameliorants. (dolomite flour, mineral components), as well as materials carriers of biodestructors - straw, pine sawdust to localize pollution and prepare the soil for cleaning were used.

The advantages of the proposed sorbents are that they are an organic part of the existing ecosystems and most closely comply with environmental requirements. Natural sorbents contribute to the creation of favorable conditions for achieving the required soil condition in economically rational ways.

Dolomite improves the physical, physico-chemical and biological properties of soil. Also it increases the amount of assimilable forms of nitrogen, phosphorus, potassium, molybdenum, the efficiency of organic and mineral fertilizers, im-

proves the nutritional conditions of plants. It enriches the soil with calcium, which promotes plant growth, improves the condition of the root system. It enriches the soil with magnesium, which is part of chlorophyll and is involved in photosynthesis.

The use of sorbents is especially effective with biological activators. The most promising are biosorption methods for eliminating hydrocarbon contamination, which consist in the creation and application of multicomponent compositions: microorganisms immobilized on a sorbent + numerous prebiotic additives.

The use of environmentally friendly sorbents based on natural materials - dolomite flour, vermiculite, etc.

Dolomite flour is produced by grinding dolomite, which contains 25-32% CaO and 14-21% MgO, and in terms of $CaCO_3$ - 79.7 - 110.8%. Besides the fact that dolomite is a good absorbent, it is also a very valuable lime fertilizer. The main active ingredient - calcium carbonate CaC03 is practically insoluble in water, but under the influence of CO_2 contained in the soil, it gradually goes into solution in the form of $Ca(HCO_3)_2$. Calcium promotes plant growth, improves the condition of the root system.

The soil is enriched with magnesium, which is part of chlorophyll and is involved in photosynthesis. Dolomite has absolute non-toxicity towards any living creatures [4,5].

Mixing the polluted soil with pine sawdust and pine bark or straw accelerates by an order of magnitude the rate of oil destruction due to the ability of microorganisms existing on the surface of the bark to destroy complex pine resin hydrocarbons, as well as by adsorption and aeration of oil products.

Phytomeliorants (vetch, alfalfa, etc.) in oil-polluted soil with their developed root system contribute to the improvement of a gas-air regime in soil; enrich it with nitrogen and biologically active compounds. This method of decomposition is called the phytodetoxication.

The effectiveness of alfalfa as a phytoremedient is ensured by the rhizosphere bioremediation, in which organic compounds of oil products decompose under the combined action of nodule plants and microorganisms living in the root zone of plants - the rhizosphere.

The effect of EM [reparation ("Baikal-EM-1", "Vostok-EM-1") is based on the beneficial soil microflora revitalization and accumulation of nutrients [3, 4]. These preparations are included in the developed complex mixtures of the BSM. "Baikal EM 1" has the following composition: lactic acid, photosynthesizing, nitrogen-fixing bacteria, saccharomycetes, culture liquid.

The main reason for the exceptional multifunctionality of the EM-preparation is the widest range of its microorganisms action. Each type of effective microorganism has its own important function, but at the same time, on the one hand, it

supports the action of other microorganisms, on the other hand, it uses substances produced by these microorganisms. When effective microorganisms develop in soils as communities, the number of beneficial microorganisms increases.

The biological product introduction increases the nitrogen mobile forms content, phosphorus and potassium content during the growing season. The introduction of "Baikal EM 1" increases the biological activity of soils by 83-94%. The number of bacteria and actinomycetes is especially increasing [5, 6, 7]. This complex of measures based on of phyto and bioremediation methods. It is affordable and highly efficient.

The integrated use of biostimulation and augmentation methods allows us to accelerate the degradation of petroleum products, reduce the cost of remediation and carry it out in a shorter time. The introduction of optimal dose of dolomite and pine sawdust into contaminated soil creates favorable conditions for the xenobiotics biodegradation by indigenous microflora due to a decrease in the concentration of pollutant and an increase in the pH value to 6.5 - 8.0. The use of dolomite contributes to the improvement of the agrochemical properties of the soil and the better restoration of soil biosystems. In addition, dolomite has a positive effect on the growth of alfalfa used as a phytomeliorant.

When cleaning the soil from oil pollution, it is proposed to use a biotechnological complex for cleaning and remediation, based on a combination of various biological methods and their integrated use.

Conclusions. Thus, the problem of finding the most efficient, optimal and affordable technologies for cleaning and remediation of oil-polluted lands is currently relevant due to the rapid development of oil fields and the oil industry and extensive environmental pollution by oil and oil products.

As a result of the analysis of the works of domestic and foreign authors, the properties of oil and petroleum products and the features of their transformation in the soil, changes in the soil properties in the process of its pollution and restoration were studied.

On the basis of experimental data and comparative analysis of methods and technologies, we have developed a set of measures for the oil pollution biodegradation and proposed effective technological approaches to detoxification and biorestoration of oil-contaminated lands. The results of these studies and the developed complex of biological methods can be recommended for use in the Samara region for effective cleaning and restoration of land contaminated by oil and oil products.

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使用具有高胞外多糖潜力的乳酸菌来生产基于乳制品的生物产品
THE USE OF LACTIC ACID BACTERIA WITH HIGH EXOPOLYSACCHARIDE POTENTIAL FOR THE PRODUCTION OF DAIRY-BASED BIOPRODUCTS

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注解。 本文介绍了乳酸菌胞外多糖潜力的研究结果 – 各种俄罗斯保加利亚杆菌和嗜热链球菌的发酵剂，合成了最大数量的胞外多糖的酵母培养物，一种保加利亚杆菌和一种嗜热链球菌的微生物群体。 创造了一种具有高功能性的生物产品..
关键词：乳酸菌，保加利亚杆菌，嗜热链球菌，胞外多糖，生物制品。

Annotation. *The article presents the results of research of the exopolysaccharide potential of lactic acid bacteria - various Russian starters of Bulgarian rods and thermophilic streptococcus, ferment cultures were synthesized that synthesize the greatest number of exopolysaccharides, a microbial consortium of Bulgarian rods and a thermophilic streptococcus to produce a biological product with high functionalities was created..*

Keywords: *lactic acid bacteria, Lactobacillus bulgaricus, Streptococcus thermophilus, exopolysaccharides, bioproducts.*

Intensive expansion of the range of dairy products in the late 20th - early 21th centuries led to the widespread use of various food additives in the technology of dairy products. To improve the consistency and increase the shelf life of fermented milk products, polysaccharides of various origins were used (from seaweed — agar, carrageenans and alginates, from plants — pectins, starch, galactomannans, modified — potato, corn starch, etc.) each of which has a complex of functional properties.

In recent years, in Russia and abroad there has been an increased interest in the search for new probiotic cultures synthesizing exopolysaccharides (EPS), which are not only an alternative to natural bio-thickeners, improve consistency and prolong the storage time of food bioproducts, but also contribute to the adhesion of beneficial microflora on human intestinal walls , provide colonization and maximum efficiency of impact on the host organism [1, 2, 3].

Of particular interest to probiotic cultures of lactic acid bacteria and bifidobacteria, which actively synthesize EPS, is also due to the high security status of GRAS (Generally recognized as safe) given to these bacteria at the international level, which confirms the possibility of using EPS producing cultures of lactic acid bacteria and bifidobacteria in production safe food. This direction defines the prospect of widespread use of bacterial EPS in the food industry to meet the growing demand for therapeutic and prophylactic foods [4, 5]. Scientists from the United States, the Netherlands, Belgium, Switzerland, Russia, Canada and other countries are engaged in research on lactic acid cultures producing EPS. This direction is particularly promising, since contributes to the provision of the population with natural, biologically complete, environmentally friendly food bioproducts that meet the modern requirements of the science of nutrition. Research of various scientists have found that EPS cultures of lactic acid bacteria have increased resistance to aggressive environments due to the presence of an exopolysaccharide capsule, which probably serves as a link when they are colonized and adhesion in the intestine, therefore, this property increases the likelihood of accumulation of such cultures of lactic acid bacteria in the human digestive tract . EPS, which synthesize lactic acid bacteria, are able to intensify the fermentation of milk, stimulate the growth of bacteria themselves and the synthesis of amino acids, volatile fatty acids, vitamins, act as active antagonists against cancer cells, reduce cholesterol in the blood, show anti-ulcer activity and help reduce blood pressure in hypertension [6, 7].

Research of various scientists (Gasscm, Schmidt, Frank, 1995; van den Berg et al., 1995; Macedo et al, 2002, etc.) have found that lactic acid bacteria of the genus Lactobacillus have great potential for the synthesis of EPS, therefore they are given special attention . From the literature [8] it is known that the EPS of Lactobacillus delbrueckii subsp. bulgaris have an impact on the cytokine status of the organism of mice in normal conditions and with staphylococcal infection, increase the number of certain microorganisms in the large intestine of mice [9], show an immunomodulating effect [10]. Research results Khryashchevskaya D.V. et al. [11] showed that when injected into the body of EPS mice, Lactobacillus delbrueckii subsp. bulgaris obtained from domestic Bulgarian sticks used in Russia for the production of yogurt, increased motor activity of mice, decreased aggression, improved coat and increased the number of lactic acid bacteria in the large intestine. EPS Streptococcus salivarius subsp. thermophilus can exhibit an immunostimulating effect [12] and antagonistic properties with respect to pathogenic and conditionally pathogenic microorganisms [13].

In the dairy industry, starter cultures are widely used, which include Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus salivarius subsp. thermophilus [14]. According to most researchers, there is a symbiotic relationship between these lactic acid bacteria, which is characterized by the mutual benefits obtained by microorganisms during co-cultivation. It is also known that microbial consortia are more resistant to adverse environmental factors and have a higher biochemical activity compared to starters prepared using pure cultures [6].

In this regard, it was of interest to study the synthesis of exopolysaccharides of various domestic starter cultures of the Lactobacillus bulgaricus and Streptococcus thermophilus, in order to develop a biotechnology for the production of a bioproduct based on a microbial consortium with a high exopolysaccharide potential.

The objects of research were the domestic starter cultures of the Bulgarian rod Lactobacillus delbrueckii subsp. bulgaricus: bacterial starter for koumiss obtained from the GNU VNIMI of the Agricultural Academy, Moscow; starter L-4, obtained from JSC "Vektor-BiAl'gam", p. Koltsovo, Novosibirsk region; Bacterial starter of the Bulgarian stick of viscous BZ-BV and bacterial starter of the Bulgarian stick of inviscid BZ-BNV, obtained from "Barnaul'skaya biofabrika" LLC, Barnaul, Barnaul and bacterial concentrates of Streptococcus salivarius subsp. thermophilus: BK-Uglich-TNV, obtained from the FSUE "Eksperimental'naya biofabrika" of the Russian Agricultural Academy, Uglich; BK-STv, BK-ST and BK for Ryazhenka-KTS, obtained from "Barnaul'skaya biofabrika" LLC, Barnaul.

The main microbiological and physicochemical parameters of bioproducts were determined by standard methods generally accepted in research practice. The number of EPS was determined by the anthron method: 4 volumes of distilled water and 10 volumes of freshly prepared anthrone reagent were added to 1 volume of starter culture or microbial consortium, the mixture was incubated for 10 minutes at 1000C in a water bath, the concentration of EPS was determined by spectrometry at 620 nm. For the cultivation of starter cultures and microbial consortia as a nutrient medium used cow's milk with a mass fraction of fat 2.5%. The obtained research results were subjected to statistical processing.

When selecting the Lactobacillus bulgaricus and Streptococcus thermophilus for the development of a bioproduct, the polysaccharide potential of the starter cultures and the microbial consortium was studied (Table 1). The greatest ability to synthesize EPS was found in the bacterial starter of the Bulgarian stick of viscous BZ-BV, the bacterial starter of the Bulgarian stick in the non-viscous BZ-BNV and the bacterial concentrate of Streptococcus thermophilus for ryazhenka BK for ryazhenka – KTS.

Taking into account the biotechnological potential, the basic laws of the biosynthesis of exopolysaccharides of lactic acid bacteria from cultivation conditions were established, the optimal ratio of starter cultures of Lactobacillus delbrueckii subsp. bulgaricus (BZ-BV) and Streptococcus salivarius subsp. thermophilus (BK for ryazhenka - KTS) to obtain a bioproduct, whose microflora has a high exopol-

ysaccharide potential.

Table 1 - Polysaccharide potential of starter cultures

№	Starter cultures	Sourdough Composition	Manufacturer	The number of EPS per 100 g of sample, mg
1.	BK for koumiss	Lactobacillus delbrueckii subsp. bulgaricus	GNU VNIMI of the Agricultural Academy, Moscow	30,54±0,04
2.	L-4	Lactobacillus delbrueckii subsp. bulgaricus	JSC "Vektor-BiAl'gam", Koltsovo, Novosibirsk Region	33,81±0,04
3.	BZ-BV	Lactobacillus delbrueckii subsp. bulgaricus	"Barnaul'skaya biofabrika" LLC, Barnaul	37,31±0,04
4.	BZ-BNV	Lactobacillus delbrueckii subsp. bulgaricus	"Barnaul'skaya biofabrika" LLC, Barnaul	36,15±0,04
5.	BK-Uglich-TNV	*Streptococcus thermophilus*	FSUE "Eksperimental'naya biofabrika" of the Russian Agricultural Academy, Uglich	27,22±0,04
6.	BK-STv	*Streptococcus thermophilus*	"Barnaul'skaya biofabrika" LLC, Barnaul	31,34±0,04
7.	БК-СТ	*Streptococcus thermophilus*	"Barnaul'skaya biofabrika" LLC, Barnaul	30,57±0,04
8.	БК для ряженки -КТС	*Streptococcus thermophilus*	"Barnaul'skaya biofabrika" LLC, Barnaul	34,28±0,04
9.	БЗ-БВ : БК для ряженки – КТС 1:3	Lactobacillus delbrueckii subsp. bulgaricus *Streptococcus thermophilus*	"Barnaul'skaya biofabrika" LLC, Barnaul	39,13±0,04

Synthesis of EPS starts from the first hours of culture of the starter cultures and reaches the maximum amount of EPS in the stationary phase at the end of the fermentation. Selected starter cultures actively fermented milk to form a homogeneous dense consistency, giving the bioproduct good organoleptic characteristics. As a result of the research conducted, it was established that selected cultures of lactic acid bacteria are promising for the production of a bioproduct for functional nutrition.

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河流网络上游的山谷：从斜坡基本侵蚀形成到河谷的过渡链
THE VALLEYS OF THE UPPER LINKS OF THE FLUVIAL NETWORK: A TRANSITION CHAIN FROM SLOPE ELEMENTARY EROSION FORMS TO RIVER VALLEYS

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注解。河流网络的上部连接是均匀侵蚀系统的组成部分，其中每个元素贡献其水径流和沉积物产量的比例。其中水流的形成取决于给定区域的水文气候条件，集水区的形态和形态。在这种情况下，河流网络的空间位置上链的序列及其形态和形态特征可以在单一的转化系统中发生变化，因为它们从溪流网络生长和发育到山沟的形成并且转变为干谷（巴尔卡）。河流网络上部链路的一组单个元素的过渡聚集到其层次结构中的更高层次，水和沉积物的单向流动在侵蚀形式的行中进行：小溪 – 短暂的沟壑 – 沟壑 – 干谷（巴尔卡） – 河。在这种情况下，数量（水径流量）变为质量（径流转换为通道流与谷的形成）

关键词：非渠道排水，渠道流（排水），渠道，渠道过程，小溪，沟壑，短暂沟壑，沟壑，干谷（巴尔卡），河流。

Annotation. *The upper links of the fluvial network are components of a uniform erosion system, where each element contributes its proportion of the water runoff and sediment yield. The formation of water flow in them depends from the hydro-climatic conditions of the given territory, the morphology and morphometry of the catchment. In this case, the sequence of spatially located upper chains of the fluvial network and their morphometric and morphological characteristics can change both in a single system of transformation, as they grow and develop from the stream network to the formation of the ravine and its transformation into a dry valley (balka). The transition of a set of individual elements of the upper links of the fluvial network aggregate to a higher level in its hierarchy with a unidirectional flow of water and sediments proceed in the row of the erosion forms: rill- ephemeral gully – gully- dry valley (balka) – river. In this case, the quantity (the amount of water runoff) changes into quality (the conversion of the runoff to the channel flow with the formation of the valley)*

Introduction

The upper links of the fluvial network are components of a single erosion-channel system, where each of its elements contributes its own share of the flow of water and sediment. The formation of water flow in them is subject to the hydroclimatic conditions of a given territory, the morphology and morphometry of the catchment area (such as slopes, the system of their irregularities, the geological structure, the degree and form of anthropogenic load). At the same time, the sequence of spatially located upper links of the fluvial network and their morphometric and morphological characteristics can change both in a single transformation system, as they grow and develop from a stream network to the formation of a ravine and its transformation into a beam, and depending on the characteristics of the river catchment elements of which they are and in feedback reflect the impact on the river basin as a whole.

Valleys of the upper links of the fluvial network

In a sequence «rill→ephemeral gully→gully→ravine→dry valley (balka)→river» there is a transition of a set of individual elements of the upper links of the fluvial network to a higher level in its hierarchy with unidirectional movement of water flow and sediment.

The Rillis the top element of the erosion network. Here, a planar (reservoir) runoff is transformed into a streaky or furrow, in particular due to falling raindrops causing a transition from laminar to turbulent motion [Makkaveev, 1955; Makkaveev, 1971].

The formation of a rilldepends on a variety of external conditions. The main types are slope type, slope catchment area, intensity of snowmelt and precipitation in liquid form, lithological basis, slope sodging and anthropogenic variability of the slope catchment (agricultural tillage). L.F. Litvin [Litvin, 2002] identifies three types of slope watersheds: radially divergent (dissipating watersheds), parallel and radially converging. In the latter case, the gaps between the main trunks of the rillare narrowed down the slope, which speeds up the flow of water from their inter-rivings into their beds, increases the concentration of runoff and the overall eroding capacity of runoff.

A network of micro streams formed on a slope is a system of ephemeral channels, which under the influence of external conditions (depth of flow, erosion of micro- and nanoform slope relief and redeposition of erosion products, change in the size of raindrops, etc.) can change the network configuration, length and the width of individual channels [Litvin, 2002; Golosov, 2006]. Depending on the volume of water flow and its intensity in the microwires, "channel" processes arise with the formation of channel relief forms, the dimensions of which correspond to the size of the flow and lithogenic basis.

At thaw, the speeds in actively eroding slope microflows are on average 0.3–0.5 m/s, the average minimum depths of the flows are 1-3 cm, and the water flow rates are from tenths to first tens l/s [Lidov, 1981; Golosov, Litvin, 1987].

Unlike the higher ranked links of the fluvial network, the rillis completely dependent not only on the shape of the slope, but also on the micro and nano-relief of the slope. The emerging rillhas no spatial restrictions in the form of a valley, and the network itself is ephemeral not only from what can be destroyed during agricultural processing, but also to transform when the intensity of melt water and precipitation changes or under wind influence. With each new runoff episode, a new rillis formed with its own unique pattern. The drawing of the rilldepends not only on the relief of the slope watershed, but also on the direction of plowing the slope, the presence or absence of vegetation, the species composition and its vegetative state.

Ephemeral gully. The merging of microtubules into a single stream, together with an increase in the eroding ability of the flow of water, causes the formation of a more morphologically expressed form of the slope relief — the ephemeral gully. Like the creek network, the ephemeral gully repeat the longitudinal profile of the slope, but they also have a relatively stationary bed. Ephemeral gully depths of up to 1-1.5 m, located within the cultivated field, are plowed at the next tillage. Shallower ones can be destroyed by harrowing. Ephemeral gullys outside the field may exist for a long time. In a ephemeral gully, the flow rates of water can reach 1–1.5 m / s, and the maximum instantaneous flow rates of the first hundreds of liters / s (Litvin, 2002). These parameters for quite a long time allow you to maintain a morphologically pronounced temporary course of the ephemeral gully.

Gully. Gully with ephemeral gullys serves as a link between the slope watershed and ravine. They no longer belong to the slope, to a large extent cut it. The depth of the gully reaches 3-4 m, the length of tens of meters with a width of up to 8-10 m. The transitional form from the initial form of slope erosion to ravine [Lidov et al., 1954]. The morphological and morphometric parameters of the gully, a constant channel with a temporary water flow often leads to their assignment to ravine, especially if they are not a continuation of ravine and rely on their mouth on a subhorizontal surface.

