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SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

International Conference

Beijing, China 2019

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 1: Participants’ reports in English

2019年2月11-12日，中国北京
February 11-12, 2019. Beijing, PRC

ISBN 978-5-905695-93-3

Materials of the International Conference
“Scientific research of the SCO countries: synergy and integration”. Part 1 - Reports in English

(February 11-12, 2019. Beijing, PRC)

ISBN 978-5-905695-93-3

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.

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ISBN 978-5-905695-93-3

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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”

改进计算业务计划投资回收期的方法
IMPROVING THE METHODOLOGY FOR CALCULATING THE PAYBACK PERIOD OF BUSINESS PLANS

Buinevich Anna Sergeevna
Master
Petrucheny Irina Vladimirovna
Candidate of Economic Sciences
Associate ProfessorTrade and Economic Institute of the Siberian Federal University

关键词：业务计划，业务计划方法，业务计划投资回收期，投资回收期计算，业务计划投资回收期计算方法，影响投资回收期的因素，制定业务计划时的费用。

Keywords: *Business plan, business planning methodology, business plan payback period, payback period calculation, business plan payback period calculation method, factors affecting the payback period, expenses when developing a business plan.*

In modern business conditions, determining the payback period is one of the fastest and easiest ways to determine the investment attractiveness of projects. In order to make a final investment decision, it is necessary first of all to have information on the nature of full cost recovery, as well as on the correspondence of the level of additional income received to the degree of risk of uncertainty in achieving the final result. As a universal indicator, the payback period is used when choosing the best options for the activities of enterprises regarding design and technical solutions, sales of goods, production technology, etc.

However, in the economic literature, in addition to the advantages of this indicator, there are a number of shortcomings, including the lack of consideration of the time value of money, low accuracy in the calculations due to the use of aggregated indicators (total costs, frequency of the breakdown of the project lifetime into calculation intervals, total inflow cash), etc. In this regard, often the study of this indicator is reduced only to its calculation and evaluation of the obtained value.

To improve the quality assessment of the business plan of enterprises, increase the accuracy of determining the time interval for the return of invested funds, as well as the prospects for profit, in our opinion, it is advisable to single out the following sequence for determining and estimating the indicator - the payback period of the business plan (Figure 1).

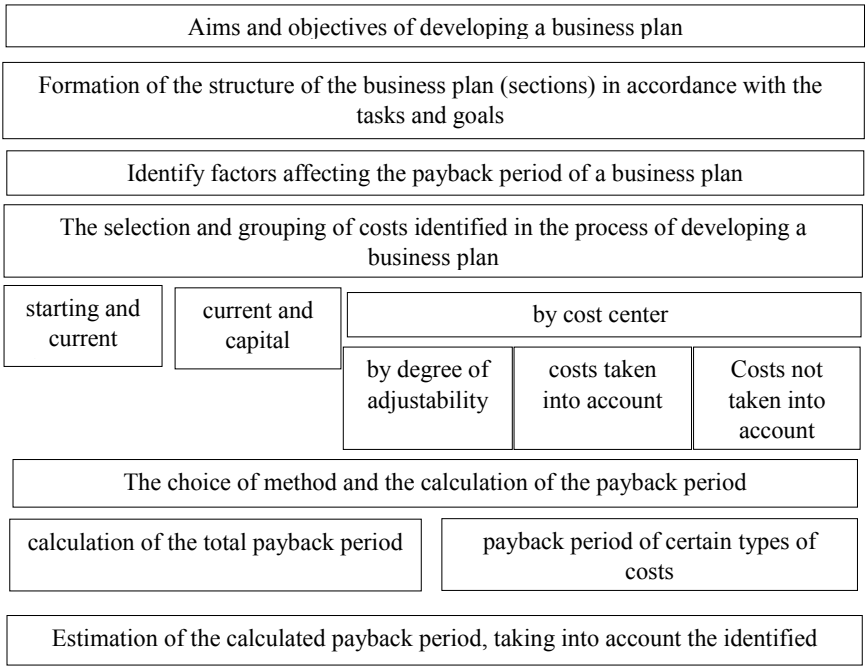

Figure 1. *The method of estimating the payback period of business plans*

In accordance with the method presented above, when developing a business plan, the estimated costs must be grouped by type in order to detail the calculations of the payback period and a more qualitative assessment of the effectiveness of the business plan. The grouping of costs should be carried out primarily on the basis of a study of factors affecting the payback period, both external and internal. The internal factors include costs that are entirely and entirely dependent on the owner of the business plan and type of business. External factors include factors that cannot be affected.

Table 1 *Factors affecting the payback period*

Factor	Characteristic
EXTERNAL	
market factors	diversification of the enterprise's activities, increase of competitiveness, organization of effective advertising, level of development of the country's foreign economic relations, changes in tariffs and prices for supplied products and services as a result of inflation
economic and administrative factors	taxation, legal acts, regulations and regulations governing the organization's activities, state regulation of tariffs and prices
INTERNAL	
Costs depending on the business owner	organizational, managerial, economic factors, social factors
Costs depending on the type of business	Sectoral, logistical, specific.

Grouping costs, taking into account the factors affecting the payback period of investment projects (business plans), will make it possible to isolate adjustable and adjustable costs in order to minimize the return period on invested funds.

The main features of the classification of costs can be such as - by frequency of occurrence (starting and current), depending on the time of occurrence - current and one-time (capital), by cost center (i.e., costs are grouped by production, workshops, sites and other structural units of the enterprise), according to the degree of controllability (regulated and unregulated), the costs are taken and not taken into account (common and non-valid - insignificant). Grouping costs according to these characteristics will allow you to determine not only the cumulative time interval for returning investments in a business plan, but also the period for returning specific types of investments, as well as which costs are most beneficial in terms of payback.

Table 2 *Methods for calculating the payback period*

The sign of the classification of the payback period	Types of payback period of investments and business plans	Typical cost structure	The method of calculating the payback period	Characteristic method
1. Depending on the frequency of expenses	1.1 The payback period of the initial investment business plan	Site creation; Advertising expenses; Labor costs; Equipment acquisition costs	Plain	A simple method of calculation allows you to calculate the period that will pass from the moment of investment until the moment of their recoupment. It should be noted that it will be informative enough only if the following conditions are met: in the case of comparing several alternative projects, they must have an equal life span; investments are made at the same time at the beginning of the project; income from invested funds comes in approximately equal parts.
	1.2 the payback period of dynamic investments.	Advertising expenses; Labor costs; Handling costs; Investments.	Dynamic (discounted)	The dynamic or discounted payback period of a project is the duration of the period that runs from the beginning of the investment to the time of its payback, taking into account discounting. Under it understand the onset of such a moment when the net present value becomes non-negative and in the future it remains.
2. Depending on the time of expenses	2.1. Payback period of current investments	Sections of the business plan, depending on the objectives and type of the selected plan	Discounted	Within this indicator, it is advisable to calculate the payback period of the initial (starting) investment or PP - This indicator tells the investor about the return period of the initial investment. Moreover, if this factor is included in the calculation of the payback indicator, then it will be called the payback period of the initial investment, calculated taking into account cash flow discounting
	2.2. Payback period of capital investments	Sections of the business plan, depending on the objectives and type of the selected plan	Dynamic (discounted)	The dynamic or discounted payback period of a project is the duration of the period that runs from the beginning of the investment to the time