Gully occupy a transitional place in the chain of links of the upper links of the fluvial network. On the one hand, they cause the growth of ravine, and on the other hand, they are a continuation of the ravine or beam (vertex ravine), arising from a regular decrease in the catchment area. In the first case, gully serves as a supply channel. Water flow in the ravine is the same as in the ephemeral gully, i.e. can reach the first hundred l/s. The recorded consumption is 450 l/s at the top of Egorov ravinea (Borovsk Educational Research Station of the Lomonosov Moscow State University) [Geography of ravine erosion, 2006].

Ravines. If the creek network, ravine and gully are in essence a different type of channel, then ravine, at different stages of development and depending on the

volume of water flow, can be both the channel and the elements inherent in the valley in which the channel is its element.

Depending on the stage of ravine development, the geological structure of the territory, the volume of water flow and sediment, the latter can, as fully removed from ravine, and accumulate in it. The term "channel" for a gully form has a double meaning - at different stages of ravinea development, with a certain gully form morphology and volumes of water flow, it can be the channel itself. In this case, the ravine itself is reformed. At the first stage of development, ravine is a deep scape, slit-like with steep walls. The channel occupies the entire bottom, slightly sinuous with the complete removal of soil-agglomerations or strongly looping between them. During one intensive shower, the entire length of ravine can be developed. Thus, ravine passes simultaneously the first and second stages of its development. In this case, all sediments are carried beyond its limits. The longitudinal profile of the bottom of the ravine-shaped convex, often stepped, transverse - V-shaped, the main course basically repeats the ravine design itself and occupies the entire bottom.

The subsequent stages of ravine development are characterized by the transition to quasidoline. The third and fourth stages, according to S.S. Sobolev [Sobolev, 1948] correspond, in the first case, to the development of an equilibrium profile, in the second, to attenuation of gully processes and the transformation of ravine into dry valley (balka).

Dry valley (balka) – morphologically distinct ancient relief forms. Dry valley (balka) sizes and shapes can vary significantly. I.P. Gerasimov [Gerasimov, 1976] distinguishes two types of dry valley (balka): 1) short, with a large slope of the bottom, without secondary incisions; 2) long, wide, often with a secondary incision. The secondary incision can be an erosion incision up to a depth of 2-3 m and a width of up to 4-5 m, with a constant channel that meanders within the incision [Geography of ravine erosion, 2006]. The water flow rate, taking into account the permanent water flow in the flood (flood), can reach 1-2 m^3/s. The depth of dry valley (balka) depends on the depth of local bases of erosion and ranges from 10–15 m in low-lying areas and up to 100–200 m in steep slopes of valleys of large rivers. The length of the dry valley (balka) varies from the first hundred meters to 10-15 km. In sandy-clay rocks, the slopes of the dry valley (balka) are gentler, in semi-rock and rock (limestone, dolomite, opoka, writing chalk, etc.) the slopes have an average steepness. Most of the dry valley (balka) has a late Pleistocene age, but there are also more ancient forms that survived several stages of transformation [Sobolev, 1948].

However, now we can observe the transition of ravine to dry valley (balka). This is clearly expressed in ancient or very long ravine. Such a transition from the gully stage to the gully was observed along the Borovetsky ravine (outskirts of the city of Naberezhnye Chelny, left tributary of the Toima River, examined in 1991). Borovetsky ravine with a length of 2300 m in the upper quarter of the length had the appearance

of an actively developing ravine with a summit ledge of about 2 m. The middle part showed all stages of ravine development as it moved downstream. The lower section, after the appearance of a permanent watercourse and a small scarp, was characterized by a conversion to dry valley (balka). Here, ravine becomes asymmetrical with a steep right slope (25-30º) and more gentle left (≈20º), had a distinct small terrace 2-3 meters high and 5 meters wide. The terrace has a clearly erosive origin, as it starts above the source of the stream and mates with the bottom of the ravine at the height of the ledge.

V.V. Dokuchaev [Dokuchaev, 1878] noted "... dry valley (balka) is nothing but the secondary level of ravine ... rivers are only the next, third stage of development of ravines", thus emphasizing the consistency and continuity of transformation of the upper links of the fluvial network. In the sequence of the upper links of the fluvial network (rill→ ephemeral gully → gully → ravine → dry valley (balka)) dry valley (balka) the last element of non-channel flow [Makkaveev, 1955], although quite often there is a constant water flow in the bottom of the beam, emphasizes its transitional state to the river valley with all its inherent valley elements - channel, floodplain and terraces.

Conclusion

The sequence of the upper links of the fluvial network of the channel network → hollow → ravine → ravine → flushing → valley is a genetic series of changes in the properties of elements that have different degrees of stationarity of water flow. The Rillis a system of ephemeral channels that can change not only under periodic conditions, but also during a single flow, even when exposed to raindrops and wind. Water consumption - from tenths to first tens of l/s. The merger of microtubules causes the formation of ephemeral gullys with temporary channels. They are more resistant to the appearance of natural factors. Water consumption - up to the first hundred l/s. More resistant to mechanical sight gullies. Morphometric characteristics allow you to save a long time. The time of their existence and the channel in them is years. Recorded maximum water flow - 450 l/s. The pit and the ravine belonging to the propensity, repeating its profile, are a link between the inclinations of the catchment and ravines. Ravenins at different stages of their development. Completes the sequence of the upper links of the fluvial dry valley (balka)ing network. It already has a clearly defined valley with a temporary or permanent water flow and a permanent channel. Water consumption can reach 1-2 m^3/s.

Thus, the sequence of the upper links of the fluvial network is a streamline network → ephemeral gully → ravine → ravine → dry valley (balka)ing → valley - this is a genetic sequence of transformation of a plane (reservoir) flow, which has no clear geomorphological boundaries, into a channel with the formation of a continuous valley. When this occurs, the transition of the quantity into the channel with the formation of the valley.

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极地和极地乌拉尔的主要含金地区
THE MAIN GOLD FIELDS OF THE SUBPOLAR AND POLAR URAL

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注解。 该研究提供了关于极地和极地乌拉尔西坡的Kozhim和Manitanyrd地区的含金能力的基本信息。 描述了Sinilg, Karavanny, Katalambinsky, Verkhnenyyayusky事件的金硫化物矿化, Chudnoye的金 – 铂 – 陨石矿化, Nesterovsky事件。 给出了黄金和相关矿物的特征。 结果表明, 在大多数矿石的金组成中, 杂质元素中存在银。 随着银, 铜和汞通常在Verkhnenyyayusky发生的黄金中被注意到; 通常在Chudnoye事件的金中观察到铜, 汞和钯。 结果表明, 金矿床主要发生在矿物形成的后期阶段。
关键词: 黄金, 矿石, 金硫化物和金 – 铂 – 岩心矿化, 亚极性乌拉尔, 极地乌拉尔。

Annotation. The study presents basic information about the gold-bearing capacity of the Kozhim and Manitanyrd regions of the western slope of the Subpolar and Polar Urals. Gold-sulphidic mineralization of the Sinilg, Karavanny,

Katalambinsky, Verkhnenyyayusky occurrences , gold-platinoid-fuchsite minerali-zation of the Chudnoye, Nesterovsky occurrences is described. The characteristic of gold and related minerals is given. It is shown, that of the impurity elements there is silver in the gold composition of most ore occurrences. Along with silver, copper and mercury are often noted in gold of Verkhnenyyayusky occurrence; copper, mercury, and palladium are often observed in gold of the Chudnoye occurrence. It was shown that gold deposit occurred predominantly in the later stages of mineral formation.

Keywords*: gold, ore occurrences, gold sulphide and gold-platinoid-fuchsite mineralization, Subpolar Urals, Polar Urals.*

Introduction

A systematic study of the gold content of the north of the Urals began in the 1970s. To date, numerous alluvial and vein occurrences of gold have been discovered. In the Kozhimsky region of the Subpolar Ural, industrial alluvials previously developed were discovered. Also identified are the primary gold deposits, in particular, Verkhnenyyayusky in the Polar Urals, the Chudnoye in the Subpolar Urals. The research results are presented in many published papers [1-7].

Results and its discussion

This paper summarizes our findings regarding the gold-bearing capacity of the Kozhim and Manitanyrd districts.

Kozhimsky district

In the Kozhimsky district of the Subpolar Urals, covering the territory of the headwaters of the Kozhim river with tributaries Balbanju, Catalambi-Yu, Kuz-Pua-Yu, Nikolay-Shor, the main occurrences of alluvial and vein gold are concentrated (Fig. 1).
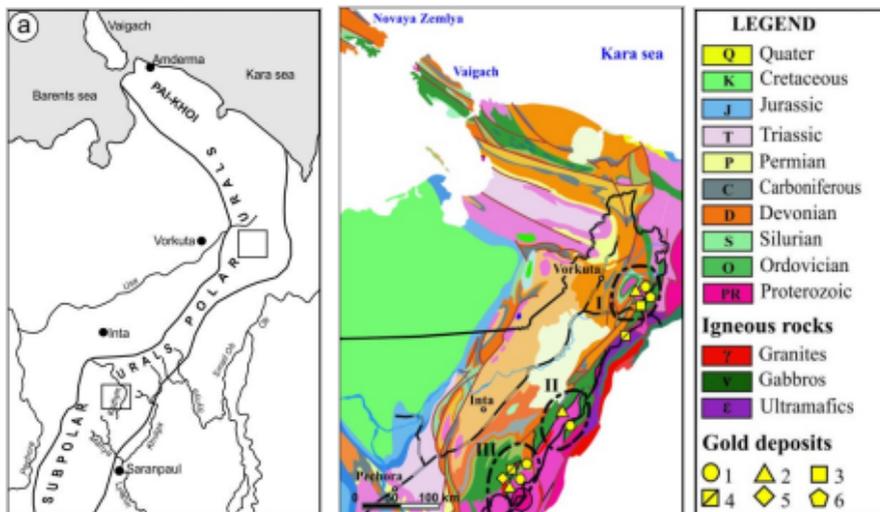
Fig. 1. *The main gold-bearing regions of the north of the Urals:*
I - Manitanyr, II - Pogurey-Tykotlovsky, III - Kozhimsky.
1 - deposits and occurrences of alluvial gold,
2–6 - deposits and manifestations of vein gold: 2 - gold-sulfide,
3 - gold-sulfide-quartz, 4 - palladium-gold-fuchsite,
5 - gold-bearing quartz conglomerates, 6 - gold-bearing weathering crusts.

Sedimentary, volcanic-sedimentary and igneous rocks of different composition and age from the early Proterozoic to the Ordovician take part in the geological structure of this area. Maldinskaya (western) and Rossomakhinskaya (eastern) ore zones are distinguished, which are controlled by large faults of the northeast orientation. The largest primary gold ore objects are the Chudnoye deposit, occurrences of Nesterovskoye, Karavannoe, Sinilga, Katalambinskoye [3, 8].

Chudnoye deposit is located in the watershed part of the Maldynyrd ridge within the Maldinskaya ore zone. In geological terms, it is confined to the axial zone of the Maldinskaya anticline, oriented in the northeast direction and complicated by a series of faults. The deposit area is mainly composed of rhyolites of the Sablegorsk formation of the late Riphean-Vendian.

The overwhelming majority of gold is concentrated in fuchsite veins in rhyolites. There are two main areas - Slavny and Ludny. In close association with gold are the minerals of platinum metals — mertiit (isomertiite), atheneite, stiluloite, native palladium, sperrylite, stibiopalladinite, and native platinum [8]. Gold is mostly fine - usually up to 50 microns, the size of individual grains reaches 8

mm. The form of grains is predominantly scaly, less often tabular or lumpy. In the gold of the Slavny site, the Ag content is 8.21–11.65, Cu - 1.28–3.03 wt.%. Hg up to 1.28 and Pd up to 1.72 wt.% are often noted. Copper gold is found with the structure of the decomposition of the solid solution. Gold is characteristic of the Ludny area with a high Ag content up to 20–25 wt.% or more, while Cu and Hg may be absent.

The Nesterovskoye ore occurrence, as well as the Chudnoye, is located within the Maldinskaya ore zone 1.5–2 km south-west of the latter. Here, terrigenous deposits of the Alkesvozh strata of the Upper Cambrian – Lower Ordovician are developed, occurring on the volcanic rocks of the acidic and basic composition of the Sablegorsk srtata of the Late Riphean – Vendian.

In the zone of tectonic disturbances of the SV course associated with the Maldinsky fault, areas of fuchsitization and clarification of rocks associated with the imposition of hydrothermal-metasomatic processes are well defined. Fuchsite develops along the stratification or schistosity of gravelites, sandstones and extremely rarely aleurolites, occurs in quartz veins, sometimes forms independent thin veinlets up to 1–2 cm in thickness of different orientations.

Gold is found throughout the section of the Alkosvazhskaya strat [9]. Its distribution is very uneven. In areas of fuchsitization and clarification of rocks, the gold content is usually significantly higher than in the formations at a distance from them. Gold is characterized by a scaly, lumpy form, reddish-yellow, yellow color, often porous with inclusions of zircon, rutile. The size of the gold is rarely greater than 0.1 mm. The content of impurities, as a rule, is low: Ag - 0.28–0.75, Cu - 0.99–3.82 wt.%. It is important to note that Cu prevails over Ag. Hg is sometimes noted - up to 0.5 wt.% and in a very small amount - Pd, Sb, Fe. In association with gold, palladium minerals are noted, in particular, atheneite.

The Karavannoye ore occurrence is located in the southwestern part of the Rossomakninskaya ore zone. The area of occurrence is composed of quartz-chlorite-sericitic, albite-quartz-chlorite schists with interlayers of the orthoslanders of the Puivin strat of the middle Riphean. Well-defined are the zones of intense schisting of rocks of the northeast strike. The explosive dislocations of the sublatitudinal and northwestern strike are traced. Numerous small folds are observed. Gold-bearing are sulphide-quartz often with carbonate veins, impregnated and vein-impregnated mineralization zones.

Sulfides are represented by sphalerite and galena, pyrrhotite, pyrite, and chalcopyrite are constantly observed in the subordinate amount. In the areas of sulfide

development, relatively high Se contents are observed, and in the near-ore rocks - Ni, Co, Ag.

Gold sulphide development sites. The size of gold particles varies from 0.1 to 0.6 mm and does not exceed 0.2 mm. Particles with respect to isometric, flattened, elongated or complex shapes with bulges, protrusions and uneven edges prevail. Sometimes intergrowth of gold with quartz, sphalerite, galena is noted. Gold has a simple composition; of the impurities only Ag (2–9.8 wt.%) is found in it.

The Sinilga ore occurrence is located to the south of the Karavanny occurrence in the southwestern part of the Rossomakninskaya ore zone. It is confined to the northeast exocontact of the Narodinsk granite massif. The host rocks are represented by chlorite-muscovite-quartz schists of the Puivin srtat of the middle Riphean. In slates, thin bodies of metabasites and plagiogranites are noted. The metamorphism of rocks corresponds to muscovite-chlorite subfacies of the greenschist facies. Major faults have a north-northeast and a sublatitudinal strike.

Within the limits of occurrence, quartz, carbonate-quartz, carbonate-chlorite-quartz veins and C-SV course are the most widespread, consistent with shale of the host rocks (consonant veins). At the same time, for the manifestation of Sinilg, there are characteristic veins that perform steeply dipping tears of the sublatitudinal strike, which cut the schistosity of the rocks (the crossing veins). Gold ore (gold sulphide) mineralization is associated with them.

Gold is in close association with galena, pyrite, pyrrhotite, arsenopyrite, chalcopyrite. The size of gold particles varies from 0.1 mm to 4 mm (medium-sized gold and large gold). The form of grains is mainly flat-lumpy and isometric. The surface of gold particles is pit-like, cavernous. Of the impurity elements in gold, Ag is established, the content of which in most cases does not exceed 10 wt.%.

The Katalambinskoe ore occurrence is located in the northeastern part of the Rossomakha Ridge [10]. Gold is concentrated in the formations of the linear weathering crust superimposed on the sericite-chlorite-quartz, sericite-quartz schists, quartzites of the Moroin and Chobean formations of the late Riphean. The rocks are crumpled in isoclinal folds, along the faults of the northeast strike are milonitized, hydrothermally altered. The zones of veinlet-disseminated sulfide mineralization with a length of 1200 m are traced. Pyrite predominates among sulphides, pyrrhotite, chalcopyrite, sphalerite, arsenopyrite are less common. Gold is mostly free, fine and small (0.25–0.5 mm). The form of grains is complex; crystals are often found. The main elements-impurities are silver and copper. Ag content ranges from 0.1 to 19.1 wt.%, Cu content reaches 0.4 wt.%.

The weathering crust is traced to a depth of 250 m. The accumulation of gold in the weathering crust is due to the destruction and change of parent rocks. Fine and thin gold with a size of 0.05–0.5 mm prevails. The form of grains is lamellar, complex, dendritic, crystallomorphic. The surface of grains is matt, microfibre or even shiny. Many grains have inclusions of hematite, quartz, magnetite prints. In composition, the gold of the weathering crust is not significantly different from ore gold. The hypergenic change in gold is expressed in the development of high-grade, thinnest veins in primary grains, growths, and dissolution structures.

Manitanyrdsky district

The Manitanyrdsky district is located on the western slope of the Polar Urals and is a brachyanticline oriented in the northeast direction, located within the Central Ural structural zone. Sedimentary, volcanogenic and igneous formations of the late Riphean, Vendian and Paleozoic take part in the geological structure of the area. It is characterized by large faults of the north-east strike. The gabbro and gabbro-dolerite bodies, zones of intense shearing and crushing of rocks are confined to these violations. Widely developed hydrothermal quartz, quartz-carbonate, quartz-chlorite, quartz-tremolite veins, performing mainly crack SV course, oriented according to shale rocks. Several gold occurrences and deposits are known in the Manitanyrdsky area: Verkhnenyayuskoye 1, Verkhnenyayuskoye 2, Nyahoyskoe 1, Nyahoyskoe 2. The main field is the Verkhnenyayuskoye 2 [11].

The Verkhnenyayuskoye deposit is located in the central part of the Manitanyrd district. The deposit area is composed of the Bedamel strat of the middle-late Riphean, represented by effusive rocks of the main, medium, less often acidic composition, their tuffs, tuff-sandstones, and tuffs with rare limestone lenses. Ore mineralization is confined to the rupture disturbances of the SV course and the zones of intensive shale rocks accompanying them. Ore zones traced to a distance of 600 m.

According to the mineral composition, the ores of the Verkhnenyayuskoye deposit are predominantly arsenopyrite-pyrite. At the same time, they often have high contents of chalcopyrite, sphalerite, galena, which sometimes prevail over arsenopyrite. The textures of the ores are massive, banded, ployed, interspersed, streaky-interspersed, spotty.

The main ore minerals are pyrite, arsenopyrite, secondary - chalcopyrite, sphalerite, galena, pyrrhotite, bornite, deuterogene - chalcocite, covellite, skorodite, cerussite, iron hydroxides. In isolated cases, pentlandite, tetrahedrite, tennantite, aurosybitite, native bismuth are noted.

Gold is fine, the shape of particles is complex, particles in the form of dendrites, plates and individuals with fragments of faceting are sometimes noted. In the polished sections studied by us, gold is observed in the form of the smallest isolated isometric inclusions with a size of 1–5 μm in arsenopyrite, less often in pyrite. At the same time, both small and relatively large (up to 10-50 microns) elongated, irregularly shaped grains are noted. They are found in microcracks in pyrite and arsenipirite, often together with chalcopyrite, galena, sphalerite. The main impurity element in gold is silver, mercury and copper are marked. The fineness of gold varies from 500 to 850. Often there are grains in which the silver content is higher than gold and reaches 61 wt. %. In such gold, mercury is almost always present in amounts up to 3.6 wt. %

Conclusion

The most important gold-bearing regions on the western slope of the north of the Urals are the Kozhimsky and Manitanyrdsky areas. The spatial development of gold-sulphide mineralization is controlled mainly by rupture faults of the submeridional and northwestern (sublatitudinal) strike. Most ore occurrences are gold-sulphide, gold-sulphide-quartz types. The gold of occurrences is closely associated with galena, sphalerite and chalcopyrite and deposited in the later stages of mineral formation. Ore occurrences of the Manitanyrdsky region are distinguished by the presence of arsenopyrite. Of the impurity elements, gold is present in the gold composition of most ore occurrences. Zones of development of gold-sulphide mineralization are a favorable substrate for the extensive development of gold-bearing weathering crusts found in some areas in the Kozhimsky and Manitanyrdsky regions.

Of great interest are the gold ore occurrences of the Chudnoye and Nesterovskoye located in the Kozhimsky district, many genesis problems of which remain debatable. These occurrences are characterized by gold-platinoid-fuchsite type of ores. Gold is found in intergrowths with platinum and palladium minerals. The composition of gold includes silver, copper, palladium, mercury.

The formation of gold mineralization on the western slope of the northern Urals is associated with hydrothermal processes, manifested at different stages of the geological development of the region. The most important, but not yet fully resolved, is the problem of the age of ore mineralization. In our opinion, in the north of the Urals, admitting the possibility of ore formation in the Precambrian, the Late Paleozoic stage was most productive due to the Hercynian endogenous activation, the widespread occurrence of hydrothermal-metasomatic processes and regional metamorphism.

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Udokan油田铜矿石加工特点
FEATURES OF PROCESSING OF COPPER ORES
OF THE UDOKAN FIELD

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这篇文章讨论了Udokan油田铜矿石的加工，氧化程度不同。　　已经确定，鹿茸和硼酸盐的氧化铜矿物是具有异常性质的氢化铁矿和氢溴酸盐。考虑使用浮选从Udokan油田中选矿的各种方案，包括不对原矿进行分类。建议对所有类型的铜矿石使用单一工艺流程图。
关键词：铜矿石，氧化矿石，浮选，电化学，盐浮选，肌氨酸，铜精矿，Udokan油田。

Annotation. *The article deals with the processing of copper ores from the Udokan field with varying degrees of oxidation. It has been established that oxidized copper minerals of antelerite and brochantite are hydroantelerites and hydrobrothantites with anomalous properties. Various schemes for the beneficiation of ores from the Udokan field using flotation are considered, including without classifying the original ore. A single process flow diagram was recommended for all types of copper ores.*

Keywords: *copper ores, oxidized ore, flotation, electrochemistry, salt flotation, sarcosine, copper concentrate, Udokan field.*

It is known that three types of copper ores are distinguished in the Udokan field: sulfide, mixed and oxidized with an oxidation state of up to 30%, 30 ... 70% and more than 70%. Research has determined that sulphide and mixed ores can be enriched only with the use of flotation, and the use of hydrometallurgical methods is possible when processing oxidized ores.

It has been established that the mineral composition of sulfide ores is diverse, but the bulk of copper in the sulfide form is represented by bornite, chalcocite and chalcopyrite. In the oxidation zone there are mainly mixed ores. Oxidized ores are represented by two varieties - carbonates (malachite, azurite) and sulphates (bro-

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chantite, antlerite, chalcanthite), with antlerite and brochantite, characterized by weak flotation activity, prevailing. Rock-forming minerals are 95% represented by quartz and feldspars. Copper sulfates predominate over sulfides and carbonates. In total, antlerite and brochure make up 1.33% ore, malachite and azurite, 0.43%, and copper sulfides, 0.45%. 59.39% of copper is associated with sulfates, 21, 9% with carbonates, no more than 23% with sulfides.

It has been established that, in an oxidized sample of ore with an oxidation state of 81.4%, antlerites and brochantites are hydroanthlerites and hydrobrothantites with anomalous properties that significantly change their surface during flotation and require the use of non-standard technological solutions when developing an oxidized ore processing scheme [1,2].

Of early research on the development of copper ore dressing technology at the Udokan field, an interesting option is that developed by the Irkutsk Polytechnic Institute, which recommended the use of flotation to produce two copper concentrates — sulphide and mixed. The technology scheme consists of cycles of sulphide operations, oxidized and flotation splices. The concentrates obtained in the first two cycles are brought to standard separately with the introduction of roughing operations into the scheme. The enrichment technology in this case provides for the supply of the initial portions of ore of various degrees of oxidation into the flotation process without dividing it into grades. The production of two concentrates, different in composition minerals of copper and host rocks, is justified by the need to reduce the cost and increase the efficiency of their subsequent metallurgical processing according to the pyro- and hydrometallurgical variant. At the same time, carbonate flotation conditions were additionally developed, providing for obtaining a carbonate product from the copper control flotation tailings, which are necessary for use in the subsequent pyrometallurgical processing of copper concentrates from the Udokan field.

The scheme is "flexible", since it makes it easy to regulate the flotation process only at the expense of the reagent regime when the degree of oxidation of minerals changes.

It has been established that the indicators of enrichment by the flotation method very strongly depend on the degree of oxidation of the ore. Extraction of copper in the concentrate obtained in the laboratory Gintsvetmet is: with the enrichment of sulphide ores 87.93%, mixed - from 81.51 to 88.7, oxidized - 72.75 to 81.25% (using hydrometallurgy 93%) .

Investigations by the Zabaikalye Research Institute on sulfide, mixed and oxidized copper ore samples from the Udokan field with an oxidation state respectively of 30; 69.5 and 81.4% have developed methods for regulating the stability of a dispersed flotation system using pulsating vibrations and other physicochemical effects, which provide for the intensification of flotation of hard minerals.

Methods are proposed for regulating the structuring processes of the dispersion medium of the flotation pulp and the development of some other areas of mineral separation has been resolved, which has increased the recovery of copper in the concentrate during the flotation of sulfide, mixed and oxidized ores to 91.82; 91.5 and 88.3%, respectively.

These studies were continued at the Trans-Baikal State University in order to search for more efficient methods for processing copper ores containing in their composition hardly oxidizable oxidized minerals without dividing the original ore into grades [3].

The work was carried out on the oxidized ore of the Udokan field with an oxidation state of 81.4% and with an off-balance copper content of 0.36 ÷ 0.44% in two directions - using weak energy effects on the dispersed system and using salt flotation. In addition, for the first time for flotation of such ores, new reagents from a number of sarcosines were investigated and applied.

The research results showed that flotation of oxidized copper ores using electrochemical pulp processing and the use of a new reagent allows to obtain a copper concentrate with a copper content of 16.83% and extraction of 78.02%. With salt flotation, the best copper recovery was 76.19%, which is 4% more than without the use of sarcosine.

In order to improve the results obtained, a series of experiments were carried out with the use of salt flotation of oxidized copper minerals in open and closed cycles, together with electrochemistry.

The research results shown in the table showed that flotation of oxidized copper ores according to the recommended scheme with feeding in the process of neutral salt NaCl and using electrochemical pulp processing allows to obtain a copper concentrate with a copper content of 17.72% and recovery of 81.31%. The quality of the obtained copper concentrate corresponds to the mark KM-7.

Table - *Results of circuit experiments in open and closed cycle*

Product name	Output, %	Content, %	Extract, %	Note
Concentrate 1	1,51	12,56	49,22	
Concentrate 2	34,87	0,22	20,11	
Industrial product 1 cleaning	3,92	0,69	7,06	
Industrial product 2 cleaning	4,07	0,9	9,52	in open cycle
Tails tails	55,63	0,09	14,09	
Original ore	100,00	0,38	100,00	
Copper concentrate	2,01	17,72	81,31	
Tails tails	97,99	0,08	18,69	in closed cycle
Original ore	100,00	0,43	100,0	

According to the results of the research, a technological scheme for the beneficiation of copper ores is recommended, which is acceptable as a single scheme for all types of ores, allowing to achieve the extraction of copper in concentrate during the flotation of oxidized minerals at the level of extraction of copper sulfides. The developed technology allows to increase the flotation rate by 1.5-2 times while simultaneously improving the selection of copper and rock-forming minerals.

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湖泊"小天鹅"环境修复的绿色技术
GREEN TECHNOLOGY FOR ENVIRONMENTAL REHABILITATION OF THE LAKE "SMALL SWAN"

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本文讨论了膨润土垫Bentolock GL10制成的防过滤网装置的技术。 经过考虑的自然节约技术可以显着减少通过湖碗过滤的水的损失，降低劳动力成本和设备成本，提高其工作的可靠性。
关键词：湖泊修复，膨润土垫，技术，筛选。
Annotation. *This article discusses the technology of anti-filtration screen device made of bentonite mats Bentolock GL10. The considered nature-saving technology can significantly reduce the loss of water for filtration through the lake bowl, reduce labor costs and the cost of their devices, improve the reliability of their work.*
Key words: *rehabilitation of lakes, bentonite mats, technology, screen.*

The lake system "Lebyazhye" has a great recreational value being especially protected natural area of local importance, forest Park area of Kazan [1,6].

To combat the filtering of water through the lies of the system of lakes Swan is desig-nated in the Western part of the city of Kazan, as impervious screen is-used material Bentolock GL10 in the form of innovative screening bentonite Mat.

The main (in terms of cost and complexity of implementation) of hydrotechnical measures of ecological rehabilitation of the lake is the device of the anti-filtration screen. As impervious screen was used waterproof bentonite geotextile mats Bentolock GL10.

 The design of the anti-filtration geotextile bitumen Mat Bento-lock GL10 is a

frame of two geotextile fabrics between which the granules of the active substance based on bentonite are located. The canvases are connected with each other by transverse fibers in a needle-punched way, which ensures the strength and elasticity of the structure, as well as the uniform location of the granules inside the frame and their fixation.

The principle of operation of biotechnical mats based on the property of bentonite with full hydration swell and increase in volume up to 16 times. When the free space is limited in the presence of water, a stress state is created in the structure of the formed bentonite gel, as a result of which the material becomes waterproof. Bentolock GL10 has the unique property of rapid bootstrapping with the damage.

The advantages of bentonite mats Bentolock GL10 [3] include:

- the ability to use to solve several problems;

- bentonite mats withstand an unlimited number of cycles of freezing-thawing and hydration-dehydration;

- saving material (for example, one layer of bentonite mats can replace the waterproofing of clay soil with a thickness of 1 meter);

- the materials used are environmentally safe;

- high frost resistance;

- possibility of laying bentonite mats Bentolock GL10 at temperatures up to-40º C;

- significant time savings compared to the device "clay screen", the need for layer-by-layer compaction of soil, soil-compacting construction equipment is absent;

- during operation, the material tends to regenerate itself, eliminating minor mechanical damage that may occur in the process of laying bentonite Mat Bentolock GL10 and backfill the ballast-protective layer and a layer of soil-fertile soil;

- simplicity of the device, it is possible to make a waterproofing or to carry out repair of waterproofing at any time of the year;

- resistant to aggressive environment;

- ability to use in complex hydrogeological conditions, materials withstand hydrostatic pressure up to 7 atmospheres;

- durability of waterproofing, due to the immutability of the properties of bentonite over time;

- high seismic resistance;

- ease of use and low labor intensity of the anti-filtration screen device;

- the possibility of introducing works in any weather and climatic conditions.

The course of work on the object "eco-Rehabilitation of the lake Maloe Lebyazhye system" was made in the following sequence [2]:

- kulturtechnik work on removal of dead and low-value species de-there are

trees, underbrush and shrubs from the bed of the lakes "Big Swan" and "Light Le Baile".

device conventions for excavation in the bed of the lakes "Big Swan" and "Swan Light".

- deepening of water bodies, which consisted of removal of soil-fertile layer and development of mineral soil in the lodges of lakes "Big Swan" and " Light Swan»;

- formation of the perimeter of the coastline through the development of a trench on the peri-meter of the water edge of the lakes;

- the layout of the bottom and shores of the lakes bowls;

- laying of impervious screen Bentolock GL10;

- dumping protective and ballast layers on the surface of the impervious screen Bentolock GL10;

- dismantling of the existing dam.

- fill a new earthen dam from the ground with the device water guide-rehnic-eskij structures No. 1;

- dumping of temporary earthen dam-moving;

- recultivation of soil-fertile soil layer of the surface of the embankment and its layout;

- the device of the exit to the temporary dam-moving;

- filling of the cutting dam;

- construction of the hydraulic structure № 2;

- organization and implementation of water supply to the lake Light Lebyazhye.

Bentonite mats Bentolock GL10 were delivered to the object in rolls weighing 1150 kg [4], 40 m long, 5 m wide, 6.6 mm thick.

Delivery to the object of ecological rehabilitation of lake systems "Lebyazhye" was carried out by on-Board vehicles. The lifting and feeding of the material in the bed of the lakes were carried out with the help of cranes equipped with traverses, allowing free rotation of the reels with a diameter of 0.8 m.

Bentonite mats Bentolock GL10 were laid on a planned base with a surface error not exceeding + 12 mm, in the absence of roots of plants, stones and other inclusions.

In the production of loading and unloading and installation works used nozzle "stinger", which is inserted into the opening of the roll. Bentonite mats Bentolock GL10 were fixed on the upper edge of the slopes. Immediately before laying ben-tonite mats Bentolock GL10 removed the packaging polyethylene film. Cloths bentonite mats Bentolock GL10 laid in overlap at least 150 mm with each other.

For sealing and providing additional reliability of the polyethylene screen in places of overlap of bentonite mats were sprinkled with a continuous layer of bentonite granules. The edges of the upper Mat were bent and bentonite granules

were sprinkled on the lower Mat. Consumption of bentonite granules was 0.4-0.8 kg / m. p. seam.

The number of stacked bentonite mats Bentolock GL10 at the facility daily did not exceed the intensity of work on the laying of protective ballast layer of soil. The intensity of laying of bentonite mats was linked to the intensity of the work on laying the protective-loading layer, i.e. bentonite mats were loaded on the same day with a protective-loading layer.

The high efficiency of the device of the anti-filtration screen from bentonite mats Bentolock GL10 is confirmed by the following data in relation to water losses for filtration [5,6]:

- 470 times lower in comparison with the clay screen;
- 11 times lower compared to the polyethylene film screen.

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使用水力旋流器的经验用于工业废水处理
EXPERIENCE IN THE USE OF HYDROCYCLONE PLANTS FOR INDUSTRIAL WASTEWATER TREATMENT

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许多工业企业生产的污水被石油产品和机械杂质污染。 在喀山国立建筑与土木工程大学（KSUACE）水力旋流器装置中，包括KSUACE结构的压力水力旋流器和各种设计的水槽，在压力和非压力模式下运行，已经开发出用于清洁的水力旋流器。

"水力旋流器 – 贮槽单元"型设备可以将废水中石油产品的浓度从1000-3000 mg／l降低到10-50 mg／l，并将机械杂质含量从100-200 mg／l降低 1至20-50 mg／l。

这些装置是用于净化工业企业含油废水的有前途的设备。

关键词：含油废水，清洗，压力水力旋流器，集水坑。

Annotation. *Many industrial enterprises produce wastewater polluted with petroleum products and mechanical impurities. In Kazan State University of Architecture and Civil Engineering (KSUACE) hydrocyclone units, that consist of pressure hydrocyclones of the KSUACE construction and sumps of various designs, operating in both pressure and non-pressure modes, have been developed for its cleaning .*

Devices of the "hydrocyclone – sump unit" type make it possible to reduce the concentration of petroleum products in wastewater from 1000–3000 mg/l to 10–50 mg/l, and reduce the content of mechanical impurities from 100–200 mg/l to 20–50 mg/l.

These units are promising equipment for the purification of oily wastewater from industrial enterprises.

Keywords*: oily wastewater, cleaning, pressure hydrocyclones, sumps.*

At industrial enterprises of various industries, wastewater polluted with petroleum products and mechanical impurities (industrial and atmospheric) is generated. Before discharging into the diversion system of populated areas or surface channels, oily wastewater should be cleaned at local wastewater treatment plants to reduce the concentration of petroleum products and mechanical impurities to standard indicators.

For several years, Kazan State University of Architecture and Civil Engineering (KSUACE) has been conducting research and development work on the treatment of oily wastewater in hydrocyclone units, the main element of which are pressure hydrocyclones of the KSUACE design. Research has established that when processing oil-containing waste water in pressure hydrocyclones, not only separation of oil emulsions occurs, but "booking" shells around drops of oil products are destroyed, its coalescence is increased and the monodispersity of the emulsion increases, which significantly intensifies the process of subsequent sedimentation [2]. All this led to the development of various designs of the "hydrocyclone – sump unit" type devices [1–3].

So for cleaning oilfield wastewater of the "Tatneft" association enterprises hydrocyclone – sump unit BGO-5000 with a capacity of 5000 m³/day was developed, consisting of two batteries of pressure hydrocyclones with a diameter of 75 mm and a pressure sump of 200 m³ divided by a baffle into sections of the lower and upper drains [1,3]. Both sections are equipped with distribution and drainage devices, oil collectors. Hydrocyclone – sump unit operates as follows. Oilfield wastewater from the sumps of preliminary drainage under excess pressure is fed to the hydrocyclone batteries for preliminary treatment. The lower and upper drains of hydrocyclones through the distribution systems are fed to the sumps, respectively, in the sections of the lower and upper drains. Purified water is collected by drainage systems and discharged into buffer tanks, from which it is pumped to a cluster pumping station of a reservoir pressure maintenance system. Caught oil products through oil tanks are diverted to the buffer tank and pumped to the oil treatment unit. When testing the BGO-5000 unit, the content of oil products in purified water was 7.2–58.2 mg/l, and mechanical impurities 25–50 mg/l [1, 3].

At the enterprises of the "Tatneft" Association, the BGS-3000 hydrocyclone unit with a capacity of 3000 m³/day was also installed and tested, including a BGO-3000 hydrocyclone – sump unit, a tank for purified water and caught oil, block pumping stations for pumping purified water and oil, the BR-10, a corrosion inhibitor dispensing device for purified water. The hydrocyclone - sump unit BGO-3000 consists of one hydrocyclone battery with a diameter of 75 mm and a sump with a volume of 80 m³, divided into sections of the lower and upper discharge. When testing the BGS-3000 station, the content of petroleum products in purified water was 2.6–58 mg/l with their concentration in oilfield waste water up to 3000 mg/l; the cleaning effect

on mechanical impurities averaged 40–50% [1,3].

In KSUACE there is a positive experience in the treatment of industrial wastewater from industrial enterprises polluted with oil products and mechanical impurities. For cleaning of fuel oil containing wastewater from the Donetsk Excavator Plant boiler-house (Donetsk, Russian Federation), a hydrocyclone - sump unit was developed, BGO – 300, with a capacity of 300 m^3/day, consisting of two pressure hydrocyclones with a diameter of 75 mm and sumps of the lower and upper hydrocyclone drains equipped with coalescing nozzles, distribution and drainage devices, oil collectors and interfacial level regulators [1]. Installation BGO – 300 operates as follows. Fuel oil containing wastewater from the pit of fuel oil storage tanks is pumped for preliminary treatment into pressure hydrocyclones, in which, under the action of a centrifugal field, the flow is separated into oil and water. Water, with a small admixture of fuel oil is taken out through the lower drain holes of hydrocyclones and enters the sump of the lower drain. Fuel oil, as a lighter phase, is concentrated in the axial part of hydrocyclones and with an upward flow (along with part of the water) is carried through the upper drain holes of hydrocyclones to the sump of the upper drain. Both sumps are divided into three sections: preliminary sump, coalescing fitting and additional sump section.

The waste water treated in hydrocyclones goes through a switchgear to the preliminary sump section, in which some fuel oil and emulsified fuel are removed. Floated fuel oil is removed through the oil tank. The level of the oil-water phase separation is maintained by the interfacial level regulator. Waste water with the remaining fine fuel oil passes through a coalescing fitting, in which small particles of fuel oil are enlarged and removed after floating through an oil tank. Purified water is collected through a perforated drainage pipe and disposed. When testing the BGO-300 unit, the content of petroleum products decreased from 6.5-912 mg/l to 0.8-9.1 mg/l. The content of mechanical impurities decreased from 100 - 316 mg/l to 20-30 mg/l [1].

For the treatment of drainage wastewater generated in storage tanks of fuel oil of the Almetyevsk Pipe Plant, a hydrocyclone – sump unit GOU – 5 with a capacity of 5 m^3/day has been developed, consisting of a hydrocyclone and a pressure vertical sump [2].

Another field of application for hydrocyclone units is the purification of bilge sewage waters generated in the holds of river and sea vessels and contaminated with suspended solids (100–200 mg/l) and oil products (1000–2000 mg/l) [1.2]. Regulatory documents prohibit discharging bilge waters into water bodies without treatment. In the White Sea & Onega Shipping Company a water treatment station was installed on a self-propelled barge, consisting of a system of cascade sumps, impeller flotators and adsorption filters loaded with activated carbon. The bilge waters from the shipping vessels were pumped to the receiving tank of the sta-

tion by pumps and sequentially treated in sumps, floaters and adsorption filters. The oil products caught in the sumps and flotation plants were collected in a tank and transported to the tank farm of Petrozavodsk. The sediment was collected in a sludge collector, and the purified water was discharged into Lake Onega. In order to improve the efficiency of the treatment station of the underground water treatment system, a hydrocyclone unit GU-150 with a capacity of 150 m^3/day was developed, consisting of a pressure hydrocyclone with a diameter of 75 mm, a stilling chamber, tanks for lower and upper drains, connecting pipelines, valves and control instrumentation [1,2].