Table 2 (a continuation) *Methods for calculating the payback period*

The sign of the classification of the payback period	Types of payback period of investments and business plans	Typical cost structure	The method of calculating the payback period	Characteristic method
3. Depending on the composition and structure of the business plan.	3.1. The payback period of the business plan as a whole	The whole set of sections of the business plan	Plain	The payback period is one of the main parameters that should be guided in the process of creating an enterprise; this indicator is the period of time necessary to cover the costs associated with financial injections, income derived from investment activities
	3.2.Срок окупаемости отдельных разделов бизнес-плана:	Разделы бизнес-плана в зависимости от целей и вида выбранного плана	Dynamic (discounted)	It is calculated at each planning stage and reflects the payback of individual sections of the business plan
4. Depending on the scale of calculations	4.1 total payback period	The whole set of sections of the business plan	Plain	A simple method of calculation allows you to calculate the period that will pass from the moment of investment until the moment of their recoupment.
	4.2 payback period of certain types of costs	Sections of the business plan, depending on the objectives and type of the selected plan	Dynamic (discounted)	The dynamic or discounted payback period of a project is the duration of the period that runs from the beginning of the investment to the time of its payback, taking into account discounting.
5. At the cost center	5.1 Payback period of movable and immovable property	The whole set of sections of the business plan	Plain	A simple method of calculation allows you to calculate the period that will pass from the moment of investment until the moment of their recoupment.

As a rule, in the economic literature there are two standard options for calculating the payback periods for business plans (projects) - simple and dynamic (discounted).

The main criterion for choosing one or another method, as a rule, is to take into account changes in the value of spent investments. But when applying these methods in calculations, the cumulative amount of cash investments is used without taking into account the time when expenses of their frequency, place of origin, etc. arise. In accordance with the methodology proposed above, it is advisable to calculate the payback period in accordance with Table 3.

Table 3

Calculation of the payback period depending on the time of occurrence

Costs depending on the time of occurrence	**Payback period depending on the type of expenses**	**Characteristic**	**Sections of BP in which expenses are reflected**	**Cost content**	**The method of calculating the payback period**	**Characteristic method**
1. Current expenses	1.1. Payback period of current expenses	Current costs can be defined as the costs incurred for profit or to maintain the profitability of the enterprise and consisting of the expenses for everyday needs. The benefit from these costs is used in the current reporting period, which affects the payback period.	Marketing plan	Site creation	Т= (Затраты) / (Количество сделок в день х Прибыль)	The smaller the settlement, so, as a rule, less for the site and profitability and longer payback.
				Advertising expenses	Т=(Зр+Нр)/В*	The calculated payback period allows you to determine the period of return on investment in the promotional activities of the company.
			Organizational plan	Labor costs	Т=З ед./Эф*	The greater the experience of the employee, and the higher his qualifications the faster the payback
			Financial plan	Invest-ments	Т = № г. + Сн /ДДП*	The result allows a potential investor to get an idea of the time when he will be able to return the amount invested, what capital gains he expects..

Table 3 (a continuation)

Calculation of the payback period depending on the time of occurrence

Costs depending on the time of occurrence	Payback period depending on the type of expenses	Characteristic	Sections of BP in which expenses are reflected	Cost content	The method of calculating the payback period	Characteristic method
2. Capital expenditures	2.1 Capital costs payback period	Capital costs can be defined as any expenses incurred in creating, acquiring, expanding or improving an asset intended for use in an enterprise. The benefit from such capital expenditures will be received over a number of accounting periods, which affects the payback period..	Trading (production) plan	Expenses for the purchase of equipment and inventory	T = K / ВД,*	It characterizes the time for which the money spent on the purchase of the next means of production, will return in full through the use of purchased equipment and inventory
				Construction and installation work	T = P / ВД,*	It characterizes the time for which the money spent on construction and installation work, will return in full through the use of the built goods.
			Financial plan	Capital investment	T = IC / FV*	Allows to calculate the payback period of the project.
				Return on equity	T=Кс.ср/ЧП*	The payback period of equity capital is important for owners and shareholders of an enterprise, since through the assessment of its magnitude and dynamics, we can conclude about the effectiveness of managing our own capital [1]

As a rule, the indicator "payback period" is one of the main estimated indicators in the practice of investment analysis. Sometimes, in practice, the application of the “payback period” criterion is crucial for the purposes of making investment decisions. In particular, if financial investments are associated with high risk, and then the shorter the payback period is, the more preferable such a project is. Often, enterprises may have a certain limit on payback periods, which is primarily due to the liquidity problem, since the main goal of an enterprise is the fastest payback period on an investment. The criteria of the RR (payback period) and DPP (discounted payback period) make it possible to judge the liquidity and riskiness of the project: the shorter the payback period, the less risky the project; more liquid that project, which has less payback period.

To assess the value of the payback period depending on the time frame, it is advisable to apply the following criteria (table 4).

Table 4

Characteristics of the time frame of the payback period of various types of investments at various stages of project development.

Types of investments	Payback period	Characteristic
1. For initial (except for capital investments) investments	Up to a year	Very fast
	From year to 3 years	average
	From 3 to 5 years	long
	From 5 and more years	Unacceptably long
2. For dynamic financial investments (except for capital investments)	Up to half a year	Very fast
	From six months to a year	quickly
	From year to 3 years	average
	From 3 to 5 years	long
	From 5 and more years	Unacceptably long
3. Capital investment	Up to 3 years	quickly
	From 3 to 5 years	average
	From 5 to 7 years	long
	More than 7 years	Unacceptably long
4. The payback period of investments in the business plan as a whole	Before and over 7 years	Long

The proposed methodology for determining the payback period and the project will allow defining a kind of indicator of control over the stages of devel-

oping a business plan, as well as providing a better assessment of the effectiveness of business plans in modern business conditions. That in turn should lead to an increase in the viability and accuracy of the planning results, and also is intended to cause a positive response from potential investors to the business plan, indicating a high level of control over the business plan development process and a careful attitude of developers to the distribution of funds.

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确定可持续农业土地利用经济效率的方法
METHODOLOGY FOR DETERMINING THE ECONOMIC EFFICIENCY OF SUSTAINABLE AGRICULTURAL LAND USE

Zdanova Ruslana Vladimirovna
Candidate of Economic Sciences, Associate Professor
Rasskazova Anna Aleksandrovna
Candidate of Economic Sciences, Associate Professor
State University of Land Use Planning
Moscow, Russia

注解。 文章讨论了可持续土地管理系统。 研究了可持续土地利用管理的信息支持过程，以及土地利用系统的一系列相互关系。

关键词：管理，系统，信息支持，土地利用，可持续土地利用。

Annotation*. The article discusses the sustainable land management system. The process of information support for sustainable land use management was studied, as well as a set of interrelationships of the land use system.*

Keywords*: management, system, information support, land use, sustainable land use.*

Managing sustainable land use is a complex system. At the same time, the specifics of land legal relations gives management in this area special features, which are reflected in the content of government functions, the system and structure of state bodies.