In railway transport enterprises, in the process of rolling stock repair work, oily wastewater is generated, for the treatment of which structures are used, consisting, as a rule, of oil traps and flotators. To intensify the work of the wastewater treatment plant of the Yudino station locomotive depot (Kazan), a hydrocyclone unit GU-20 with a capacity of 20 m^3/hour was developed, consisting of six pressure hydrocyclones with a diameter of 75 mm. The lower discharge of hydrocyclones (purified water) is fed for further processing to the pressure flotation unit, and the upper discharge into the receiving reservoir of the sewage pumping station [2].

Block hydrocyclone units are characterized by high efficiency, high specific productivity, compactness, ease of operation, are fully automated, have a high industrialization of manufacturing, installation, and are promising equipment for cleaning oil-containing sewage from industrial enterprises.

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用碳水化合物填料形成糊状加工奶酪的结构
FORMATION OF STRUCTURE OF PASTE LIKE PROCESSED CHEESES WITH CARBOHYDRATE FILLERS

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注解。本文研究了使用野生生长原料（CWGR）和成分（荨麻，酢浆草，倾斜）的浓缩物进行甜加工奶酪结构形成的过程。作为蛋白质基础，使用通过酸凝固获得的干酪，以确保熔融过程，使用稳定化混合物（碳酸氢钠–1.0%和"Genulact LRA-50"结构的稳定剂–0.5%）。研究的任务是研究处方成分和热机械加工对甜，糊状加工奶酪结构形成的影响，以及冷藏过程中的变化。使用旋转粘度计研究成品的结构和机械特性。在不同的剪切速率梯度下测定糊状加工的干酪的粘度，并且还获得流动曲线。使用顺序单纯形规划的方法使我们能够获得加工奶酪的最佳组成。推荐以下熔化模式（熔点，加入蔗糖和CWGR之前的熔化时间，加入蔗糖和CWGR后的熔化时间）：1）80℃，20分钟，10分钟；2）85oC，18min，5–10min；3）90℃，15分钟，5–10分钟。在产品的冷藏期间，其进一步的结构形成发生，这在前三天是最明显的。这是由于使用碳水化合物成分 – 蔗糖和野生原料的浓度。
关键词：结构形成，糊状加工奶酪，野生原料，粘度。

Annotation. *The paper studied the process of structure formation of sweet processed cheeses using a concentrate of wild-growing raw materials (CWGR) with a composition (nettle, sorrel, cant). As a protein basis, cottage cheese obtained by acid coagulation was used, to ensure the melting process, a stabilization mixture (sodium bicarbonate — 1.0% and stabilizer of the "Genulact LRA-50" structure — 0.5%) was used. The research task was to study the effect of prescription components and thermomechanical processing on the formation of the structure of sweet, paste-like processed cheese, as well as its change in the process of refrigerated storage. Structural and mechanical characteristics of the finished products were studied using a rotational viscometer. Viscosity of pasty processed cheeses was determined at different gradients of shear rate, and flow curves were also taken. Using the method of sequential simplex planning allowed us to obtain the*

optimal composition of processed cheese. The following melting modes are recommended (melting point, melting time before sucrose and CWGR are added, melting time after sucrose and CWGR are added), respectively: 1) 80ºC, 20 min, 10 min; 2) 85ºC, 18min, 5-10min; 3) 90ºC, 15min, 5-10 min. During the cold storage of the product, its further structure formation occurs, which is most noticeable in the first three days. This is due to the use of carbohydrate components - sucrose and the concentration of wild-growing raw materials.

Keywords: *structure formation, paste-like processed cheeses, wild-growing raw materials, viscosity.*

Melted cheeses are concentrated protein products. Compared with natural cheeses and cottage cheese, processed cheeses contain more soluble proteins and non-replaceable amino acids (methionine, tryptophan, cysteine). The high nutritional value of these products is also associated with the presence in their composition of natural milk fat, calcium and phosphorus, which are in an easily digestible form, and a wide range of both fat-soluble and water-soluble vitamins.

The main indicator of the quality of processed cheese is the consistency, which is mainly formed in the process of melting the cheese mass. It is influenced by many factors, including selection of raw materials, salts-melters and structure-forming agents, pH of the mixture, as well as modes of melting, homogenization and cooling [1-5].

Processed melted cheeses are distinguished by a plastic, smearing paste-like consistency. When they are obtained, unflavored cheese from under the press, cottage cheese, milk protein concentrates, etc. are used as protein components. In the process of melting, protein dairy products in the presence of melting salts or structure-forming agents, with or without adding various products or additives, undergo thermomechanical processing. As a result of this treatment, the initial matrix of protein raw material is completely destroyed and the molten mass is transferred to a homogeneous state [1, 6, 7].

The formation of the structure of processed cheese is influenced by all its constituent components: fat, water, protein and fillers. Increasing the protein content causes an increase in strength, viscosity of the product and a more dense texture. The rest of the components that make up the system exhibit plastic properties and contribute to the formation of a soft texture [5,6,7].

A characteristic feature of processed cheeses, which have a different texture, is a definite, but almost constant ratio between moisture and dry fat-free substances [1]. For pasty processed cheeses, this ratio ranges from 2.1 to 2.5. In some cases, with the wrong variation of the components, various kinds of consistency defects appear - incoherence, stickiness, excessive hardness, sandiness, flouriness, etc.

Producing a processed cheese with a stable, homogeneous, homogeneous structure, in many respects, depends on the sequence of the components and, in particular, the water in the mixture for melting. In the production of sweet processed cheeses, the moment of adding sucrose, a water-soluble substance with high hydrophilic properties and capable of affecting the water activity, and therefore the course of the melting process, is of great importance [8]. Thus, sucrose when heated dissolves and binds all the free moisture that is part of the curd, thereby making it difficult for the protein to dissolve during melting. In order to prevent the competition of protein and sucrose for water during the melting process, it is necessary to provide conditions for maximum hydration of the protein during melting, avoiding diluting the system with water so that the reaction between the salt-melter and the protein is effective [9, 10].

The peculiarity of the processed cheese technology allows the use of various food ingredients, including functional, which ensures the creation of new types of products with directionally controlled composition and preventive properties. The promising functional ingredients include wild-growing raw materials, which contain a rich complex of biologically active components of natural origin [11]. The advantages of its use over traditional agricultural plant raw materials include the fact that it grows in ecologically clean areas, does not require additional costs for cultivation, does not contain genetically modified organisms.

Despite the fact that the scientific support for the production of processed cheeses is quite well developed, when creating new technologies, there are problems associated with the use of non-traditional raw materials and, first and foremost, obtaining a good homogeneous, cohesive consistency.

The goal of the work was to establish patterns of structure formation of sweet, pasty processed cheeses using wild-growing raw materials that have a mainly carbohydrate nature.

The objects of research in the work were: low-fat cottage cheese obtained by the method of acid coagulation, with a moisture content of $80 \pm 1\%$; sodium bicarbonate (E500 ii,); Stabilization of the structure: "Genulact LRA-50", which includes carrageenans; concentrate of wildly growing raw materials CWGR (nettle, sorrel, lingonberry) with a dry matter content of $50 \pm 2\%$.

To obtain CWGR, a composition of fresh raw nettle, sorrel, and lingonberries was used in a ratio of 2:1:1; it was finely ground beforehand using a UHM (universal homogenizing module) prior to obtaining a homogeneous dispersion. Then partially dried under vacuum to a solids content of $50 \pm 1\%$.

Structural and mechanical characteristics of the finished products were studied using a rotational viscometer "RHEOTEST Messgerate Medingen GmbH", Germany. The viscosity of pasty processed cheeses was determined at different gradients of the shear rate, and the flow curves were also taken. The coefficient of structure

restoration (α_B) was determined as the ratio of the coefficients of the consistency of the samples after removal of the load and during the structure formation.

The microstructure of sweet processed cheese was studied using microscopic preparations, which were obtained by grinding between slides. The staining of the preparations was carried out using Sudan and Karazzi hematoxylin dyes.

Evaluation of the organoleptic characteristics of processed cheese was carried out on a 5-point scale.

Experimental studies were carried out as follows. Preparing raw materials for melting. To this end, a stabilization mixture (sodium bicarbonate — 1.0% and stabilizer of the structure "Genulact-50" —0.5%) was introduced into the curd obtained by the method of acid coagulation and the mixture was aged for 30 ± 5 minutes. The composition of the stabilization mixture during the melting of the curd raw material was substantiated in [12]. The resulting base was used for melting. Then, the influence of prescription components and thermo-mechanical treatment on the formation of the structure of processed cheese, as well as its change in the process of cold storage, was investigated.

Results and its discussion. When producing processed cheeses with a good consistency, a certain ratio of components within their prescription composition is of great importance, and for cheeses of a pasty consistency, the ratio between the moisture content of the product and the dry skim milk residue (DSMR) plays a dominant role.

Preliminary studies of the rheological characteristics of good quality pasty processed cheeses, namely: a delicate, plastic, smearing consistency characteristic of the best pasty processed cheeses showed that the viscosity of the cheese should be in the range from 127 to 160 Pas $^{-1}$ at a shear rate gradient 3 s^{-1}. Considering the a priori information on this issue, the composition of sweet processed cheese based on low-fat cottage cheese was optimized. They used the method of sequential simplex planning, which proved itself well in solving such problems. After mathematical processing of the results, the following composition of melted cheese was obtained in%: fat in dry matter - 20; moisture - 52-54 (ratio of moisture to dry skimmed milk residue 2.5); sugar - 12-14; concentrate wild raw materials - 14-15; skimmed milk powder - 3-7.

To determine the quantitative relationship between the viscosity index and the main prescription components, studies were conducted using model systems in which the ratio of these components was changed according to the plan of the full factorial experiment. Analysis of the obtained mathematical model showed that the most significant influence on the viscosity of the pasty processed cheese in the studied range of factors was influenced by the mass fraction of sucrose. The simultaneous increase in the mass fractions of skimmed milk powder and sucrose increased the viscosity of the finished product.

Explain the role of moisture, skimmed milk powder and sugar in the formation of consistency of sweet paste-like processed cheese with wild-growing raw materials can be based on the existing theoretical ideas about the structural elements of processed cheese.

Melted cheese is a heterogeneous system, the main structural element of which is the protein framework (three-dimensional grid). It is formed by the molecular interaction between protein conglomerates. The space between the elements of the protein skeleton is filled with a dispersion medium, which is represented by water with dissolved substances, including sucrose and carbohydrate components of wild-growing raw materials. With an increase in the content of the dispersion medium (in this case, fillers), the strength of the structure of processed cheese decreases, and, consequently, its viscosity.

In the composition of the studied processed cheeses, carbohydrate components (sucrose and concentrate of wild growing raw materials) make up approximately 50% of the sum of all dry substances, therefore their effect on the consistency is significant.

Sucrose is a water-soluble substance with high hydrophilic properties, so it actively influences the course of the melting process and the functional properties of the protein (solubility in aqueous medium, surface activity, gelling ability) [8,9,10]. This justifies the need to add sucrose at the end of the melting process. Based on literature data, thermomechanical processing of the mixture was carried out in two stages. At the first stage, after maturation of the protein components with reagents, the oil was introduced and melted to a fluid state, then sucrose, CWGR was added and melted until ready.

Organoleptic and structural-mechanical indicators (η ef is the effective viscosity at a gradient of shear rate of 3 s^{-1}, a_b is the coefficient of structure recovery) of sweet melted cheese at different melting points are given in Table 1.

Table 1 - Structural and mechanical properties of sweet pasty processed cheese at different melting points

temperature of melting, ^{0}C	Organoleptic evaluation consistency	Score	Structural and mechanical specifications	
			$\eta_{эф}$	$\alpha_в$
75	Heterogeneous, incoherent, sticky	3,0	189	0,82
80	Gentle, plastic, smearing	4,5	156	0,85
85	Gentle, plastic, smearing	5,0	134	0,94
90	Gentle, plastic, smearing	5,0	138	0,93
95	Gentle, plastic, smearing	5,0	130	0,94

Thermomechanical processing of processed cheese was considered as a combination of the effect of melting temperature and duration of exposure. During the research it was found that an increase in the duration of the melting process before the introduction of sucrose and CWGR from 10 to 30 minutes resulted in a decrease in the viscosity of the processed cheese, while at the same time, the duration of melting after adding the fillers had almost no effect on the viscosity of the product . A change in the melting point from 80 to 90 °C somewhat increased the strength of the structure of the processed cheese while simultaneously increasing the duration of the melting before the fillers were added. The results obtained are consistent with the current understanding of coagulation and crystallization structures developed by P. Rebinder. [13]. After the introduction of the CWGR and sugar, the thickness of the dispersion interlayers between the particles of the protein complex increases, the system acquires the properties of a coagulation-thixotropic structure, i.e. the ability to restore its structure in time after its mechanical destruction, the viscosity changes little with increasing duration of mechanical action.

Modern ideas about the nature of the influence of low molecular weight carbohydrates and, in particular, sucrose on the functional properties of proteins suggest the possibility of the formation of multiple hydrogen bonds between protein molecules and sugars in the volume of the aquatic environment, as well as competition between them for water molecules with a high content of harov in the system [8, 14].

The study of the microstructure of processed cheese showed that there is a relationship between the degree of emulsification of milk fat and the melting point. Samples of the product, which was melted at 75 °C, had a non-uniform structure. Small preparations (from 1 to 5 μm) and medium (from 6 to 15 μm) fat inclusions were detected in micropreparations, of which there were approximately the same number - 37% each. In addition, there were large merged fat droplets with a size of 15 microns (more - 26%). At the melting point of 85 ^{0}C, the bulk of the fat papules (68%) had small sizes from 1 to 5 microns, and a smaller part (32%) - from 5 to 15 microns. Large fat drops not detected. With a further increase in the melting point to 90-95 ^{0}C, the character of the microstructure changed slightly: more fat droplets appeared, ranging in size from 5 to 15 μm (up to 40%) and large drops (up to 3%).

The following melting modes are recommended (melting point, duration of melting before the introduction of sucrose and CWGR, duration of melting after the addition of sacharose and CWGR), respectively: 1) 80^{0}C, 20 min, 10 min; 2) 85^{0}C, 18min, 5-10min; 3) 90^{0}C, 15min, 5-10 min.

These melting modes ensure hygienic safety of the product. It is known that under such conditions a large part of the vegetative forms of microorganisms, pleuni and bacteria producing acids and alkalis, as well as some spore-forming microorganisms, are destroyed.

At the final stage of research, the dynamics of changes in the structural-mechanical parameters during storage of processed cheese with wild-growing raw materials were evaluated. On the first day of storage, the product had a weak, creamy consistency (table 2), but already on the third day the melted cheese acquired an optimal viscosity, which is typical for pasty-different melted cheeses, and a more elastic consistency.

Table 2 - Change the consistency of sweet pasty processed cheese during storage

Indicators	Shelf life, day				
	1	3	10	20	30
Viscosity, Pa·s	60	88	108	118	130
Recovery rate structures, α_{R}	0,95	0,88	0,75	0,75	0,73
Organoleptic evaluation consistency, score	4	4,5	5	5	5

The increase in strength in the initial period of storage is associated with the ongoing structure formation in the product, which is typical, apparently, for this type of processed cheese. As is known, in casein solutions, the induction period of gelation increases with decreasing protein concentration. The use of large amounts of carbohydrate components (sucrose, pectins, fiber) in the production of processed cheese determines its characteristic rheological properties. In the first storage period, when a very slow formation of the protein structure occurs, the properties of pectins appear, which contribute to the formation of the structure of sweet processed cheeses with wild-growing raw materials.

Thus, a sweet pasty processed cheese using a concentrate of wild-growing raw materials has the following features in the formation of its structure. Between the recipe components, a certain ratio must be observed to obtain a pastoral consistency. With an increase in the mass fractions of sucrose, dry skimmed milk and moisture, the viscosity of the finished product decreases. Melting points (80-90⁰C) provide the highest rheological and organoleptic indicators of processed cheese. During the cold storage of the product, its further structure formation occurs, which is most noticeable in the first three days. This is due to the use of carbohydrate components - sucrose and concentrate of wild-growing raw materials.

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伟大的费马定理 – 几个世纪的任务
THE GREAT FERMAT'S THEOREM - THE TASK OF CENTURIES

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注解。 目的是通过找到将任何数字的最后一位数字和数字的最后一位数改变到任意程度的循环性来给出大费马定理的原始证明。
关键词：循环，最后一位，数字的幂。

Annotation. *The aim is to give an original proof of the Great Fermat's theorem by finding the cyclicity of changing the last digit of any number and the last digit of a number to an arbitrary degree.*

Keywords: *cyclicity, last digit, power of a number.*

Introduction

Fermat's Great Theorem is one of the most popular theorems of mathematics. Its condition is formulated simply, at the "school" arithmetic level, but many mathematicians have been looking for proof of the theorem for more than three hundred years. It has been proven by Andrew Wiles in 1995.

In general, the theorem was formulated by Pierre Fermat in 1637 on the margins of Arithmetic of Diophantus. He wrote down the theorem with an addition that the witted proof of this theorem found by him was too long to be placed in the margins of the book.

Many outstanding mathematicians and many amateurs worked on the full proof of the Great Theorem; it is believed that the theorem is in the first place in terms of incorrect "proofs".

The last important step in proving the theorem was made by Wiles in September 1994. His 130-page proof was published in the 1995 Annals of Mathematics magazine.

In the present paper, an attempt to simplify the proof of the Great Fermat theorem is made.

Formulation of the problem

The theorem states that for any natural number $n > 2$ the equation

$$x^n = y^n + z^n \tag{1}$$

has no solutions in non-zero numbers x, y, z. There is a narrower version of the formulation, which states that this equation has no natural solutions. The proof of the theorem was sought by many mathematicians for over three hundred years [1,2]. Violant i Holtz, Albert and Alvarez L.F. wrote about the three-century challenge of mathematics and the most complex problem in the world. [3,4]. Finally, Fermat's Great Theorem was proved in 1995 by Andrew Wiles and Richard Taylor [5,6].

<div align="center">Proof.</div>

The number n can vary from 3 to infinity. The numbers x, y, x can also vary from one to infinity.

In order for the proof to be visual, cyclicity must be found. If for a cycle with small values of x, y, z and powers of n it is proved that equation (1) has no solutions in non-zero integers, then this proof will also be extended to cycles going to infinity.

Any number ends with a digit ranging from zero to nine. When raising a number to any power, the last digit of this power is determined by the last digit of the number. Table 1 shows how the last digit of a number changes when it is raised to a power from $n = 1$ to $n = 5.$

The last digit of the number when raising it to the power n

<div align="right">*Table 1*</div>

n	x^n									
	...1	...2	...3	...4	...5	...6	...7	...8	...9	...0
1	...1	...2	...3	...4	...5	...6	...7	...8	...9	...0
2	...1	...4	...9	...6	...5	...6	...9	...4	...1	...0
3	...1	...8	...7	...4	...5	...6	...3	...2	...9	...0
4	...1	...6	1	...6	...5	...6	...1	...6	...1	...0
5	...1	...2	...3	...4	...5	...6	...7	...8	...9	...0

It is clear from tab.1 that there is a repeat of the last number of the power after four powers $(1,5,9,13,17...\infty); (2,6,10,14...\infty); (3,7,11,15...\infty); (4,8,12,16...\infty)$.

Thus, the last digit of any number to an arbitrary power x^n can be represented in four types (Table 1);

$$- x^n = f[(n_1 = 1 + 4m; where\ m = 1.0 \ ... \infty)];$$

$$- x^n = f[(n_2 = 2 + 4m; where\ m = 1.0 \ ... \infty)];$$

$$- x^n = f[(n_3 = 3 + 4m; where\ m = 0 \ ... \infty)];$$

$$- x^n = f[(n_4 = 4 + 4m; where\ m = 0 \ ... \infty)];$$

For example: $n = 217$, then $n_i = \dfrac{n}{4} = \dfrac{217}{4} = 54 + \dfrac{1}{4} => n_1 = 1 + 4m$,

$n = 218$, then $n_i = \dfrac{n}{4} = \dfrac{218}{4} = 54 + \dfrac{2}{4} => n_2 = 2 + 4m$; etc.

two cyclicities were found:

- the last digit of any number $\dot{x}(\ldots x)$ ranges from zero to nine;

- the cyclicity of the change in the last digit of the number $\dot{x}$ when it is raised to an arbitrary power $n\ (\ldots x^n)$ (it repeats every fourth power) was found, i.e.

$$x^{n_i} = f(i, m),$$

where $n_i = i + 4m, i = 1 \ldots 4, m = 0 \ldots \infty$

Arbitrary powers of different numbers are considered. For x^n analysis, only those numbers are taken for which the last digit of the number x^n is equal to the last digit of the sum $(y^n + z^n)$.