The implementation of management functions always requires a certain amount of time and effort, as a result of which the controlled object is brought into a given or desired state. This is the main content of the concept of "management process". Most often, it is understood as a certain set of managerial actions that logically communicate with each other in order to ensure the achievement of goals by transforming resources at the “entrance” into products or services at the “exit” of the system. This definition emphasizes the purposeful nature of the process carried out by the management apparatus, as well as its connection with the functions, goals and resources necessary for their realization.

Along with this, another definition of the management process is widely used in the literature, in which, as its key point, not functions, but management deci-

sions are considered, the efforts and organizational activity of professional managers are directed to developing, adopting and executing. The management process is presented as a set of cyclical actions related to identifying problems, finding and organizing the implementation of decisions made.

Work on the collection, processing and evaluation of information is carried out at all stages of the decision-making process (Fig. 1), but has features that reflect the specifics of the actions performed and tasks to be performed.

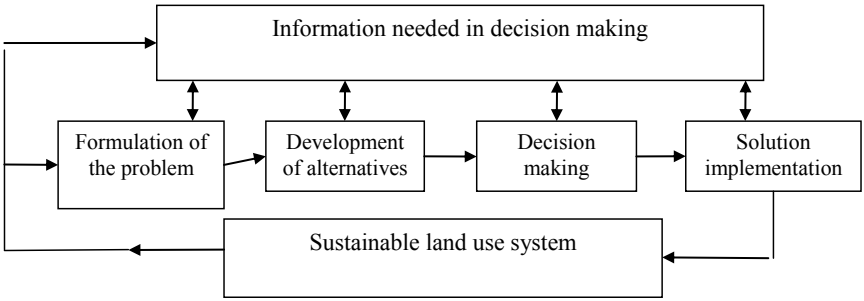

Figure 1- *The process of information support for sustainable land management*

Information - a set of various information about the internal and external state of the controlled system (control object) used to assess the situation and develop management decisions. The availability and possibility of movement of information is a necessary condition for management [5].

Management is carried out when there are both coinciding interests of people and information about the nature of these interests and the possibilities of their realization. Information has certain properties: accumulation, movement, preservation when used, cost, measurement, communication, variety of forms. These properties of information play an important role in understanding the characteristics of management information support. Such characteristics include: completeness and value of information, reliability, form of presentation, volume, timeliness, structure of information. These characteristics in their totality reflect the information management potential [1].

In the practice of sustainable land use management, information of various kinds is used. Chief among them are: economic, organizational, social and sociopsychological, technological information (Fig. 2). In addition, an important role is played by the allocation of operational, current and strategic information, information on individual management functions (planned, statistical, personnel, etc.).

Management efficiency is largely determined by the types and means of information transmission and processing. Information can be transmitted orally, using paper or electronic media. In modern management, combined options are used.

The nature of this combination is determined by many factors of management organization: staff professionalism, the availability of a sufficient number of technical means, the nature of the problems to be solved, the specific situation, responsibility and the current control system, management style. Some of the information used in management is documented, which is necessary for the implementation of performance monitoring, as well as for management research to improve its efficiency [5].

Information characteristics of sustainable land management (volume of information, structure, processing methods, etc.) are of great importance for the design of the management system and the organization of its operation. Information characteristics of management determine the size of the links of the management system, their organizational status, the nature of the link, its interaction in management processes. An important problem of modern management of sustainable land use is the differentiation of information in the management system [5]. Each link in the management system must have all the necessary information to implement its functions and powers. The volume and structure of the necessary information reflect the professionalism of the activity, creative approach to work, independence and responsibility of officials, management style.

Therefore, an information system should not be built on the principles of a monopoly on information or a severe restriction of information support. It should include elements of both the forced movement of information and the proactive acquisition of information through the information (computing) center.

The distribution of information and the construction of a management information system largely characterizes the art of management [1].

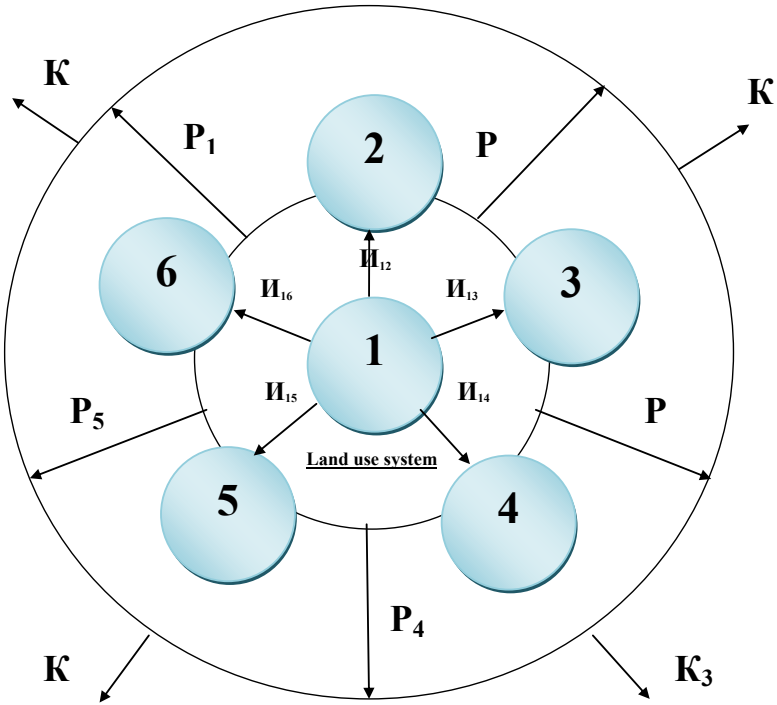

Figure 2- *The set of interrelations of the agricultural land use system*

Currently, the problem of effective management of sustainable land use is largely unresolved due to the lack of objective information on the status and use of agricultural land, which should be achieved through the creation and operation of a permanent cadastre system and land monitoring.

Designations: 1 - land resources; 2 - legal subsystem; 3 - ecological subsystem; 4 - economic subsystem; 5 - social subsystem; 6 - organizational subsystem; Iij - the direction of flow of information; Pi - operators of interrelations of elements of the land use system in the general socio-ecological-economic system of the territory; K i - criteria for optimal land use system.

All this is due to the fact that so far failed to carry out a complete inventory, state cadastral registration and registration of rights to land and other real estate transferred to private, state and municipal property.

When organizing a sustainable land use management system, firstly, it is necessary to determine its functional features that determine the essence of the entire system. Secondly, determine the procedure for creating an information base. The

information base of land management, in our opinion, should be based on cadastre and land monitoring data, with the help of which the information system is formed, and then the organization of management accounting (Fig. 3).

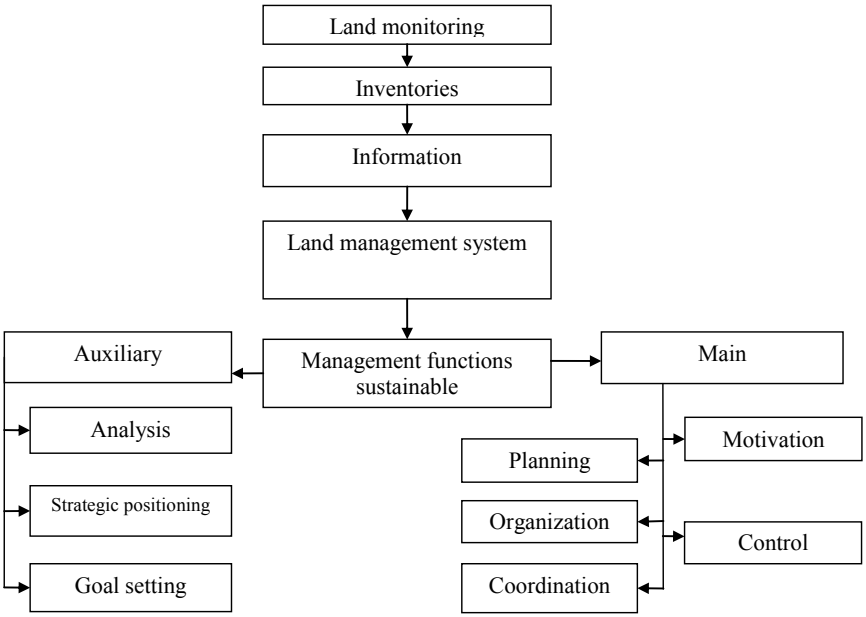

Figure 3 - *Scheme of systematization of sustainable land management*

The general concept of information can be defined as a measure to eliminate the uncertainty of the recipient's knowledge of the status of an event. From the point of view of management, information is presented as a set of information about the internal and external state of the controlled system or control object. At this stage, the management process itself is not carried out. But information is the basis for managing the entire system, in our case, the land management system, including the management of agricultural land use.

The search for ways of economical and effective use, reproduction and protection of lands causes a constant need for reliable information on land resources. Along with the data on the quantity, qualitative state and spatial distribution of land, the information database on land resources should also have information on climate, water and plant resources, include technical and economic indicators of land users, demographic characteristics, land assessment results and other data.

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价值体系中的法律意识：政治法律思想史
LEGAL CONSCIOUSNESS IN THE SYSTEM OF VALUES: FROM THE HISTORY OF POLITICAL AND LEGAL THOUGHT

Frolova Elizaveta Alexandrovna
Doctor of Juridical Sciences, Professor
Lomonosov Moscow State University

抽象。　本文从法律哲学和政治法律思想史的角度论述了法律意识的问题。作者侧重于将正义现象理解为相对主义背景下的价值判断系统。
关键词：法哲学，政治和法律学说史，正义感，道德，人格

Abstract. *The article deals with the problems of legal consciousness from the standpoint of legal philosophy and the history of political and legal thought. The author focuses on understanding the phenomenon of justice as a value judgment system in the context of relativism.*
Keywords*: philosophy of law, history of political and legal doctrines, sense of justice, morality, personality*

Problems of legal consciousness, comprehension of political and legal reality, the search for ideal structures in the field of law and the state permeate the life of each person as a member of society and are the subject of fundamental scientific research. To study the content of law - the social regulator - is primarily a matter of the theory of state and law and the sociology of law. Analyzing the nature and focus of the right to the internal needs of the individual is rather a task of philosophy and the psychology of law.

Unlike the phenomenon of legal culture, which is more likely to be social in nature (and therefore assessed in the system of social categories - group, society, people), the concept of legal consciousness is focused on the individual: this is the sphere of self-awareness and motivation of each person's legally significant actions. reality and the desired models in the sphere of state and law, etc. "A person has legal conscience regardless of whether he knows about it or does not know it, values this property or treats it with disrespect. The whole life of a person and the whole fate of him are composed with the participation of justice and under his leadership; moreover, living means for a person to live with legal consciousness, in its functions and its terms..." [2, p.163].

Legal consciousness is commonly understood as a set of views, beliefs, emotions, attitudes, assessments in the field of law and the state. The study of this sphere, in addition to structural difficulties (of various types and levels of legal consciousness), suggests a methodological dualism: the phenomenon of legal consciousness is considered in the system of categories of due and existing.

Legal consciousness contains value judgments about the law. In this regard, the area of legal consciousness constitutes an element of culture and is thus characterized in the system of value coordinates. In the scientific literature it has been repeatedly stressed that regardless of how real the right is fair or unfair, its meaning and purpose is to be fair - the right must incorporate and realize the idea of the right [7, p.85]. The idea of law includes formulating principles and assessments of political and legal reality. These elements of the idea of law form the content of legal consciousness, which is necessary to study both as value judgments (assessments of reality) and as facts of a given being (concrete phenomena of state and law).

Experts rightly express the idea that it is necessary to study issues of legal conscience primarily from the standpoint of relativism. This method provides for the variability of the actual content - external circumstances change and our assessments of the political and legal reality do not remain unchanged. That is why in the sphere of legal consciousness it is impossible to identify and set as unchanged any patterns of human behavior. The relativism method is aimed at establishing the correctness of any value judgment only with respect to another value judgment and within a certain worldview [5, p.22-25]. This method assumes that an individual always has a choice between different views and behaviors that can be dictated by discretion, goal setting, a "heart" decision, etc. Ultimately, the choice in the sphere of legal conscience depends not so much on external factors as on the free will of a spiritually independent person. Thus, it is in the sphere of legal consciousness that systems of competing values arise, differing in content but equal in their meaning. There are no uniform assessment criteria in legal consciousness; individuals, with formal equality, differ from each other, first of all, by their different opinions; despite the fact that the laws of thinking are the same, each has its own understanding.

The content of legal consciousness is different, since not only legal and social statuses of individuals are different, but also levels of people's consciousness. And nevertheless, in the relations of individuals to each other, a certain "unified and objective rightness is revealed, which can be known only through internal experience, through genuine, substantive testing and disclosure of natural law" [2, p. 164]. Such experiences are peculiar to each person, but for the majority it remains unconscious, the so-called "instinct of righteousness". To realize the content of this "legal feeling" and discover its meaning is one of the tasks of philosophy and the psychology of law.

As noted, legal awareness of any level and type has an evaluative character. This fact allows us to compare the areas of legal consciousness and morality that are close in nature and content. Moral principles are the basis for distinguishing between good and evil (what should be done and what should be refrained from) and thus become

the measure of the assessment of the personality as a whole. Legal consciousness is characterized by an assessment of the actions of people and their associations from the point of view of legal categories: “these life circumstances have or do not have legal significance”, “in this case there is or is not an element of the offense”, “the subject in this case has the right or he has absent "," this party of legal relationship is authorized or obliged ", etc. Based on this distinction, as N.M. Korkunov, legal norms are norms of differentiation of interests, they define the boundary between law and wrong, indicating how much or not we have the right to exercise our interests when confronted with other people's interests. With this understanding, morality assesses the interests of the person, and the right makes their distinction [3, p.57-62].

However, the point of view that the legal consciousness assesses various facts and relations connected with the formal certainty of law has become more widespread in the science of law. Moreover, legal consciousness itself can act as a form of existing law (in the Middle Ages, the sanctioned custom, in essence, represented ordinary legal consciousness formally fixed as a source of law).