When compiling the table, the last digit of the number z is the most maximal, and the number y is taken such that the last digit of the sum of the last digits of the numbers y^{1+4m} and z^{1+4m} is equal to the last digit of the number x^{1+4m}.

Based on the analysis of tables 2-5 of work [7], table 2 was compiled.

The generalized table of numbers with the same values of the last digits and the minimum difference between the numbers x^n and $(y^n + z^n)$ according to the analysis of the table. 2 [7]

Table 2

Formulas n_1=1+4m, where $m = 1,2 \ldots \div \infty$. $x > z \geq y; |\delta| = |\delta_{min}|$; $\delta_{min} = x^{n_1} - -(y^{n_1} + z^{n_1})$; $0 < x \leq \infty$		Formulas n_2=2+4m, where $m = 1,2,3 \ldots \div \infty$. $x > z \geq y; |\delta| = |\delta_{min}|$; $\delta_{min} = x^{n_2} - -(y^{n_2} + z^{n_2})$; $0 < x \leq \infty$	
№ o/n	$x^{n_1} \neq y^{n_1}+z^{n_1}$	№ o/n	$x^{n_2} \neq y^{n_2}+z^{n_2}$
1	$...1^{n_1} \neq \cdots 1^{n_1} + \cdots 0^{n_1}$	1	$...1^{n_2} \neq 9^{n_2} + ...0^{n_2}$
2	$...2^{n_1} \neq \cdots 1^{n_1} + \cdots 1^{n_1}$	2	$...2^{n_2} \neq 8^{n_2} + \cdots 0^{n_2}$
3	$...3^{n_1} \neq \cdots 1^{n_1} + \cdots 2^{n_1}$	3	$...3^{n_2} \neq 7^{n_2} + \cdots 0^{n_2}$
4	$...4^{n_1} \neq \cdots 1^{n_1} + \cdots 3^{n_1}$	4	$...4^{n_2} \neq 6^{n_2} + ...0^{n_2}$
5	$...5^{n_1} \neq \cdots 1^{n_1} + \cdots 4^{n_1}$	5	$...5^{n_2} \neq 3^{n_2} + \cdots 4^{n_2}$
6	$...6^{n_1} \neq \cdots 1^{n_1} + \cdots 5^{n_1}$	6	$...6^{n_2} \neq 1^{n_2} + ...5^{n_2}$
7	$...7^{n_1} \neq \cdots 1^{n_1} + \cdots 6^{n_1}$	7	$...7^{n_2} \neq 2^{n_2} + \cdots 5^{n_2}$
8	$...8^{n_1} \neq \cdots 1^{n_1} + \cdots 7^{n_1}$	8	$...8^{n_2} \neq 5^{n_2} + \cdots 7^{n_2}$
9	$...9^{n_1} \neq \cdots 1^{n_1} + \cdots 8^{n_1}$	9	$...9^{n_2} \neq 5^{n_2} + \cdots 6^{n_2}$
10	$...0^{n_1} \neq \cdots 1^{n_1} + \cdots 9^{n_1}$	10	$...0^{n_2} \neq 7^{n_2} + ...9^{n_2}$

Formulas $n_3=3+4m$, where $m = 0,1,2 ... \div \infty.$ $x > z \geq y; |\delta| = |\delta_{min}|;$ $\delta_{min} = x^{n_3} - -(y^{n_3} + z^{n_3}); \quad 0 < x \leq \infty$		Formulas $n_4=4+4m$, where $m = 0,1,2 ... \div \infty.$ $x > z \geq y, |\delta| = |\delta_{min}|,$ $\delta_{min} = x^{n_4} - -(y^{n_4} + z^{n_4}); \quad 0 < x \leq \infty$	
№ o/n	$x^{n_3} \neq y^{n_3} + z^{n_3}$	№ o/n	$x^{n_4} \neq y^{n_4} + z^{n_4}$
1	$... 1^{n_3} \neq \cdots 3^{n_3} + \cdots 4^{n_3}$	1	$... 1^{n_4} \neq \cdots 2^{n_4} + \cdots 5^{n_4}$
2	$... 2^{n_3} \neq \cdots 1^{n_3} + \cdots 3^{n_3}$	2	$... 2^{n_4} \neq \cdots 1^{n_4} + \cdots 5^{n_4}$
3	$... 3^{n_3} \neq \cdots 1^{n_3} + \cdots 6^{n_3}$	3	$... 3^{n_4} \neq \cdots 4^{n_4} + \cdots 5^{n_4}$
4	$... 4^{n_3} \neq \cdots 2^{n_3} + \cdots 6^{n_3}$	4	$... 4^{n_4} \neq \cdots 1^{n_4} + \cdots 5^{n_4}$
5	$... 5^{n_3} \neq \cdots 1^{n_3} + \cdots 4^{n_3}$	5	$... 5^{n_4} \neq \cdots 5^{n_4} + \cdots 0^{n_4}$
6	$... 6^{n_3} \neq \cdots 1^{n_3} + \cdots 5^{n_3}$	6	$... 6^{n_4} \neq \cdots 3^{n_4} + \cdots 5^{n_4}$
7	$... 7^{n_3} \neq \cdots 3^{n_3} + \cdots 6^{n_3}$	7	$... 7^{n_4} \neq \cdots 4^{n_4} + \cdots 5^{n_4}$
8	$... 8^{n_3} \neq \cdots 3^{n_3} + \cdots 5^{n_3}$	8	$... 8^{n_4} \neq \cdots 7^{n_4} + \cdots 5^{n_4}$
9	$... 9^{n_3} \neq \cdots 6^{n_3} + \cdots 7^{n_3}$	9	$... 9^{n_4} \neq \cdots 8^{n_4} + \cdots 5^{n_4}$
10	$... 0^{n_3} \neq \cdots 1^{n_3} + \cdots 9^{n_3}$	10	$... 0^{n_4} \neq \cdots 5^{n_4} + \cdots 5^{n_4}$

The analysis of the results of the calculations given in table 2.

1. The power $n_1= 1+4m$ and the numbers x^{1+4m}, y^{1+4m}, z^{1+4m}, where $x > z \geq y$, $m = 1 ... \infty$, are considered. The numbers x, y, z are taken in accordance with Table 6 so that the last digit of the number x^{1+4m} is equal to the last digit of the sum of the numbers $(y^{1+4m} + z^{1+4m})$. All other numbers will have the difference $\delta > |\delta_{min}|$ or the last digits of the number x^{1+4m} and the sums of the number $(y^{1+4m} + z^{1+4m})$ will differ.

$$x^{1+4m} = y^{1+4m} + z^{1+4m} \tag{2}$$

Equation (2) is represented as $xx^{4m} = yy^{4m} + zz^{4m}$ (3)

In the right side of equation (3), the quantity z^{4m} is taken out of brackets

$$xx^{4m} = z^{4m}\left(\frac{y^{4m}}{z^{4m}}y + z\right). \tag{4}$$

In equation (4), the value of $x > \left(\frac{y^{4m}}{z^{4m}}y + z\right)$, and the value of x^{4m} is greater than z4mx4m> $z^{4m}(x^{4m} > z^{4m})$, since $x > z$.

Therefore, $xx^{4m} > z^{4m}\left(\frac{y^{4m}}{z^{4m}}y + z\right)$ and their difference $|\delta_{min}| = x^{1+4m} - (y^{1+4m} + z^{1+4m}) > 0$.

Thus, for $x > z \geq y, m = 1 ... \infty$ and equation (2) can be written as

$$x^{1+4m} \neq y^{1+4m} + z^{1+m}. \tag{5}$$

2. The power $n_2 = 2+4m$ is considered, as well as the numbers $x^{2+4m}, y^{2+4m}, z^{2+4m}$,

$(x > z \geq y, m = 1 ... \infty)$. The numbers x, y, z are taken in accordance with table 6 for $n_2 = 2+4m$,

so that the last digit of the number x^{2+4m} was equal to the last digit of the sum of numbers $(y^{2+4m} + z^{2+4m})$. All other numbers will have a difference $|\delta| > |\delta_{min}|$ or the last digits of the number x^{2+4m} and the sum of the numbers $(y^{2+4m} + z^{2+4m})$ will be different.

$$x^{2+4m} = y^{2+4m} + z^{2+4m} \tag{6}$$

Equation (6) is represented as $x^2 x^{4m} = y^2 y^{4m} + z^2 z^{4m}$ (7)

In the right side of equation (7), the quantity z^{4m} is placed outside the brackets.

$$x^2 x^{4m} = z^{4m}\left(\frac{y^{4m}}{z^{4m}}y^2 + z^2\right). \tag{8}$$

In equation (8), $x^2 > \left(\frac{y^{4m}}{z^{4m}}y^2 + z^2\right)$, and $x^{4m} > z^{4m}$, since $x > z$.

Therefore, $x^2 x^{4m} > z^{4m}\left(\frac{y^{4m}}{z^{4m}}y^2 + z^2\right)$ and their difference $|\delta_{min}| = x^{2+4m} - (y^{2+4m} + z^{2+4m}) > 0$.

Thus, for $x > z \geq y, m = 1 ... \infty$ and equation (6) can be written as

$$x^{2+4m} \neq y^{2+4m} + z^{2+4m} \tag{9}$$

3. Considered power $n_3 = 3+4m$, as well as numbers $x^{3+4m}, y^{3+4m}, z^{3+4m}$

$(x > z \geq y; m = 0 ... \infty; x = 1 ... \infty, y = 1 ... \infty, z = 1 ... \infty)$.

The numbers x, y, z are taken in accordance with Table 6 for the power $n_3 = 3+4m$, so that the last digit of the number x^{3+4m} is equal to the last digit of the sum of numbers $(y^{3+4m} + z^{3+4m})$. All other numbers will have a difference $|\delta| > |\delta_{min}|$ or the last digits of the number x^{3+4m} and the sum of the numbers $(y^{3+4m} + z^{3+4m})$ will differ.

$$x^{3+4m} = y^{3+4m} + z^{3+4m} \tag{10}$$

Equation (10) is represented as $x^3 x^{4m} = y^3 y^{4m} + z^3 z^{4m}$ (11)

In the right side of equation (11), the quantity z^{4m} is placed outside the brackets.

$$x^3 x^{4m} = z^{4m}\left(\frac{y^{4m}}{z^{4m}}y^3 + z^3\right) \qquad (12)$$

In equation (12) in accordance with table 6, the value of $x^3 > \left(\frac{y^{4m}}{z^{4m}}y^3 + z^3\right)$, and the value of $x^{4m} > z^{4m}$, since $x > z$.

Therefore, $x^3 x^{4m} > z^{4m}\left(\frac{y^{4m}}{z^{4m}}y^3 + z^3\right)$ and their difference $|\delta_{min}|=$ $x^{3+4m}-(y^{3+4m}+z^{3+4m})$

Thus, for $x > z \geq y$, $m = 0 \dots \infty$ and equation (10) can be written as

$$x^{3+4m} \neq y^{3+4m} + z^{3+4m} \qquad (13)$$

4. The power $n_4 = 4+4m$ is considered, as well as the numbers x^{4+4m}, y^{4+4m}, z^{4+4m}

$$(x > z \geq y; m = 0 \dots \infty; x = 1 \dots \infty, y = 1 \dots \infty, z = 1 \dots \infty).$$

The numbers x, y, z are taken $n_4 = 4+4m$, so that the last digit of x^{4+4m} ordance with Table 6 for the degree $n_4 = 4+4m$, so that the last digit of x^{4+4m} is equal to the last digit of the sum of numbers $(y^{4+4m} + z^{4+4m})$. All other numbers will have a difference $|\delta| > |\delta_{min}|$ or the last digits of the number x^{4+4m} and the sum of the numbers $(y^{4+4m} + z^{4+4m})$ will be different.

$$x^{4+4m} = y^{4+4m} + z^{4+4m} \qquad (14)$$

Equation (14) is represented as $\qquad x^4 x^{4m} = yy^{4m} + z^4 z^{4m} \qquad (15)$

In the right side of equation (15), the quantity z^{4m} is placed outside the brackets.

$$x^4 x^{4m} = z^{4m}\left(\frac{y^{4m}}{z^{4m}}y^4 + z^4\right) \qquad (16)$$

In equation (16) in accordance with table 6, the value of $x^4 > \left(\frac{y^{4m}}{z^{4m}}y^4 + z^4\right)$, and the value of $x^{4m} > z^{4m}$, since $x > z$.

Therefore, $\qquad x^4 x^{4m} > z^{4m}\left(\frac{y^{4m}}{z^{4m}}y^4 + z^4\right) \qquad$ and $\qquad$ their $\qquad$ difference

$|\delta_{min}|=x^{4+4m}-(y^{4+4m}+z^{4+4m}) > 0.$

Thus, for $x > z \geq y$, $m = 0 \dots \infty$ and equation (14) can be written as

$$x^{4+4m} \neq y^{4+4m} + z^{4+4m} \qquad (14)$$

As can be seen from tables $1 \div 6$, any power $n = 1 \dots \infty$ can be expressed in four powers $n_1 = 1+4m$; $n_2 = 2+4m$; $n_3 = 3+4m$; $n_4 = 4+4m$, where $m = 0 \dots \infty$.

The number x^n can be equal to the sum of the numbers $(y^n + z^n)$ only for $n \leq 2$. For $n = 3 \dots \infty$, there can be no equality of the numbers $(y^n + z^n)$, i.e. $x^n \neq y^n + z^n$ with $n = 3 \dots \infty$.

Thus, for any values of the numbers $x=1\dots\infty, y = 1 \dots \infty, z = 1 \dots \infty$ and the power $n = 3 \dots \infty$ there can be no equality between x^n and the sum

$(y^n + z^n)$, i.e. $x^n \neq y^n + z^n$. (15)

An additional analysis of the data of table 6.

1. We consider the magnitude of the power $n_1 = 1 + 4m$.

The right sides of all ten values in the first power are equal to the left part in the first power, i.e. $x = y + z$ If we replace the left side with its value, we get $(y + z)^{n_1} \neq y^{n_1} + z^{n_1}$. or that the same $x^{n_1} \neq y^{n_1} + z^{n_1}$

Thus, the value x^{1+4m} cannot be equal to the sum of $(y^{1+4m} + z^{1+4m})$ in the range $1 \leq m \leq \infty$.

2. The values of the power $n_2 = 2 + 4m$ are considered.

The value x of the first two numbers is greater than the sum of $(y + z)$ in the first power. If x is represented as $x = y + z + d$, then the right and left sides of these two numbers can be written as $(y + z + d)^{n_2} \neq y^{n_2} + c^{n_2}$ or, which is the same $x^{n_2} \neq y^{n_2} + z^{n_2}$.

The value x^6 of the third, fourth, and fifth numbers is significantly larger than the sum $(y^6 + z^6)$. therefore an increase in m will lead to an increase in δ, i.e. the difference of x^{2+4m} and $(y^{2+4m} + z^{2+4m})$.

Thus, the x^{2+4m} value of the third, fourth, and fifth numbers cannot be equal to the sum of $(y^{2+4m} + z^{2+4m})$ in the range of $1 \leq m \leq \infty$.

The right parts of the numbers from the sixth to the tenth are equal to the left parts in the first degree, i.e. $x = y + z$.

Therefore, if we substitute its value instead of x on the left side, then we get $(y + z)^{n_2} \neq y^{n_2} + z^{n_2}$ or, which is the same $x^{2+4m} \neq y^{2+4m} + z^{2+4m}$.

Thus, the value of x^{2+4m} cannot be equal to the sum of $(y^{2+4m} + z^{2+4m})$ in the range $1 \leq m \leq \infty$.

3. The values of the power $n_3 = 3 + 4m$ are considered.

The value x of the first number is greater than the sum of $(y + z)$ in the first power. If x is represented as $x = y + z + d$, then the right and left side of this inequality can be written as $(y + z + d)^{n_3} \neq y^{n_3} + z^{n_3}$ or $x^{n_3} \neq y^{n_3} + z^{n_3}$.

The x^3 value of the second, third, and fourth numbers is significantly greater than the sum of $(y^3 + z^3)$. therefore an increase in m will lead to an increase in δ, i.e. the differences of x^{3+4m} and $(y^{3+4m} + z^{3+4m})$.

The left parts of the numbers from the fifth to the tenth are equal to the right parts in the first power, i.e. $x = y + z$.

If in the left part, instead of x, we substitute its value, then we get $(y + z)^{n_3} \neq y^{n_3} + z^{n_3}$ or $x^{n_3} \neq y^{n_3} + z^{n_3}$.

Thus, the value x^{3+4m} cannot be equal to the sum of $(y^{3+4m} + z^{3+4m})$ in the range of $0 \leq m \leq \infty$.

4. The values of the power $n_4 = 4 + 4m$ are considered.

The value x of the first three numbers is greater than the sum of $(y + z)$ in the first power. If x is represented as $x = y + z + d$, then the right and left

sides of these three numbers can be written as $(y + z + d)^{n_4} \neq y^{n_4} + z^{n_4}$ or $x^{n_4} \neq y^{n_4} + z^{n_4}$.

The value x^4 of the first, second, third, and fourth numbers is much larger than the sum of $(y^4 + z^4)$. therefore an increase in m will lead to an increase in δ, i.e. difference of x^{4+4m} and $(y^{4+4m} + z^{4+4m})$.

Thus, the value x^{4+4m} of the first, second, third, and fourth numbers cannot be equal to the sum of $(y^{4+4m} + z^{4+4m})$ in the range of $0 \leq m \leq \infty$.

The left parts of the numbers from the fifth to the tenth are equal to the right parts in the first power, i.e. $x = y + z$.

Therefore, substituting the value of x in the left-hand side of its value, we obtain $(y + z)^{n_4} \neq y^{n_4} + z^{n_4}$ or $x^{4+4m} \neq y^{4+4m} + z^{4+4m}$.

Thus, the value x^{4+4m} cannot be equal to the sum of $(y^{4+4m} + z^{4+4m})$ in the range $0 \leq m \leq \infty$.

The number x^n can be equal to the sum of the numbers $(y^n + z^n)$ only for $n \leq 2$. For $n = 3 \ldots \infty$, there can be no equality of the numbers x^n and $(y^n + z^n)$, i.e. $x^n \neq (y^n + z^n)$ with $n = 3 \ldots \infty$.

Thus, for any values of the numbers x = 1 ... ∞, y = 1 ... ∞, z = 1 ... ∞ and the power $n = 3 \ldots \infty$ there can be no equality between x^n and $(y^n + z^n)$, i.e. $x^n \neq y^n + z^n$. (15)

The great Fermat's theorem is proved.

Conclusion

Any number ends with a digit ranging from zero to nine. The cyclicity in changing of the last digit of the number x when it is raised to an arbitrary power n is found. It is shown that the last digit of the number x will be the same every fourth power. Thus, there is a repeat of the last digit of the power every four powers. The same numbers will be at powers $n_i (1; 5; 9; 13; 17; \ldots; \infty)$; $(2; 6; 10: 14; \ldots; \infty); (3; 7; 11; 15; \ldots \infty); (4; 8; 12; 16; \ldots \infty)$.

Any power of x can be expressed in one of four values.
$$n \to n_i = i + 4m, \text{ where } i = 1 \div 4, \ 0 \leq m \leq \infty.$$

Based on the analysis of tables $1 \div 5$, a generalized table 6 was compiled. This table gives the minimum value of $|\delta_{min}|$, i.e. the difference between the numbers x^{n_i} and $(y^{n_i} + z^{n_i})$ when they are raised to any power n_i. The analysis of the values in Table 6 showed that increasing the power at a constant value of the number x or increasing the number x at a constant power n_i leads to an increase in $|\delta_{min}|$. Thus, it was found that as $x \to \infty$ and $n_i \to \infty$, the minimum difference between the number x^{n_i} and the sum $(y^{n_i} + z^{n_i})$ tends to infinity; i.e. $|\delta_{min}| \to \infty$. Thus, $x^n \neq (y^n + z^n)$ for $3 \leq n \leq \infty$. The great Fermat's theorem is proved.

Indicators:

ПЦЧ - the last digit of the number; ПЦС - the last digit of the power.