Note, the process of awareness of the right by society, especially at the level of mass justice, is not the mechanical memorization of numerous norms of law - this is not only impossible in fact, but, on the contrary, an excessive number of legal prescriptions creates mistrust, caution and skepticism towards them from the population. Awareness of the right must be expressed in its creative assimilation. “Normal legal conscience” (I.A. Ilina's term) includes, in addition to the actual knowledge of the norms of positive law, the will and feeling of a person. “True mind” (Stoics), “spiritual love of God” (Spinoza), “nature of things” (Grotius), “spirit of the law” (Montesquieu), “legal feeling” (Iering) - should be experienced and experienced by the thinking subject and only in this case it can be argued about the meaningful nature of the legal phenomenon.

Assessing the area of legal awareness, it can be noted that it is mainly about the “legal feeling”, inclinations, moods, opinions and other manifestations of the personality’s subjectivity, which allow us to see in the law a creative, active, acting individuality, and not just an individual, possessing legal personality. Paraphrasing Hegel, it can be said that the legal consciousness of each individual must reveal his mind, that is, the idea of law, which has a universal character; everyone must perceive the objective value of the right, which is preserved under any political regimes, regardless of disagreement, accidental ignorance or systematic disobedience on the part of one or another legal entity [2, p. 181]. However, for all its relativity and formality, law has a constant internal component aimed at justice, correctness, truthfulness of the solution of conflicts arising between the subjects of law. Law and the state - social regulators - are created for public consent, a “pacified environment” and are implemented through legal consciousness, through the will and feelings of each member of society. In order to fully reflect the interests of the individual and society, the right in its objective meaning and semantic content must be realized by thought, verified by experience and recognized by the will of man.

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消极或消极堕落的法律
NEGATIVE OR NEGATIVE LECHEROUS RIGHT

Zakhartsev Sergey Ivanovich
Doctor of Juridical Sciences, Leading Researcher
Institute of State and Law of Russian Academy of Sciences
Salnikov Viktor Petrovich
Doctor of Juridical Sciences, Professor
Honored Scientist of the Russian Federation,
Honorary Worker of Higher vocational education Russian Federation,
President of the University Foundation

注解。 作者继续将法律作为一种复杂的社会现象进行研究，这是由他们制定的kreprehendny法律理论。 文章讨论了法律的这一方面，即对一个人和国家的消极和不道德行为的监管。

关键词：哲学，法哲学，法律，法律理论，法律濒临，消极法，放弃消极法。

Annotation. *The authors continue to study law as a complex social phenomenon within the framework of the formulated by them kreprehendny theory of law. The article discusses such a side of law as the regulation of negative and immoral actions of a person and the state.*

Keywords: *philosophy, philosophy of law, law, komprehendny theory of law, verge of law, negative law, dissolutely negative law.*

In 2012-2014, we (S.I. Zakhartsev and V.P. Salnikov) formulated and proposed to the Russian legal community a komprehendny theory of knowledge of law [1; 2]. This theory has become popular in Russian law. Moreover, the komprehendny theory has aroused interest among Western European specialists. Our book has been translated into several European languages, including into English and published in Cambridge. [4].

Studying various facets of law within the framework of the komprehendny theory of law, we thought about one more. In many states, including Russia, the law itself is considered a positive phenomenon and regulates, accordingly, only the necessary correct behavior. But this is not entirely true. Law allow and regulate not only positive, but also negative actions of a person and the state.

During the preparation of this work, we interviewed one of the leaders of the Amsterdam police. This policeman literally asked us this question: why do Russians, and not only Russian specialists, consider law to be a good phenomenon? The law, he continued, is imperfect in terms of regulating good deeds, but it perfectly regulates immorality and immorality. It is enough to see that in Amsterdam, in the region officially referred to as the "red light district", the law regulates the sale of soft drugs. And not just the use of drugs in the specified area is allowed, but it is precisely indicated how many drugs, at what age, at what time and under what circumstances you can buy. How many because of this permission, summed up our interlocutor, crippled people!

Then we went directly to this "red light district". To our surprise, despite the abundance of so-called "high places" in the area itself, order and tranquility reigned. Moreover, there were a lot of police in the area. This is to talk about, explained our satellite, what the police are guarding: the safety of normal people or the safety of drug dealers!

Then we saw a mother with a child of about twelve, most likely a resident of the Netherlands or a tourist. Mother in English was outraged by the fact that her son was not sold a light drug. The administration of the place where they sell drugs answered this mother that the sale of drugs at that age was forbidden to her son. To which the mother said the phrase that shook us: "By law, it is forbidden for a son to buy and use drugs at an early age, but this violates her son's freedom and his right to drugs!"

The conversation took place before our eyes. We asked the mother: does she really want her son to become a drug addict? She replied that the use of soft drugs for health is not dangerous. Her son, she continued, just like any free citizen has the right to use drugs, and the law that establishes the age of their sale unreasonably restricts this right. Like this!

Note that the woman did not identify the law and the law. At the same time, as they sometimes like to think with us, she spoke of a good right with a bad law.

In a number of countries (and there are quite a lot of them!) Legal acts officially allow prostitution. In the laws of these countries, as a rule, it is clearly stated: who, from what age, with the availability of what documents can work as a prostitute. And there, as we were told, conflicts also occur. For example, a woman has the right to work as a prostitute, but there are not enough documents. And women, including their mothers, are outraged that the child is not allowed to work!

What is this country? Let's call at least European: Belgium, Denmark, the Netherlands, Finland. In each of the countries on the regulation of prostitution there are curious references to the law. For example, the topic of prostitution was openly discussed in Finland not so long ago. As a result, it was decided that selling

love is not against the law, if it is properly hidden from the public eye, and every woman has the inalienable right to prostitution!

Under certain conditions, prostitution is permitted in the UK, Germany, Switzerland. In 2010, in Switzerland, a brothel was officially opened for men with non-traditional sexual orientation in Switzerland.

How to treat such examples? If we proceed from the fact that law should regulate good and justice, does drug use and prostitution mean good, right, fair deeds? The correct answer is still different: the right cannot be fully exercised with good deeds, positive goals, positive behavior, etc. The right can successfully regulate and frankly negative actions.

In such states, apparently, the norms of morality and ethics are not at the proper level. Logically, the right should protect moral and ethical behavior. But, as we see, this is not always the case.

One of our opponents objected that the law regulates such phenomena only because they are still present in society. So it is better, according to him, to officially allow drug trafficking and prostitution since they, as inevitability, have always been in Europe! But after all, with such reasoning you can go further. For example, in Europe they always steal - then they will offer to allow theft? But it is possible to go even further: murders have always been committed in Europe - will we regulate the rules and procedure for committing murders?

By the way, about the killings. A few centuries ago in Europe, the rules of law regulated the order of duels and murders on them. That is, the law regulated and murder! It was in the XVI-XVII centuries, they will object to us. But, by no means, questions remained.

Just recently, a seemingly surprising event occurred in Russia. After the conflict, the head of the Russian Guard, V. Zolotov, and the opposition member A. Navalny, in 2018, one of the parliamentarians appealed to the State Duma of the Russian Federation and the Ministry of Justice of Russia to establish a duel code in Russia and submitted its draft. This project is not yet supported, but considered. From the point of view of science, it must be emphasized that before official permission in Russia causing bodily injuries to duels was not far away. And when adopting a duel code, many obvious crimes would cease to be such (if committed in a duel). Thus, the right is always ready to regulate negative, immoral, and in general abnormal actions, including murder.

Regarding the killings, we can give a vivid example from the experience of the State of Israel. Israeli security services officially have the right to kill persons who have previously committed terrorist acts in Israel. And kill anywhere in the world. In other words, if the Israeli secret services found out that a person living in Egypt, for example, was involved in the commission of a terrorist act in Israel, then the Israeli secret services, according to the laws of the named state, could kill

this person. And kill virtually without trial and in the territory of another state, including in a socially dangerous way! And such things are also regulated by the rules of law. And no one is even interested in such a simple question: What if the special services were mistaken?

We asked questions to an Israeli law enforcement officer. He replied that, according to the law, murder is, of course, forbidden. But the state of Israel, he continued, has the right to punish the commission of terrorism, and the law is above the law. Then we asked the question: "And who gave Israel such a right?". He replied that the existence of such a right is unfortunately one of the prerequisites for the survival of this state in a troubled world. Here is such a horror!

Additionally, we note that the law in a number of countries allows and regulates the production of such ambiguous actions as abortion.

Law in a number of countries allows the use of corporal punishment, which now, in the 21st century, seems wild.

Law in a number of countries establishes a cruel attitude towards people. This list, unfortunately, can be continued.

It is appropriate to recall here that many theorists of law understand law as a necessary form of freedom, equality and justice in the public life of people [3; p. 1]. The proposal sounds beautiful and beautiful, but still - let's be honest - somewhat naive. The right, as we noted, is a complex social phenomenon, a multifaceted phenomenon, with its positive and negative manifestations [1, pp. 44-53]. And one of the facets of law, apparently, is the regulation of negative, immoral actions of people and states. Now many well-known Russian and foreign philosophers of law, recognizing our authority, began to agree with us.

We called this facet of law: “negative right” or “perversely negative right”.

Questions on this facet of law are not taught in law schools. Scientists try not to pay attention to it, but it exists. And here there is a big moral problem. If young people know that the law does not prohibit the use of drugs - it means they can be used. Moreover, young men, as we ourselves have heard, have the right to use drugs. That is, it is not even about having to try a drug once, but about a right that can be exercised at any time. How many human lives worth such a right!

If girls from their youth know that prostitution is their right, then it is almost impossible to convince them of the immorality of such actions.

About other actions mentioned in the article - we do not even speak.

The right has always had an educational function. Moreover, the function can be both positive and negative again. If, for example, Finnish girls have the right to be prostitutes, then how to convince the residents of St. Petersburg who are only two hundred kilometers from them that there is no such right in Russia? Again, if prostitution is officially legalized, then logically, is it not immoral to use the services of prostitutes? Moreover, now in Europe every man has the right to be a homosexual?

Residents of Russia recently are attentive to the European way of life and European values. And these negative phenomena are increasingly taking root in Russia. Morality and cultural traditions of Russia, alas, are rapidly deteriorating. And not without the help of law, performing a negative educational function. Remember, drug addiction was recently declared in Russia as one of the main ills, the fight against drugs was propagandized on all central television channels and in other mass media. Legal science has also kept abreast: dozens of scientific conferences and seminars were held annually devoted to ways of taking young people out of drug addiction. Now, if we are not mistaken, only the journal Narkokontrol remained in legal science in Russia, which functions thanks to the enthusiasm of its editor-in-chief.

In the 1990s, girls engaged in prostitution stood along Russia's busy roads. Now this is not. Is prostitution gone? By no means. According to law enforcement, prostitutes have moved into brothels, which in Moscow alone more than a hundred. And with them, by and large, no one fights. But legal science almost ceased to notice the problem of prostitution. But again there is a reference to *the natural human right* (highlighted by us - SZ, VS) to sleep with anyone for money.

Conclusion: the right is multifaceted and it must be studied without illusions.

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技术教育的发展动力与问题
DYNAMICS OF DEVELOPMENT AND PROBLEMS OF TECHNICAL EDUCATION

Erofeeva Galina Vasilevna
Doctor of Pedagogic Sciences, Professor
National Research Tomsk Polytechnic University

Any system develops, experiencing deviations from the equilibrium state, including the atom and the Universe (Fig. 1). The dynamics of development is manifested in the fact that the equilibrium state also shifts. If we imagine a change in the equilibrium position in the form of an Archimedes spiral, and the state of the system in an oscillatory mode, then we can somehow explain the return to the former, but at a different level. The education system is no exception.

The founder of pedagogy, Ya.A., who tried first to bring into the system the objective laws of education and training, the founder of pedagogy. Comenius [1] in his foundations wrote:

Foundation V:

It is necessary to study ... the things themselves, and not other people's statements about things;

Can be interpreted as a desire for experiment.

Foundation IX:

... your nothing, if the other does not know that you know it.

Society needs knowledge of students, not a teacher.

Traditional training scheme based on the ideas of a large number of teachers and the foundations of Ya.A. Comenius, as well as responding to a later submission by KD Ushinsky [2], et al., Made it possible to prepare a huge number of highly professional specialists who created theories, technologies, and equipment, which sometimes outstripped the concept of science fiction writers.

Thus, traditional technical training was based on three pillars:

1. Fundamentality
2. Systematic and systematic
3. Relationship with professional activities and scientific achievements in it.

To achieve success only by the declaration of ideas is impossible. Many ways and methods of teaching were developed that made it possible to transfer the knowledge of teachers to students.

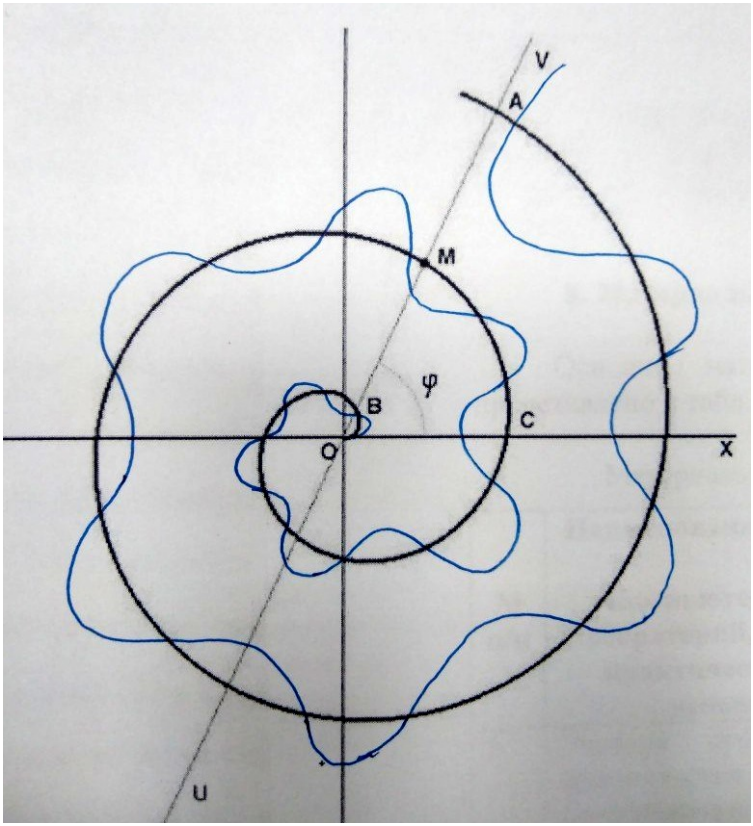

Fig. 1. *Dynamics of development*

But the population of the Earth was growing and the number of students, which appeared new equipment, unfortunately, often did not go to higher education institutions and, therefore, did not participate in the training of students. By the way, the developed computer technologies allowed to remove many problems.