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秩效的基础 – 粘度
THE BASICS OF THE RANQUE EFFECT - VISCOSITY

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注解。给出了粘度对Ranque效应影响的证据。给出了沿轴向和周边气流的涡流管长度和半径的总压力和总气体温度变化的规律。

结果表明，周边气流的总压力由于液压阻力而减小，并且由于与轴向流动的交换而增加。这种相互作用的结果是阀前面的总压力的大小。外围和轴向气流的总温度由它们相互作用的大小决定。

已经进行了确定涡流管的工作室中的外围和轴向气流的轨迹的实验。

已经发现了从轴向气体层到外围气体层的能量转移机制。

关键词：Ranque效应，涡流管，能量交换，周边气流，轴向气流，粘度，角速度梯度。

Annotation. *The evidence on the effect of viscosity on the Ranque effect is given. The regularities of changes in the total pressure and the total gas temperature along the length and radius of the vortex tube of the axial and peripheral gas flows are given.*

It is shown that the total pressure of the peripheral gas flow decreases due to hydraulic resistances and increases due to the exchange of work with the axial flow. The result of this interaction is the magnitude of the total pressure in front of the valve. The total temperature of the peripheral and axial gas flows is determined by the magnitude of their interaction.

The experiments to determine the trajectory of the peripheral and axial gas flows in the working chamber of the vortex tube has been conducted.

The mechanism of energy transfer from the axial to the peripheral gas layers has been found.

Keywords*: Ranque effect, vortex tube, energy exchange, peripheral gas flow, axial gas flow, viscosity, gradient of angular velocities.*

Introduction

The Ranque effect - separation of a gas flow into two parts, having different energy, is implemented in a device called a vortex tube (Fig. 1) [1].
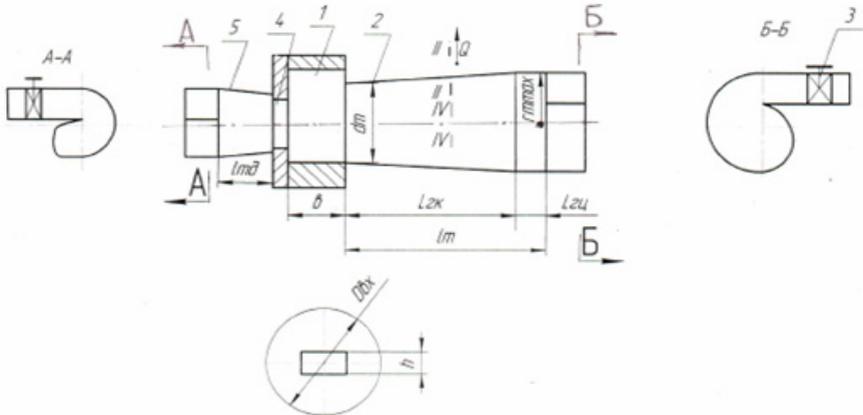

Fig.1. *Scheme of the vortex tube: 1 - input tangential nozzle; 2- chamber of energy separation (truncated hyperboloid); 3 - valve; 4- diaphragm; 5 - pipe for cooled gas stream removal (in the form of a truncated hyperboloid)*

The total temperature and pressure of the fluid (compressible and incompressible) can change only during the exchange of work and heat [2].

Formulation of the problem

The main objective of this work is:

- to determine the possibility of energy exchange (work and heat) between the axial and peripheral gas flows;

- to find out the possibility of excess energy transfer from the axis to the periphery and backwards;

- to find the mechanism of energy transfer from the axis to the periphery and backwards.

Evidence

To verify the mathematical models used in the calculations, experimental studies have been performed on various vortex tubes. The reliability and validity of the results is ensured through the use of certified measuring equipment, means for processing experimental data and carrying out numerical analysis, compliance

with the similarity criteria. The obtained results correspond to the known reliable data, descriptions and observations of other authors.

The ability to exchange work and heat between the peripheral gas flows was tested on an experimental setup (Fig. 2).

The air temperature was measured with a 16-channel temperature scanner EL - SCADA 4050; plug-in thermocouples - L (chromel - copel) with a measurement error of $\pm 0,5^0 C$. Bandwidth - 40 measurements /channel /C; supply voltage - 28 V (direct current); power consumption - 70 V in (with heating); working temperature $(-30) \div (+60)^0 C$.

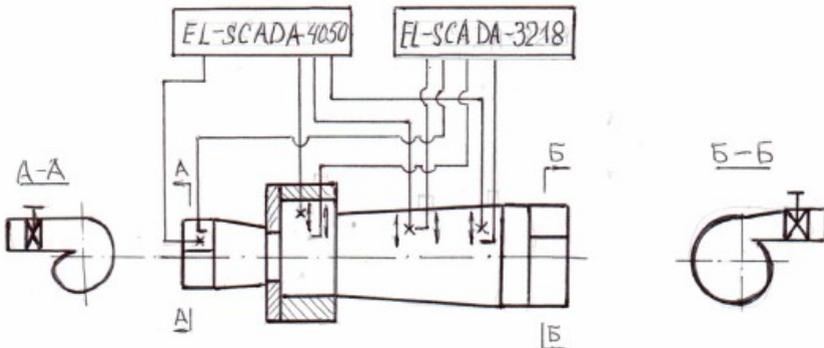***Fig.2.*** *The scheme of preparation of the vortex tube:*
EL - SCADA – 4050 - multichannel temperature sensor; EL-SCADA-3218 - 16 channel pressure scanner (measures gas pressure);
* - temperature sensor; ⌐ - pressure meter.

The total and static air pressure was measured with an EL-SKADA (3218) multichannel pressure scanner. This is a 16-channel pressure scanner designed to measure gas pressure with an accuracy of $\pm 0,05\%$ of the full scale of measurement in the pressure range up to 690 kPa. Operating temperature $(-45) \div (+55)^0 C$.

Measurements in a swirling flow inside the energy separation chamber were made using a full-pressure cylindrical nozzle equipped with a braking temperature sensor with an outer diameter of 3 mm. Two receiving holes of a nozzle with a diameter of 0.3 mm were separated by an angle of 81^0. This angle corresponds to the position of a point on the surface of the sensor in which the pressure is equal to the static pressure [3]; The deceleration temperature recovery factor for the sensor was calibrated using a jet flowing from the receiver nozzle.

After entering the nozzle of full pressure into the vortex chamber in the radial direction using a coordinate device having a displacement accuracy of 0.01 mm, the angle of attack, the total and static pressure P_0, P and the stagnation temperature T_0, respectively, were measured. The maximum errors of these measurements

were: $\alpha = \pm 0,25^0$; $P_0 = \pm 0,7 kPa$; $P = \pm 1, kPa$; $T_0 = \pm 0,5K$.

Based on measured values using equations:

$$M = \sqrt{\frac{2}{k-1}\left[\left(\frac{P_0}{P}\right)^{\frac{\kappa-1}{\kappa}} - 1\right]}; \frac{T_0}{T} = 1 + \frac{\kappa-1}{2} M^2; a = \sqrt{\kappa R T}; V = Ma;$$
$$V_\varphi = V \cos \alpha; V = V \sin \alpha$$

for each nozzle radial position, the values of standard temperature T, absolute speed V, tangential V_y and axial V_z velocity components were calculated. The radial component of the absolute velocity at a given radius r_i was found from the continuity equation for a steady axisymmetric flow

$$V_{ri} = -\left(\frac{\partial}{\partial z}\int_0^{r.} \rho V_r r dr\right)/\rho_i r_i, \text{ where } \rho_i \text{ is the air density, kg/m}^3$$

The results of experimental studies are shown in Fig. 3,4,5.

Fig. 3 shows the pressure distribution of the inhibited air flow over the relative radius r in three zones of the vortex tube (in nozzle section, at a distance of $4d_\tau$ from the plane of the diaphragm and at a distance of $8d_\tau$ from the plane of the diaphragm).

The relative radius r is the ratio of the current radius to the radius of the working chamber of the vortex tube in this section. Fig. 3 shows that the largest differential pressure across r is in the nozzle section, the smallest is in front of the valve 3.
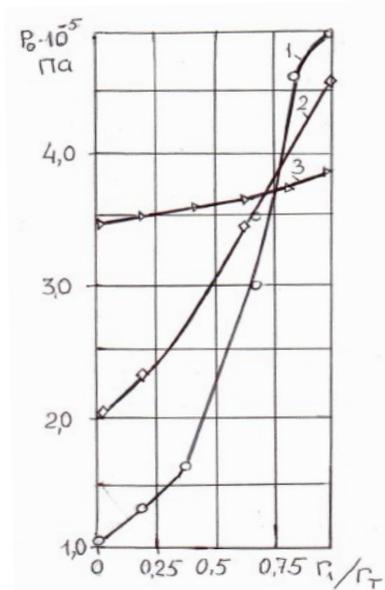

Fig. 3. Distribution of total pressure by relative radius in different zones of the vortex pipe:
1– in the nozzle section,
2 — 4dT distance from the plane of the diaphragm,
3 — at a distance of 8dT from the plane of the diaphragm

Such a distribution of total pressure over r is explained as follows. As the peripheral air flow moves from the inlet nozzle to the valve 3 (screw movement), two opposite effects are produced on the air:

- supply of kinetic energy from the axial layers of air by viscosity due to the gradient of angular velocity, leading to an increase in the total pressure of the peripheral flow;

- the drop in the total pressure of the peripheral air flow due to hydraulic resistance to friction and local resistance.

The drop in the total pressure of the peripheral air flow due to hydraulic resistance is significantly greater than the increase in the total pressure from the energy supply from the side of the axial air layers. The result of this interaction is to reduce the total pressure at the valve relative to the total pressure at the inlet to the tangential nozzle. The axial flow of air begins its movement from the valve and is a part of the peripheral flow that has passed from a larger radius to a smaller one. The axial flow moves along a helix, i.e. as well as the movement of peripheral flow. The total pressure of the axial air flow in front of the valve is slightly different from the total pressure of the peripheral flow in the same section. As it moves from the valve to the diaphragm, the axial flow by viscosity due to the gradient of angular velocities transfers excess energy to the peripheral layers. As a result of this interaction, the axial air flow has a maximum pressure in front of the valve, the minimum - before exiting the diaphragm.

Thus, the peripheral air flow has the maximum total pressure in the nozzle section, the minimum - in front of the valve; the axial flow moving in the opposite direction has the maximum total pressure in front of the valve, the minimum is in the nozzle section. When the vortex tube is operating in the design mode in a nozzle section, the energy exchange between the axial and peripheral air layers ends and the axial layers begin to rotate like a quasi-solid body.

The axial layers of the gas perform work, since their total pressure drops from P_{03} at the valve to P_{05} - at the outlet of the diaphragm. The value of the specific work, which is transferred from the axial layers of air to the peripheral ones, can be determined by the equation [4].

$$L_{3-5} = C_p T_{03} \left[1 - \left(\frac{P_{05}}{P_{03}} \right)^{\frac{\kappa-1}{\kappa}} \right] = i_{03}^* - i_{05}^*. \tag{1}$$

The value of the specific work supplied to the peripheral layers of air is deter-

$$L_{1-3} = \mu L_{3-5} = C_p T_{01} \left(\pi_{1-3}^{*\frac{\kappa-1}{\kappa}} - 1 \right) = i_{03}^* - i_{01}^*, \tag{2}$$

where $\pi_{1-3}^* = \frac{P_{03} + \Delta P_{1-3}}{P_{01}}$,

ΔP_{1-3} - loss of total pressure of the peripheral air flow to friction and local resistance as it moves from the inlet nozzle to the fan,

$\mu = G_x / G_1$ is the weight fraction of the cold flow.

The distribution curves of the relative total air temperature along the relative length of the vortex tube (Fig. 4) indicate that the total temperature of the peripheral air layers increases as it moves from the nozzle section to the valve.

The axial layers of air begin to move from the valve after the transition of a part of the peripheral flow to a smaller radius, therefore the total temperature of the axial layers of air before the valve is close to the temperature of the peripheral layers. When the axial layers move from the valve to the diaphragm, the axial air layers perform work on the peripheral layers by viscosity forces due to the gradient of angular velocities. There is a decrease in their total pressure and total temperature. In the nozzle section after the transfer of all the excess energy ends energy exchange between the axial and peripheral layers of air, resulting in the nozzle section in front of the diaphragm air temperature has a minimum value.
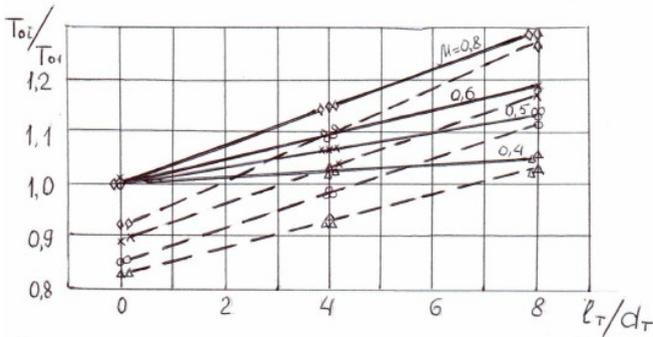
Fig.4. *The change in the total relative gas temperature along the length of the vortex tube depending on μ: ___ is the relative temperature of the peripheral layers; _ _ _ - relative temperature of axial layers*

The curves of the distribution of the angular velocity along the radius of the vortex tube are shown in Fig. 5 [4,5]. In this fig. it can be seen that in front of valve 3 (Fig. 1), the separation by angular velocity at the axial and peripheral flows is maximum (curve 3). As the axial gas flow moves from the valve to the diaphragm, the difference in the angular velocities of the axial and peripheral flows decreases (curve 2) and in the nozzle section the difference in the angular velocities of the axial and peripheral flows becomes equal to zero (curve 1). This suggests that when moving from the valve to the diaphragm, the axial flow through the forces of viscosity at the expense of the gradient of angular velocities transfers kinetic

energy to the peripheral layers. When approaching the diaphragm, the axial flow after the transfer of all its excess energy begins to rotate like a quasi-rigid body, since its excess energy becomes equal to zero. The formula for determining the radial velocity of air in a vortex tube depending on the geometric dimensions of the vortex tube and the location of the gas particle in it is determined by the equation [4].

$$V_r = \frac{G_1(r_c^2 - r^2)}{2\pi r_T l_T \rho_1 \left[1 - (r_c/r_T)^2\right] r} \tag{3}$$

From equation (3) it follows:
- if $r_c > r$, then $V_r > 0$; - if $r_c < r$, then $V_r < 0$; - if $r_c = r$, then $V_r = 0$.
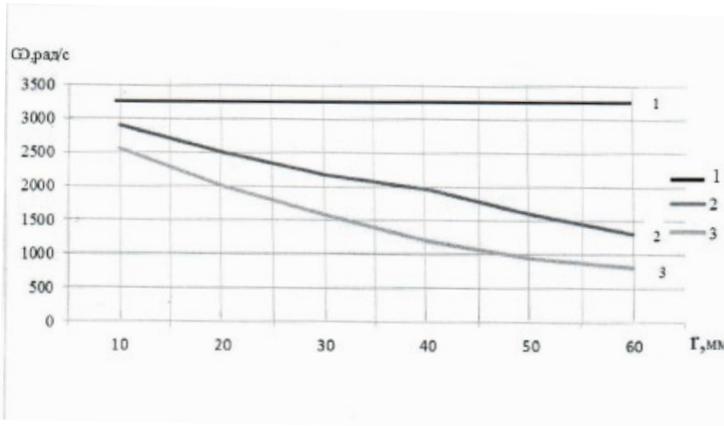
Fig. 5. *The distribution of the angular velocity along the radius of the vortex tube:*
1 – L=0 [6]; 2 – L= d$_т$ [3]; 3 – L=12,6 d$_т$ [5]

Thus, if a gas particle is in axial layers, then its radial velocity is greater than zero and it moves from the axis to the periphery;
- if the gas particle is in the peripheral layers, then its radial velocity is less than zero and it moves from the periphery to the axis;
- if a gas particle is located on the radius of contact between the peripheral and axial gas flows, then its radial velocity is zero.

Consequently, liquid does not flow through the interface of peripheral and axial gas flows ($r = r_c$), and therefore the calculation of heat transfer between peripheral and axial gas layers can be carried out using heat transfer formulas for flow of fluid in tubes through a wall of zero thickness.

Heat transfer can be carried out by heat conduction, convection and emission (or radiation) [6]. In the vortex tube, the process of heat transfer is only thermal conductivity.

For the heat flow from the peripheral gas layers to the axial in the vortex tube, we can write the equation [6]:

$$Q = K_\text{ц} F_c (T_2 - T_4),$$ (4)

where $K_\text{ц}$ - heat transfer coefficient; F_c - the contact area between the peripheral and axial layers of the gas; T_2, T_4 - the thermodynamic temperatures of the peripheral and axial gas layers, respectively.

It follows from the above that there is an exchange of work and heat in the vortex tube, which should lead to the separation of the peripheral and axial layers at total temperature.

Conclusion

The results of a theoretical and experimental study of a countercurrent vortex tube are presented.

It is proved that the Ranque effect occurs in a vortex tube during the exchange of work and heat between peripheral and axial gas flows. The mechanism of kinetic energy transfer from the axis to the periphery is the viscosity force in the presence of a gradient of angular velocities. The heat flow goes from the periphery to the axis due to the difference in thermodynamic temperatures.

Basic conventions

P — gas pressure, Pa; T - gas temperature, K; L - specific work, J/kg; G - gas flow rate, kg/s; π^* - the degree of change in gas pressure; μ - weighted fraction of cold flow = Gx/G1; i - enthalpy of gas, J/kg; k - adiabatic index; C_p -specific heat at constant pressure, J/(kg · K); V - speed, m/s; ρ - density, kg/m³; - kinetic viscosity of gas, m²/s; r - radius, m; l - length, m; ω - angular velocity, 1/s; Q - heat flow, W; $K_\text{ц}$ - heat transfer coefficient, W/m²/K; F - area, m²; R - gas constant, J/(kg · K); □ -time, s; Re - Reynolds number.

Indices

0 - parameters of the inhibited gas flow; 1 - gas parameters at the entrance to the vortex tube; 2 - gas parameters in the middle section of the peripheral flow; 3 - gas parameters in front of the valve; 4 - gas parameters in the middle section of the axial flow; 5- gas parameters at the outlet of the diaphragm.

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预测自动软件环境中主轴组件的磨损趋势

ПРОГНОЗИРОВАНИЕ ТРЕНДА ИЗНОСА ШПИНДЕЛЬНОГО УЗЛА В АВТОМАТИЗИРОВАННОЙ ПРОГРАММНОЙ СРЕДЕ

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注解。 本文讨论了预测金属加工设备之一形成单元磨损的问题。 通过提高设备的可靠性来提高生产效率的问题。 根据诊断信号的动态特性预测主轴组件的磨损是进行维修时的基础。 应用的软件环境允许根据人为因素降低预测错误的风险。

关键词：可靠性，金属加工设备，预测，趋势，磨损，主轴装配，软件环境，维修工作。

Annotation. The article discusses the issue of predicting the wear of one of the formative units of metalworking equipment. The issues of increasing production efficiency are raised by increasing the reliability of equipment. Predicting the wear of the spindle assembly according to the dynamic characteristics of the diagnostic signal is fundamental when carrying out repairs. The applied software environment allows reducing the risks of forecasting errors depending on the human factor.

Keywords: reliability, metalworking equipment, forecasting, trend, wear, spindle assembly, software environment, repair work.

Advanced machine-building enterprises, for which profitability of production is important, transfer their equipment to maintenance according to their actual condition. To this end, all sorts of non-burglary equipment diagnostics methods are being developed and implemented in order to identify the actual wear of machine components and determine the point in time for the maintenance. Such measures make it possible to identify hidden defects, to order the necessary components in advance, to carry out repair work only with worn assemblies, to reduce maintenance costs and reduce its time and plan the amount of repair and restoration

work. Such directions are dealt with by such authors as: Push A.V., Sabirov F.S., Kozochkin M.P., Khomyakov V.S., Kochinev N.A., Erzin O.A.

Methods for conducting such events are constantly being improved with the expansion of measuring equipment. Despite the fact that there are currently many works devoted to theoretical modeling and practical research of the dynamics of the functioning of the spindle assembly and diagnostic methods. Methods for predicting the wear of the spindle assembly, based on diagnostic data, have just begun to develop. The development of methods for predicting wear of the spindle assembly will make it possible to assess the trend of changes in the technical condition of the spindle assembly, predict the wear of critical machine components, predict the intensity of development of defects identified during diagnostics, reduce the likelihood of emergency situations, determine and correct overhaul periods according to diagnostic and forecast data, reduce repair costs and thereby increase production efficiency.

In work [1] proposed to predict the level of technical condition of the spindle assembly using the trend of the change in the diagnostic signal. The trend allows you to predict the onset of a critical point in time during the operation of equipment. The trend is constructed according to the history of observation of the diagnostic signal. The prediction curve is based on an exponential function. For an operative response to peak emissions in the diagnostic signal, caused by a sharp deterioration in the technical condition of the node under study, elements of the proportional-integral-differential (PID) algorithm were introduced into the mathematical model of trend building.

This method for predicting wear has been developed for spindle assemblies of vertical machining centers. The spindle assembly is the most important element of vertical machining centers. It is he who determines the main technological characteristics of the equipment. Spindles used in modern machine tools should be highly accurate, have high static stiffness, high speed and high reliability. The accuracy of the spindle rotation affects the quality of products. By quality is meant the accuracy of the form and the location of the surfaces relative to each other, roughness and waviness. The conditions of the current production dictate the necessity of operating the spindle assembly in an acceptable technical condition for the maximum possible period without breakdowns and failures. Premature failure of the machine entails unplanned downtime and the company suffers significant losses. This is especially critical in enterprises where it is impossible to transfer the manufactured part to other equipment due to site congestion or lack of equipment with similar technical characteristics. One of the tasks in the process of manufacturing parts is to prevent production from stopping, since even a minor downtime can disrupt the rhythm and cause a failure of the technological cycle. The loss of the technological parameters of the spindle assembly is a costly and

difficult problem to be solved. Spindle repair requires highly qualified specialists and an extensive material and technical base. The key objective associated with the operation of machine tools is to minimize the cases of possible failures.

Based on the proposed predictive algorithm, the Trend_SP software was developed. This program allows you to speed up the process of calculating the trend of spindle wear, eliminate the human factor in the processing of diagnostic data. The figure shows the interface of this program.

The Trend_SP software product has been developed for sharing with in-house diagnostic systems. The input data of this program are the discrete values of the diagnostic signal obtained in the process of monitoring the equipment. The accuracy of the forecast calculation and the forecast period are established when entering diagnostic data. This allows you to unify the program. Since for evaluating the technical condition of the spindle, in the case of indiscriminate diagnostics, it is preferable to use a vibrosigal, the threshold value in the program is set by default according to GOST 10816-3.

The result of the program is a schedule of wear and trend of a diagnostic state with a forecast for a set period. The graph also has a boundary value, the intersection of the trend with which indicates the need for repairs in the forecast period.

The use of the Trend_SP software product in conjunction with the non-collapsible diagnostic methods allows you to make the transition to servicing the spindle assemblies according to the actual technical condition. Optimize the cost of maintaining the technological characteristics of the equipment and maintain the quality of the products. The probability of an unplanned stop of equipment is also significantly reduced, and thus the rhythm and continuity of the technological cycle is preserved. The application of this approach throughout the enterprise reduces the cost of equipment maintenance and increases the efficiency of the repair service. With all the advantages of forecasting using Trend_SP, it does not require highly qualified staff.

Figure Trend_SP Interface

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一种创新型实验气候室的设计
DESIGN OF EXPERIMENTAL CLIMATE CHAMBER OF AN INNOVATIVE TYPE

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注解。 本文致力于利用创新型气候室结构（包括间接绝热冷却）预测生物原料的资源和节能储存方式。
关键词：气候室，绝热冷却，资源节能机制，蒸汽空气剂

Annotation. *The article is devoted to the projecting of resource and energy-saving storage regimes for biological raw materials using the climate chamber of an innovative type of construction including indirect adiabatic cooling.*

Keywords: *climatic chamber, adiabatic cooling, resource-and energy-saving regime, steam-air agent*

A stable supply of the population of the Russian Federation with safe and high-quality food products is the goal of developing the country's food and processing industry until 2020, which is set out in the Russian Government Order No. 559-r of April 17, 2012 "On the Development Strategy of the Russian Food and Processing Industry on period until 2020."

It is also necessary to take into account the fact that in recent years, research aimed at developing more energy-efficient methods of storing products has become very important.

Constructed climatic unit can be used for long-term storage of biological raw materials. The use of adiabatic cooling technology in air conditioning systems is due to the possibility of a radical solution to the issue of reducing energy consumption [1; 2].

Adiabatic humidification allows not only to increase the humidity of the air,

but also to lower its temperature, the advantage of the method is the absence of significant electricity costs. Indirect adiabatic cooling is an alternative to the use of complex and energy-intensive mechanical cooling systems.

The solution of the overwhelming majority of air conditioning tasks is possible on the basis of an integrated approach to the problem under consideration. In Western Europe, the United States, air conditioning began its development from technological systems (1906, V. Career). At the same time, an irrigation chamber for air treatment was proposed. In Russia, since its founding and until the beginning of the 50s of the XX century, the issues of air conditioning were practically not considered.

Today, the concept of "air conditioning" includes the processes of preparing air of the required quality, supplying it to the premises and automatically maintaining the complex of specified parameters of the air environment with the required degree of accuracy. In some cases, the sphere of air conditioning belongs to the section of ventilation technology (I.F. Livchak), some researchers allocate air conditioning to a separate branch of technology (E.E. Karpis).

Structurally, the experimental installation of the climate chamber consists of the following blocks:

- mixing chamber with a useful volume of 22.6 dm^3;

- cooling elements with radiators for heat removal from the heated surface of the Peltier elements and transfer of cold to the vapor-air environment of the inner space of the chamber;

- ultrasonic water aerosol generator, the average mass-median aerodynamic particle diameter of which is 4 microns [3];

- DC power supply with two adjustable outputs.

To humidify the working environment of the climate chamber, a finely divided water aerosol with an average mass median aerodynamic particle diameter of 4 microns, produced using an ultrasonic aerosol generator [3, 4], is used. The particle size of an acoustically generated aerosol is significantly smaller than the size of water particles, resulting from the mechanical spraying method (from 20 to 30 microns) [5].

The acoustic method of producing aerosols has several advantages over mechanical (dispersive), as modern ultrasonic spraying equipment allows to significantly intensify the process, improve the quality of the product. With a high aerosol concentration, a monodisperse and homogeneous spray jet with a given particle size is obtained.

A diagram of the experimental setup of the climate chamber is shown in Figure 1.
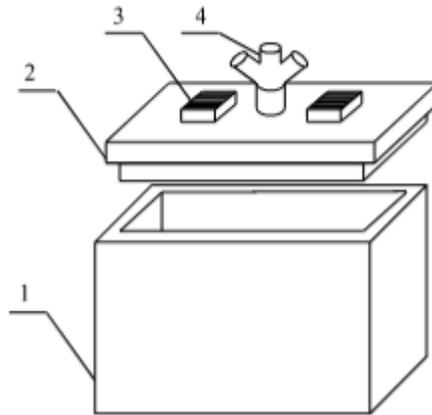
1 - case of the climatic chamber, 2 - cover of the climatic chamber,
3 - blocks of Peltier elements with cooling radiators, 4 - nozzle of aerosol supply
Figure 1 - *Diagram of the experimental setup of the climate chamber*

The body is mounted from eight-layer plates on a metal frame - a layer of aluminum foil, a layer of foamed high-pressure polyethylene laminated with mylar, a layer of silicone sealant, a layer of thermal insulation material "Corundum", a plate of extruded polystyrene foam, a layer of thermal insulation material "Corundum", a layer of silicone sealant and a layer of aluminum foil. The total thermal conductivity of the chamber wall is 0.002 W/(m·K).

The cover of the chamber is a nine-layer plate with a total thermal conductivity of 0.035 W/(m·K). The cover has holes for installing Peltier elements equipped with two radiators to intensify the removal of heat and cold flows. In the central part of the cover is mounted a pipe for supplying a fine acoustically generated aerosol.

The installation is completed with electronic thermometers with a remote sensor for simultaneous fixation of the temperature inside the chamber and the ambient temperature, as well as with a device for determining the relative humidity of the gaseous medium in the chamber.

A DC power source with two adjustable outputs is used to vary the voltage and current supplied to the Peltier elements to enable the camera to operate over a wide temperature range.

The purposes of the construction of an experimental climate chamber are:

- the study of the influence of the vapor-air environment parameters in the inner space of the chamber upon varying the density of the acoustically generated aerosol obtained from water saturated with silver ions on the persistence of biological raw materials;

- development of a mathematical model of the process of obtaining the vapor-air environment with the required parameters;

- development of a resource- and energy-efficient method for obtaining the vapor-air environment;

- development of design and technological parameters of an innovative type climate chamber;

- determination of the dependence of changes in energy and technical and economic parameters of processing and preservation of high-quality food products.

The work is based on the design methodology of resource and energy saving modes [6, 7]. In the process of studying the vapor-air environment of the designed climate chamber, the following methods are applied:

- determination of the temperature of the water used to generate the aerosol, according to GOST 29224-91;

- determination of temperature and humidity of the vapor-air medium in accordance with GOST R 53616-2009 (IEC 60068-3-6: 2001) and GOST R 53618-2009;

- microscopic analysis in relation to aerosol measurements [8];

- luxometry in relation to aerosol measurements [8];

- mathematical modeling of processes and optimization of parameters.

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<div align="center">

纤维填料涂层建模技术
MODELING OF A FIBER FILLER COATING TECHNOLOGY

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注解。 为了评估在导热纤维（更确切地说，束或线）与喷射的基质颗粒之间的界面处形成强粘附，有必要知道顶部化学反应的条件，特别是在该点建立的温度。 液体颗粒与固体亚层的接触。 对于特定系统，可以使用半空间之间的热交换模型来计算接触温度，该模型在某个接触区域上发生一段时间，但是难以估计该区域的大小。 所提出的模型允许我们在从中心到外围的接触区的横截面上建立温度分布，并因此解释涂层的粘附强度的实验结果。 它完全延伸到具有金属或金属－陶瓷基质的复合材料的纤维填料。

关键词：涂料，复合材料，纤维材料。

Annotation. *To assess the formation of strong adhesion at the interface between thermally conductive fibers (more precisely, a bundle or a wire) and sprayed matrix particles, it is necessary to know the conditions for the topochemical reaction, in particular, the temperature established at the point of contact of the liquid particle with the solid sublayer. For a particular system, it is possible to calculate the contact temperature using the heat exchange model between half-spaces, which takes place over a certain contact area for some time, but it is difficult to estimate the size of this zone. The proposed model allows us to establish the temperature distribution over the cross section of the contact zone from the center to the periphery and, accordingly, explain the experimental results of the adhesion strength of coatings. It fully extends to the fibrous fillers of composite materials with a metal or metal-ceramic matrix.*

Keywords: *coatings, composites, fibrous materials.*

Introduction

One of the most important tasks of the development of composite materials based on fibrous fillers is the simulation of the technology of applying coatings on such fillers [1, 2, 3, 5]. The coating on the fibrous filler is designed to provide either an adhesive bond with the matrix, or to perform heat-shielding functions to prevent the softening of the filler during heat treatment of the composite, or to protect the filler from active reactants when impregnated with liquid metals. The fiber-coating system can also be considered as a composite. The specificity of such a composite is that the adhesive bond of the filler with the matrix is almost impossible due to capillary effects. Such a bond is formed due to chemical interaction, either mechanically introducing the matrix particles into the filler substance, or as a result of the combined effect of these effects [6]. In most cases, a fiber bundle is considered as a fibrous filler, and the intrabundle porosity is usually not taken into account as an active pore space [7]. Methods of coating of different types on the wiring are varied. However, almost all of these methods are worked out experimentally to obtain an acceptable option, corresponding to the desired properties. One of the most promising technological methods for applying coatings of various types, in most cases metallic, is plasma spraying of a matrix substance.

Model of thermal processes between the heat-conducting fiber and the sprayed particles of the matrix

One of the main requirements for plasma technology for the manufacture of fibrous composite materials is to ensure a strong adhesion at the interface of the fiber - matrix. To assess the possibility of the formation of strong adhesion processes at the interface, it is necessary to know the conditions of the topochemical reaction, in particular the temperature established at the point of contact of the liquid particle with the solid sublayer. Currently, to calculate the temperature in the contact zone, a thermophysical model is usually used [8], which is based on the solution of the problem of contact between two half-spaces — liquid and solid; and as a basic assumption, it was assumed that the massive sublayer has a nonzero thermal conductivity only in the direction perpendicular to the plane of contact. This assumption, apparently, cannot be considered correct for the case when the sublayer is a filamentary body ($d_f \ll l$) with pronounced anisotropy of properties.

The following describes a model in which thermal processes between thermally conductive fibers (more precisely, a bundle or a wire) and sprayed particles of the matrix are considered under the following assumptions:

1. The sublayer (fiber) is an endless rod with constant initial temperature and has zero thermal conductivity only along the length of the rod l. In this direction, thermal conductivity is equal to thermal conductivity of the material of the rod.

2. The particle is melted and its initial temperature in the first approximation is taken to be equal to the melting point; it is assumed that at the initial time t_0 at the point of contact $x = l = 0$ the temperature $T_K = T_{K.MAX}$ is realized.

3. The contact of a particle with a rod is ideal, and their free surfaces are in-

sulated.

Conditions 1 - 3 determine the model of the thermal process of the impact of a pulsed heat source in the form of a liquid matrix particle on an infinite rod.

Calculation method

The equation of heat conduction in a homogeneous environment has the form:

$$\partial T / \partial t = a(\partial^2 T / \partial x^2), \tag{1}$$

where a - coefficient of thermal diffusivity, $a = \lambda / \rho$; λ - coefficient of thermal conductivity; c - heat capacity of the substance; ρ - density of matter. In the case of heat propagation in a homogeneous rod, instead of equation (1) we will have:

$$\partial T / \partial t = a(\partial^2 T / \partial l^2), \quad (0 \le 1) \tag{2}$$

The solution of equation (2) is obtained using the operator method. Assume that the temperature in the contact zone can be approximated by dependence $T_K = T_{K.MAX}(-\varphi_t t)$, from where the coefficient φ can be obtained by estimating the value of $T_K = T(t)$ as $\varphi = (1 / t_K) \ln(T_{K.MAX} / T_K)$.

The initial conditions for solving equation (2) are:

$$T_K = \begin{vmatrix} 0 \\ t = 0, \ l > 0 \end{vmatrix}; \tag{3}$$

$$T_K = \begin{vmatrix} T_{K.MAX}(-\phi_T t) \\ l = 0, \ t > 0 \end{vmatrix} \tag{4}$$

Solving the auxiliary equation $a(\partial^2 \overline{T} / \partial l^2) - P\overline{T} = 0$ at $l = 0$, where $\overline{T} = T_{K.MAX}(P + \varphi)$, we get :

$$\overline{T} = T_{K.MAX} / (P + \phi) P_{exp}[-l(P / a)^{1/2}].$$

Using the appeal to the original by Carson - Heaviside, we have:

$$T(l,t) = T_{K.MAX} \left\{ 1 - \Phi[l / (2at)^{1/2}] \right\} \exp(-\phi_T t). \tag{5}$$

where Φ is the integral of the Gauss function.

When a drop of molten metal falls on the fiber, it begins to deform intensively and spread over its surface, trying to acquire the shape of a thin cylinder. At the same time, the area that a drop will take, as well as the time of its "flattening" are determined by the parameters characterizing the process of spreading the vein of a drop on a solid substrate, as well as the high kinetic energy of the drop, under the action of which the particle is

intensively deformed, being not only in liquid, but also partially in a solid plastic state.

The amount of heat Q_n absorbed by the rod (fiber) during the time t when a liquid drop falls on it and spreads out of the liquid is:

$$Q_{n\pi} = cd_{kf} S\rho(T - T), \qquad (6)$$

where c is the specific heat of the fiber; ρ - fiber density; d_f - fiber diameter; S - the area of the lateral surface of the fiber on which the drop is "flattened out".

When $S = \pi d_f l = \pi r^2$ there is equality:

$$l(t) = r^2(t)/d_f.$$

At the same time, the amount of heat transferred from the liquid drop during its spreading and crystallization is:

$$Q_{K\pi} = _\kappa q \ m. \qquad (7)$$

Equating the right sides of expressions (6) and (7), we obtain:

$$T_{K\pi.MAX} \overline{_{n\pi}} T_\kappa - q_f \ m \ / cd \ \rho\pi, \qquad (8)$$

where m_κ, $T_{n\pi}$, $q_{n\pi}$ and $r(t)$ are the mass, melting point, specific heat of melting, and spreading radius of a drop respectively at an equivalent area of its spreading over a flat substrate.

Thus, in order to find the quasi-constant φ, it is necessary to know two quantities, namely $r(t)$, the time of spreading or flattening of the drop t_κ.

The area of the side surface on which the drop crystallized was determined experimentally. When calculating $r(t)$, the spreading of a liquid drop over a solid sublayer was considered taking into account the kinetic energy of a flying drop, for which a correction factor φ_v was introduced into the equation of the spreading radius versus time. It was evaluated experimentally by comparing the spreading area of a motionless droplet and a droplet falling on a sublayer with a certain speed. In the latter case, the equation for determining the spreading radius is:

$$r = \left\{ (3,53R_K^3 / \mu(S_p + S_{\sigma_{cp}}))^{1/6} t^{1/6} - (0,735m_\kappa R_K^3 / \mu)^{1/4} t^{1/4} \right\} \varphi_v, \qquad (9)$$

where R_K is the radius of the drop; μ - particle viscosity at $T_{n\pi}$; t - spreading time; m_κ - drop mass; φ_v - coefficient taking into account the influence of the kinetic energy of the particle on its spreading radius.

The dynamic viscosity was estimated by the formula $\mu = N\mu_0 t^{1/2}$, where N is the coefficient taking into account the chemical interaction of the particle with the sublayer.

Conclusion

Experimental assessment of the proposed model of the thermal interaction of a liquid particle with a fibrous sublayer are carried out for metallic systems. Experiments on carbon fibers require the use of special techniques that exclude the effect of carbide formation and mechanical damage to the fiber by a stream of high-speed particles.

For a particular system, it is possible to calculate the contact temperature using the heat exchange model between half-spaces, which is realized for some time in a certain contact area (real chemical interaction spot) between the particle and the sublayer. However, it is difficult to estimate the size of this zone, and the probability of the constancy of the contact temperature over its entire area is low.

The model considered above makes it possible to obtain a temperature distribution over the cross section of the contact zone from the center to the periphery, which makes it possible to estimate the course of the various stages of the interaction process at the interface.

For the experimental verification of the proposed model, the effect of thermal activation of the surface of the hardener on the strength of its adhesion with the matrix material in the process of plasma deposition of titanium and nickel on tungsten was studied.

Based on the analysis of the adhesion strength of the metal-metal system coatings, it has been established that the thermophysical processes occurring at the point of contact of the sprayed particles of the matrix and the fiber reinforcer are satisfactorily described by solving the heat conduction problem of an infinite rod affected by a pulsed heat source.

The proposed model allows us to establish the temperature distribution over the cross section of the contact zone from the center to the periphery and, accordingly, explain the experimental results of the adhesion strength of coatings. It fully extends to the fibrous fillers of composite materials with a metal or metal-ceramic matrix. In the case considered above, the modeling of the technology is primarily due to the determination of the main technological parameters that provide the greatest strength of adhesion of the coating to the sublayer, and not the order of the technological process.

This model has found its practical application in the works devoted to the creation of a prototype of a heavy-loaded sliding bearing drive of the fan-drive engine of an aircraft engine, where practical and analytical results showed good convergence of the coating parameters achieved and other works [9, 10, 11, 12].

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不同纯度铝的热物理性质
THERMOPHYSICAL PROPERTIES
OF ALUMINUM OF DIFFERENT PURITY

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注解。 冷却方法用于研究不同纯度的铝的温度在300至873K的温度范围内对时间的依赖性。 结果表明,冷却样品的过程与热辐射和对流热交换有关。 结果表明,随着温度的升高,金属冷却中的热辐射比例增加。

关键词: 铝, 冷却, 热辐射, 对流传热, 温度依赖性。

Annotation. *The cooling method was used to investigate the dependence of the temperature of aluminum of different purity in the temperature range from 300 to 873 K on time. It is revealed that the process of cooling the samples is associated with thermal radiation and convective heat exchange. It is shown that with an increase in temperature, the proportion of thermal radiation in metal cooling increases.*

Keywords: *aluminum, cooling, thermal radiation, convective heat transfer, temperature dependence.*

Studies of the thermophysical properties of aluminum are necessary to create many new composite materials based on it with the best and fundamentally new physical and technological properties.

The purpose of this work is to study the thermophysical properties of aluminum of various degrees of purity and grade in a wide range of temperatures and to establish the regularities of changes in their thermophysical parameters on the degree of purity and temperature.

All samples and standards were obtained from the physical laboratory of the State Unitary Enterprise «Tajik Aluminum Company» (GUP Talko). The chemical composition of the samples was determined using a Spectrolab spectrometer. In table 1 shows the elemental composition of the samples.