Virtual labs, computer labs and software appeared. The National Research Tomsk Polytechnic University (NI TPU) created training systems in physics and concepts of modern natural science, the idea of which originated from the consciousness that can be organized on computers "repetition and control." At the same time, we wanted to preserve the advantages of the traditional system, the basis of which was precisely “repetition and control”, according to Ya.A. Komensky, K.D. Ushinsky.

Were developed (based on the study of the experience of creating such systems and their own ideas) the main components of an interactive learning system [3]:

The theoretical part, structured to the necessary minimum, containing:

a) the federal, university and regional component of the SES and the OS of the university (on this topic);

b) the relationship of the studied physical quantities and patterns with those of previous and subsequent classes, as well as interdisciplinary connections with other disciplines contained in the curriculum of the specialist;

c) the application of the studied patterns in science and technology and the relationship with the future specialty;

d) modern achievements in this field of knowledge;

e) problematic issues, paradoxical situations, contradictions that appear, as it were, by chance when considering the theoretical part, and the answers to them.

1. The presence of feedback or communication, ensuring the organization of the dialogue between the computer and the student.

2. Test questions for testing Level I and Level II, containing non-standard questions and answers of various kinds (for each student, similar to the neighboring one, but their own variant) are productive activities.

3. Solved problems (typical, for the formation of skills to develop algorithms for solving problems and memorizing the ratios of theoretical material and the corresponding individual version for independent solution).

4. Solved integrative problems (non-standard, non-stereotypical, original) for the formation of the student's creative thinking and the corresponding individual version for an independent solution.

5. Control tasks with a wide range of skills formation, including the formation of skills of III and IV levels of learning (drawing up tasks on this subject) - a productive activity.

6. Various learning paths corresponding to the preparedness of the student and his wishes and possibilities.

7. Rating system for assessing student performance at all stages of a lesson.

8. The possibility of modeling the studied physical phenomena and the formulation of the simplest research experiment, as well as experimental and video demonstrations.

9. Historical background (instructive and entertaining story about scientists and their discoveries) and the corresponding demonstration material.

10. Reference material — a table of derivatives and integrals, trigonometric functions, physical constants, etc.

11. Comfortable learning environment and communicative interaction with the student.

12. A wide range of opportunities for individual and independent work.

13. Statistical method for analyzing students' knowledge.

The main system-forming factors of pedagogical systems: targeted, commu-

nicative, informative-organizational, and analytical-effective are fully manifested here. The basis for assessing student performance is the outcome of the control. Both qualitative and quantitative indicators of the work of students are taken into account.

Teaching systems acquired particular importance when foreign students appeared at the university: Greeks, Vietnamese, Koreans, Mongols, Chinese, etc.

Methods that have been used in training systems:

- Personal (the student can choose the trajectory independently, taking into account his ideas, level of knowledge, etc.);

- Productive (independent compilation of tasks, solving problem and research tasks, etc.);

- Project (students are divided into subgroups for the interested discussion and evaluation of materials presented in independently developed tasks and test tasks).

The training system for the course "Concepts of modern science" was intended to teach students of humanitarian areas, including many foreigners. This course broadens the students' horizons, thanks to the fact that the ideas of natural science, for example, the ideas of synergetics, have taken root in other sciences ¬¬– economics, sociology, etc. [4].

Self-organized structures considered in synergetics arise in the social, cultural or scientific systems studied by the humanities, and in all cases the processes of self-organization lead to the emergence of qualitatively new structures.

The conditions for the emergence of such structures and their features are important for students of all directions and specialties.

The rapid development of technology and technology has led to the emergence of new courses. Students from China, studying in the TPU in the direction of 03.03.02 "Physics", study the course "Physical fundamentals of nanomaterials and nanotechnologies" [5]. The construction and organizational and methodological support of the course allows students to publish articles in the International Student Scientific Journal for several years [6, 7, 8].

The emergence of the Internet and online learning has fundamentally changed the education system. The student is already cut off from the traditional training scheme, but is not yet organizationally and systematically tied to a new one (Fig. 2).

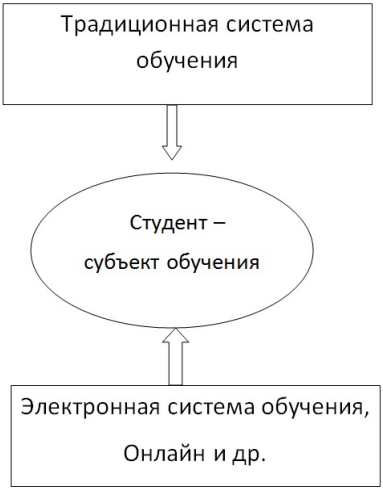

Figure 2. *Competition of education systems*

The sea of interesting information and the ability to use it around the clock do not contribute to a serious independent study of complex training courses (for example, quantum mechanics, etc.) (Fig. 3).

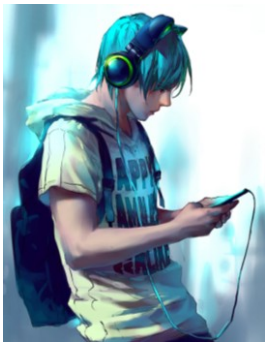

Figure 3. *A student in the modern world*

The great advantage of online learning is its accessibility, but the disadvantage is also significant: there is no reliable knowledge control system. Especially dangerous is the lack of proper control of knowledge, skills and experience for technical education, and this problem is still waiting to be solved.

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UDC 372.363

户外运动游戏是培养5–6岁学龄前儿童协调能力的一种手段
MOBILE AND SPORTS GAMES AS A MEANS OF DEVELOPMENT OF COORDINATING ABILITIES AT KINDERGARTEN 5-6 YEARS

Ivanova Larisa Vasilyevna,
Candidate of Medical Sciences, Associate Professor
Bakhareva Elena Vladimirovna
Doctor of Biological Sciences, Professor
Irkutsk State University

注解。 文章讨论了提高儿童协调能力的必要性。 特点是学龄前儿童的身体特征5–6岁。 表明移动和体育游戏对儿童和谐发展的重要性。 结果表明，专门选择的球练习有助于学龄前儿童的协调能力的发展。

关键词：儿童体育，协调能力，球类运动，学龄前儿童5–6岁。

Annotation. *The article discusses the need to improve coordination abilities in children. Characterized by the characteristics of the body of preschool children 5-6 years. Indicates the importance of mobile and sports games for the harmonious development of children. It is shown that specially selected exercises with the ball contribute to the development of coordination abilities in preschool children.*

Keywords*: physical education of children, coordination abilities, ball exercises, preschoolers 5-6 years old.*

Introduction Questions of physical education of children of preschool age steadily occupy an important place in the field of scientific interests of specialists in various fields. It is known that in the preschool years there is a “laying of the foundation” for the development of the whole organism, motor abilities, including coordination abilities [1, 3]. Currently, despite the variety of educational programs implemented in preschool institutions, 63% of children have a low level of development of coordination abilities [5]. The outdoor game is one of the important means of harmonious education of children of preschool age. Its characteristic feature is the complexity of the impact on the body and on all sides of the child's personality: in the game, physical, mental, moral, aesthetic and labor education are carried out simultaneously [4,5].