Table 1. Elemental composition of samples

№ sample	Si	Fe	Cu	Mn	Mg	Zn	Ga	Ti	Al
213	0,15	0,22	0,002	0,006	0,0074	0,01	0,016	0,009	99,61
218	0,17	0,24	0,002	0,007	0,0076	0,01	0,014	0,008	99,57
127	0,18	0,18	0,002	0,008	0,0068	0,01	0,012	0,006	99,62
26	0,21	0,26	0,002	0,009	0,0077	0,01	0,013	0,007	99,51
216	0,14	0,14	0,002	0,006	0,0068	0,01	0,012	0,006	99,70
128	0,15	0,14	0,002	0,006	0,0069	0,01	0,012	0,006	99,69
121	0,14	0,13	0,002	0,007	0,0066	0,01	0,012	0,006	99,71
21	0,27	0,32	0,003	0,008	0,0078	0,01	0,014	0,007	99,39
22	0,22	0,47	0,003	0,009	0,0076	0,02	0,013	0,008	99,28
27	0,20	0,56	0,003	0,009	0,0074	0,02	0,012	0,009	99,21
29	0,19	0,54	0,004	0,009	0,0075	0,02	0,012	0,009	99,24
118	0,21	0,68	0,004	0,01	0,0074	0,02	0,013	0,009	99,07
400	0,276	0,414	0,0035	0,0065	0,006	0,0123	0,0099	0,0113	99,27
800	0,109	0,129	0,0022	0,0045	0,0058	0,012	0,0095	0,0095	99,73
79	0,155	0,176	0,0032	0,0049	0,006	0,0126	0,0098	0,0098	99,63
30300	0,328	1,905	0,0057	0,013	0,0063	0,013	0,0096	0,0105	97,72
0,33	0,096	0,079	0,003	0,0042	0,0067	0,0132	0,0098	0,0094	99,79
407	0,109	0,16	0,003	0,0041	0,0077	0,0137	0,0096	0,0096	99,69
65	0,175	0,254	0,003	0,0056	0,0076	0,0137	0,0098	0,0099	99,53

To calculate the heat capacity of aluminum of various purities according to the Neumann-Kopp rule, data on the temperature dependence of its components is necessary. Therefore, using the Sigma Plot 10 program, by processing the available literature data on the heat capacity of aluminum, iron, silicon, zinc, copper, magnesium, manganese and titanium at different temperatures, we have obtained the equation for the temperature dependence of specific and molar heat capacities, enthalpy , entropy and Gibbs energy. For ease of use of the results obtained in engineering calculations, the dependences of thermophysical properties on the variable $x = ((T-300))\ 100$ were used. Then a graph of $C\ (T)$ versus x is plotted. After statistical processing of the schedule we get the following formula

$$C(T) = a_1' + b_1'\,x + c_1'x^2 + d_1'x^3, \tag{1}$$

where $a_1' = C(300)\ b_1' = b_0' \cdot 10^2$, $c_1' = c_0' \cdot 10^4$, $d_1' = d_0' \cdot 10^6$.

The coefficients of equation (1) are given in table. 2. The last column shows the value of the regression coefficient when processed using the Sigma Plot 10 program.

Table 2. *The values of the coefficients in equation (1)*

Metal	a_1'	b_1'	c_1'	d_1'	R
Si	727,73	71,55	-11,00	0,724	1,0000
Fe	448,41	54,10	-7,000	1,300	1,0000
Cu	388,47	17,94	-2,000	0,220	1,0000
Mn	474,33	39,21	-3,000	0,121	1,0000
Mg	1028,69	50,10	-0,370	0,070	1,0000
Zn	393,96	15,52	-0,160	0,760	1,0000
Ti	531,29	21,68	2,000	-0,419	1,0000

In the following, the graphs and equations for heat capacity we used to calculate the heat capacity according to the Neumann – Kopp rule.

The dependence of the sample temperature on time is investigated in the temperature range from 300 to 873 K by the cooling method. The experimentally obtained temporal dependences of the temperature of the samples with a fairly good accuracy (R not less than 0.9998) are described by an equation of the form

$$T = T_0 + \Delta T_{01} e^{-\frac{\tau}{\tau_1}} + \Delta T_{02} e^{-\frac{\tau}{\tau_2}} \qquad (2)$$

where T_0 - ambient temperature , ΔT_{01} , ΔT_{02} – the contributions of the first and second process in cooling at $\tau = 0$, τ_1 и τ_2 - characteristic cooling times for samples. The exponential dependence $T(\tau)$ in formula (2) shows that heat is transferred simultaneously in two ways and the amount of heat transferred is proportional to the surface area of the sample, the temperature difference between the body and the environment and the corresponding heat transfer coefficient for any heat transfer mechanism (convection or radiation).

The transfer of heat from a heated body to a less heated body is a relaxation process. In our case, the heated body transfers its heat to the body with an infinitely large heat capacity to the environment. Therefore, the ambient temperature can be considered constant T0.

Then Newton-Richman's law $CmdT = -\alpha S(T - T_0)d\tau$ we write in the form

$$\frac{d(T - T_0)}{T - T_0} = -\frac{\alpha S}{Cm} d\tau.$$

Considering $\frac{Cm}{\alpha S} = \tau_1 = const$, get the law of change in body temperature from time τ of the form

$$T = T_0 + \Delta T_{01} e^{-\tau/\tau_1} \text{ or } \Delta T = \Delta T_{01} e^{-\tau/\tau_1}, \qquad (3)$$

where ΔT - temperature difference between the heated sample and the environment, ΔT_{01} - the difference between these temperatures at the time of the start of measurements (at $\tau = 0$), τ_1 is a constant, numerically equal to the time during which the temperature difference decreases by a factor of e. The constant $\tau 1$ is proportional to the product of the mass m and the heat capacity C of the body and is inversely proportional to the heat transfer coefficient α and the total surface area of the body S. If we assume that cooling occurs due to convective heat exchange and thermal radiation, we obtain equation (2). Differentiating (2), for the cooling rate we get

$$\frac{dT}{d\tau} = -\left(\frac{\Delta T_{01}}{\tau_1} e^{-\tau/\tau_1} + \frac{\Delta T_{02}}{\tau_2} e^{-\tau/\tau_2}\right) \tag{4}$$

where $\Delta T_{01}/\tau_1$ and $\Delta T_{02}/\tau_2$ - contributions of convective heat transfer and thermal radiation in the cooling rate at $\tau = 0$.

Further, knowing the composition of the samples, according to the Neumann-Kopp rule, the values of heat capacity were calculated. Using these values and the experimental values of the cooling rate, the heat transfer coefficients $\alpha (T)$ were calculated using the formula

$$|\alpha(T)| = \frac{C_m\left(\frac{dT}{d\tau}\right)}{S(T - T_0)}, \tag{5}$$

where m and S are the mass and surface area of the sample, T is its temperature.

To calculate the specific heat capacity of aluminum of various degrees of purity, we used data on the heat transfer coefficient for aluminum A7. Further according to the formula

$$C = \frac{|\alpha(T)| S(T-T_0)}{m\left(\frac{dT}{d\tau}\right)} \tag{6}$$

calculated the value of specific heat. After compared with the rule of Neumann-Kopp.

Table 3 shows the values ΔT_{01}, τ_1, ΔT_{02}, τ_2, $\Delta T_{01} / \tau_1$, $\Delta T_{02}/ \tau_2$ equations (2) and (4) for the investigated samples of aluminum.

Table 3. Experimental values ΔT_{01}, $\tau 1$, ΔT_{02}, τ_2, $\Delta T_{01} / \tau 1$, $\Delta T_{02} / \tau_2$

| sample	D	$\tau_{1,}$ c	D	$\tau_{2,}$ c	D	$\Delta T_{02}/\tau_2$, K/c	T_0, K
213	383,13	625	222,31	227,27	0,613	0,978	298,9
218	381,37	625	228,03	222,22	0,610	1,026	299,2
127	383,11	588,24	227,58	212,77	0,651	1,069	299,4
26	353,83	666,67	256,48	238,09	0,531	1,077	298,1
216	375,22	625	235,73	227,27	0,600	1,037	298,4
128	388,78	588,24	223,02	204,08	0,661	1,093	299,2
121	384,12	625	225,42	227,27	0,615	0,992	299,1
21	388,64	588,24	220,09	208,33	0,661	1,060	299,7
22	378,63	588,24	234,45	208,33	0,644	1,125	298,5
27	391,66	588,24	215,33	200,00	0,666	1,077	300,1
29	386,28	588,24	226,41	208,33	0,657	1,087	299,3
118	375,98	625	231,05	238,09	0,602	0,970	298,5
400	388,47	588,24	225,43	204,08	0,660	1,105	288,7
0,33	345,50	666,67	262,20	270,27	0,518	0,970	294,1
79	407,38	588,24	201,64	208,33	0,692	0,968	296,8
407	420,31	588,24	195,24	212,77	0,714	0,918	288,8
800	374,32	625,00	230,72	238,10	0,599	0,969	293,4
30300	353,40	666,67	244,04	238,10	0,530	1,025	292,5
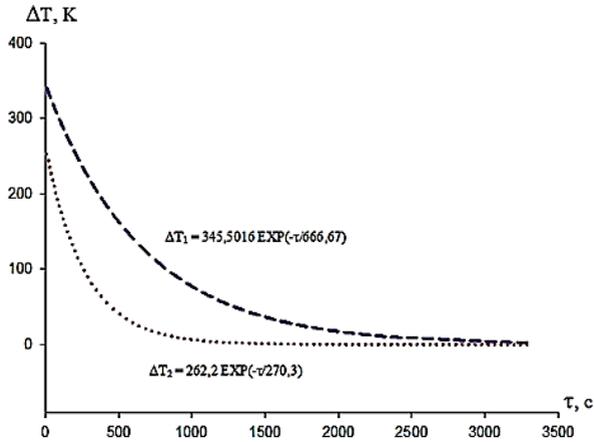
Fig.1. *The dependence of the aluminum temperature of the sample is 0.33 on time during cooling for the first and second processes*
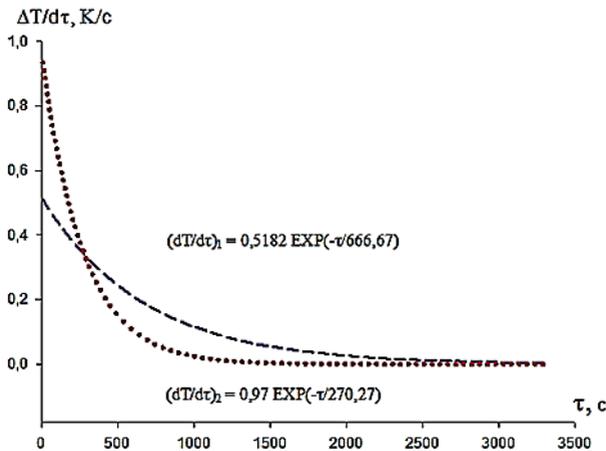

Fig.2. *The dependence of the cooling rate of aluminum samples 0.33 from the time for the first and second processes*

In fig. 1 and 2 shows the time dependencies $\Delta T_1 \left(\Delta T_1 = \Delta T_{01} exp^{-\left(\tau / \tau_1 \right)} \right)$, $\Delta T_2 \left(\Delta T_2 = \Delta T_{02} exp^{-\left(\tau / \tau_2 \right)} \right)$ and sample cooling rates of 0.33 for convective heat transfer and thermal radiation.

As can be seen from the table. 2 and fig. 1 and 2, the relaxation times of these processes are different. Cooling due to convective heat transfer is slow, and with heat radiation - very quickly.

It should be noted that using the experimental values of the cooling rate from the Newton-Richman law, only the ratio of the heat transfer coefficient to the heat capacity of the sample can be determined:

$$\alpha(T)/C(T) = \frac{m(dT/d\tau)}{S(T-T_0)}. \tag{7}$$

In fig. 3 shows the temperature dependences of these relations for aluminum of different grades. As can be seen from the figure, with an increase in the aluminum content content in the sample, the ratio of the heat transfer coefficient to heat capacity decreases. This indicates that with an increase in the aluminum content in the sample, the heat capacity increases faster than the heat transfer coefficient. Figure 4 shows the dependence of α/C on temperature for samples.

aluminum of different purity.

In the future, we have conducted studies of the thermophysical properties of aluminum grades A8, A7, A6, A5 and A0. In tab. 4 shows the values of the constant equations (2) and (4) for aluminum of different grades.
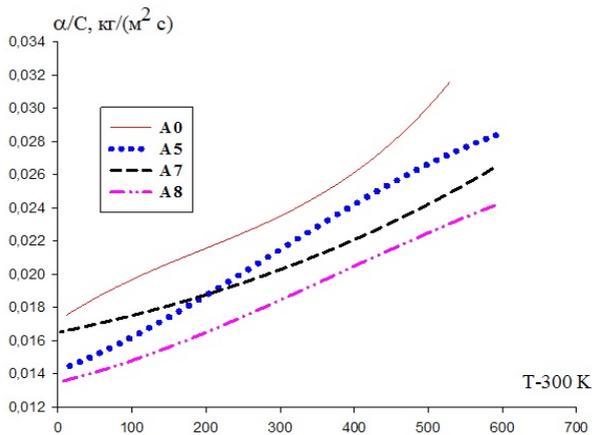

Fig. 3. The dependence of α/C on temperature for different grades of aluminum
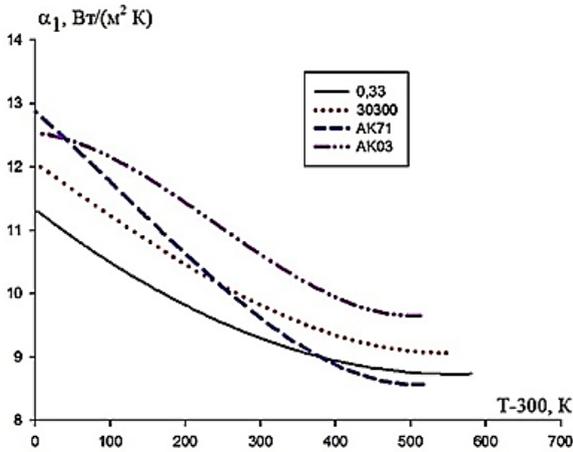
Fig. 4. *Dependence α1 from temperature for aluminum samples*

Table 4. *The coefficients in equations (2) and (4) for aluminum of different grades*

Alloy	$\dfrac{T_1 - T_0,}{K}$	τ_1, c	$\dfrac{T_2 - T_0,}{K}$	τ_2, c	$\dfrac{(T_1 - T_0)}{\tau_1, \text{K/c}}$	$\dfrac{(T_2 - T_0)/}{\tau_2, \text{K/c}}$	T_0, K
A0	468,9	416,7	66,0	90,1	1,12	0,73	311,3
A5	412,7	454.5	199,5	122	0,91	1,64	296,1
A7	523,3	417	90,7	110	1,25	0,82	292,6
A8	455,0	526,3	162,8	154	0,86	1,06	295,0

A number of theoretical and experimental studies have shown that the amount of impurities present in them can have a significant effect on the heat capacity of solids. The effect of impurities is manifested in a change in the electron and phonon spectra of the metal. The greatest influence is exerted by impurities that differ significantly in mass and interaction potential from the atoms of the main substance.

Using experimentally found cooling rates $(dT/d\tau)$ and temperature dependence of heat transfer coefficient $\alpha(T)$ for aluminum grade A7 and, assuming that it does not depend on the concentration of impurities, we determined the heat capacity of the systems studied by formula (6).

In tab. 5 shows the values of the coefficients for the studied systems in the equation

$$(T - 300) = a_0 + b_0 x + c_0 x^2 + d_0 x^3,$$ where $x = (T - 300)/100$.

Table 5. The values of the coefficients of the equation (6)

Metal, alloy	a_0, Jy /(kg K)	b_0, Jy/(кгK^2)	$-c_0$, Jy/(кгK^3)	d_0, Jy/(кгK^4)
213	901.9869	47.40	4	0.86461
218	901.8624	47.41	4	0.86468
127	902.1033	47.40	4	0.86441
26	901.7066	47.42	4	0.86472
216	902.3458	47.39	4	0.86429
128	902.3293	47.39	4	0.86427
121	902.3939	47.39	4	0.86424
21	901.3288	47.44	4	0.86490
22	900.6919	47.43	4	0.86562
27	900.3213	47.43	4	0.86604
29	900.4346	47.43	4	0.86597
118	899.6767	47.44	4	0.86647
400	900.7347	47.44	4	0.86515
0,33	902.5725	47.37	4	0.86394
79	902.0283	47.39	4	0.86429
407	902.1837	47.38	4	0.86427
800	902.3334	47.38	4	0.86416
30300	893.8240	47.55	4	0.87160

Due to the lack of elaboration of the theory describing possible changes in the thermodynamic functions of substances depending on its composition, quantitative estimates and qualitative explanations of the data obtained are still premature.

We have estimated the contributions of thermal radiation and convective heat transfer to the heat transfer coefficient of aluminum of various purities with natural cooling. According to the values of the cooling rate and heat capacity of aluminum, different grades were calculated coefficients of convective heat transfer $\alpha_1(T) = \frac{Cm(dT/d\tau)_1}{S(T-T_0)}$ and radiation $\alpha_2(T) = \frac{Cm(dT/d\tau)_2}{S(T-T_0)}$. In fig. 4 as an example, the temperature dependence of the heat transfer coefficient α_1 is given for some samples of technical aluminum.

The dependence of the heat transfer coefficient in convective exchange α_1 and the emission coefficient α_2 of the temperature is described by the equation

$$\alpha = a + b(T - 300) + c(T - 300)^2 + d(T - 300)^3. \tag{8}$$

In tab. 9 shows the values of *a, b, c* and *d* of equation (8) for α_1 and α_2.

Table 9. Values of a, b, c and d for the studied samples

Sample		a	b	$c \cdot 10^{-5}$	$d \cdot 10^{-8}$
Al-30300	α_1	12,0685	-0,0086	-0,1215	0,8191
	α_2	0,0000	0,0210	4,9393	6,1534
AK-71	α_1	12,8710	-0,0104	-0,9075	2,5311
	α_2	0,0000	0,0374	7,1833	-1,3429
AK-03	α_1	12,5382	-0,0013	-2,9086	4,0279
	α_2	0,0000	0,0284	8,3123	-1,1549
Al-0.33	α_1	9,4191	-0,0050	1,1327	-0,8498
	α_2	8,2305	0,0268	-0,7205	-0,2749

In fig. 5 shows the contribution of thermal radiation for the studied samples. As can be seen from the figures, natural air cooling has a low convective heat transfer coefficient - up to 9 - 13 W / (m² · K) and decreases with temperature and with increasing chi-density of aluminum. According to the formula $= \frac{\alpha_2}{\alpha} \, 100\%$, where $\alpha = \alpha_1 + \alpha_2$, estimated the proportion of thermal radiation in the total heat transfer.
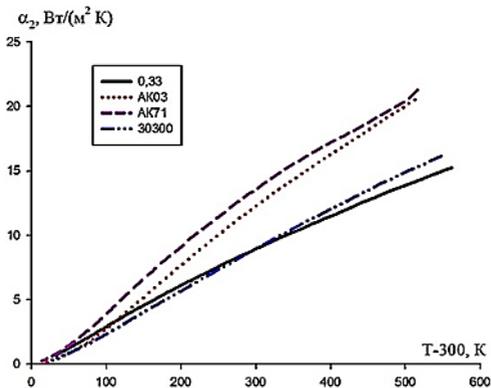

Fig.5. The dependence of the coefficient of thermal radiation on temperature for aluminum of various degrees of purity
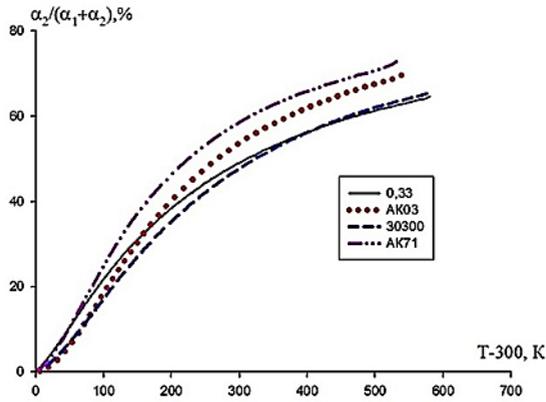
Fig.6. *Temperature dependence of the share of thermal radiation in the cooling of aluminum of different purities.*

In fig. 6 shows the temperature dependence of the share of thermal radiation in cooling for aluminum of different degrees of purity. As can be seen, with an increase in temperature during natural cooling, the proportion of thermal radiation increases.

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