The ability to coordinate is a psychophysical quality, unique and individual. Coordination is brought up in close relationship with the overall development of the child, and thanks to targeted training, this process accelerates and expands the body's capabilities, thereby affecting all spheres of human activity. Coordination abilities are considered as the leading function of the motor development of children of senior preschool age [2].

An important means of developing motor function is exercise with the ball - from small to large (fitball), since it is subject-specific manipulative activity that lies mainly in the development of motor functions [5].

The main content of the work. The purpose of the study is to form the coordination abilities of preschoolers in an educational environment using outdoor games and sports elements. It was assumed that the formation of coordination abilities important for children of preschool age - accuracy of motor actions, maintaining body balance, coordination of motor actions - increases the range of motor capabilities, contributes to confidence in behavior, expands the functional reserves of the body.

Pedagogical research was carried out on the basis of the International Children's Clinical Hospital "Kindergarten No. 33". For the experiment, a control and experimental group of 15 people each aged 5-6 years were determined.

During the formative experiment, students of the control group (CG) were engaged in the basic educational program "From Birth to School" proposed by the authors N.E. Veraksy, T.S. Komarova, M.A. Vasilyeva [3]. For students of the experimental group (EG), this program was adapted by introducing outdoor games, some elements of sports games and exercises with large gymnastic balls.

When performing exercises used frontal, group and circuit training method. Classes were held 2 times a week, with music for 25 minutes and consisted of preparatory, main and final parts.

For the development of coordination abilities, the following outdoor games are included in the program of physical education classes:

- on the ability to accuracy of movement: (stability) - "Dragon bites the tail", "Fox and jerboa", "Quick Caterpillar", etc.,

- on the accuracy of motor actions - a throw to the basketball hoop, "Jumping - jolly bells", "Clouds and the sun", "Homeless hare", etc.,

- on the coordination of motor actions (fitball) - "Mirror", "Fast Frog", "Push - Catch", etc.,

- the ability to navigate in space - "Barmaley and dolls", "Find your ball", "Penguins on the ice floe", "Ducks and dogs", etc.

Also selected exercises with elements of sports games, which contributed to the development of coordination abilities:

- keeping fitball in a circle, hitting the ball on the floor with two hands on top, separate right and left hands, imitating basketball reference,

- maintenance of a fitball with a snake around cones, throws from the chest in pairs with a blow to the floor in 10 gears, rolls of the ball in a sitting position, work in pairs in 10 gears,

- keeping fitball with feet from one sideline to another, alternately pointing with the hands, in the opposite direction - with the legs, with the club leading from one sideline to the other.

In order to test the coordination abilities of the students, control tests were also defined that made it possible to determine the level of coordination abilities. For example, to assess the stability, keeping the balance in a rack on one leg "Heron" (sec) was tested, for accuracy of motor actions - hitting the target (portable basketball ring) with a rubber ball (D = 10-12 cm), standing on the starting line at a distance 1.5 meters (point), for consistency of motor actions - exercise on fitball: leaning your back on the ball, move forward (point), for spatial orientation - shuttle run 3x10m, (s).

The results of testing the coordination abilities of preschool children at the ascertaining stage showed a low level of their development in both groups. At the control stage of the study, the indicators differed significantly (Table 1).

Table 1

Comparative indicators of the development of coordination abilities of preschool children of the control (CG) and experimental (EG) groups at the stage of stating and control experiment

Formed Quality	Tests	KG			EG		
		state exam / control experiment	growth		constant. expert / control. expert	growth	
			abs	%		abs	%
Resilience	Rack on one leg "Heron"	8,6±1,1 / 9,0±0,5	0,4	4,6	8,0± 0,9/ 12,5±0,4	4,5	56,2
Coordination of motor actions	Fitball exercise,	2,0±0,18/ 3,0±0,2	1,0	15,0	3,0±0,2 / 6,0±0,2	3,0	20,0
Accuracy of the motor action	Throw in a basketball ring	3,0±0,1 / 3,0±0,2	0	0	2±0,1 / 5,0±0,2	3,0	25,0
Spatial orientation	Shuttle run	19,3±0,4 /18,5± 1,0	0,8	5,1	18,1±0,5 / 17,2±0,2	0,9	5,0

From the analysis of the data obtained, it follows that the growth of the indicators of coordination abilities of children in the control group occurs mainly due to their natural growth and growth of the natural motor activity (up to 10.0%). In the experimental group this happens due to the effective use of the created sports and gaming environment, aimed at the formation of coordination abilities of children in the educational space of a preschool organization.

Along with this, the indicators of physical fitness improved among older preschoolers, which were significantly more pronounced in the experimental group than in the control group (Table 2).

Table 2

Some indicators of physical fitness of preschool children of the control and experimental groups at the stage of ascertaining and control experiment

Group	Test	Experiment		Increase result		
		ascertaining	control	absolute	%	P
EG	Running 30 m. (S)	7,3± 0,7	6,5±0,2	0,8	12,3	<0,05
CG		7,8± 0,8	7,2±2,1	0,6	8,3	>0,05
EG	Long jump (cm)	118,0± 5,5	133,0±1,9	15,0	12,7	<0,05
CG		103,0± 4,5	112,0±0,7	9,0	8,1	>0,05
EG	Throwing (m)	8,3± 0,3	11,5±0,2	3,2	38,5	<0,05
CG		8,3± 0,4	9,1±0,2	0,8	9,6	>0,05

Thus, the results of the pedagogical experiment testify to the effectiveness of the adapted program for the physical education of older preschoolers. Moving and elements of sports games, exercises with fitball-balls contribute to the development of coordination abilities of preschool children 5-6 years old and can be recommended for wide use in children's pre-school educational organizations.

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为心理和教育活动准备未来社会教师的特点

FEATURES OF PREPARATION OF FUTURE SOCIAL TEACHERS FOR PSYCHOLOGICAL AND PEDAGOGICAL ACTIVITY

Berinskaya Inna Vladimirovna
Candidate of Pedagogical Sciences, Associate Professor
Irkutsk State University

注解。 本文介绍了与形成未来专家基本专业能力基础相关的理论和应用性质的材料，该专家能够理解教师专业的高度社会意义和人道主义特异性，负责任地和有效地执行该领域的专业任务。 心理学，教育学和社会教育活动的培养方向44.03.02“心理学和教育学”，是“心理学和社会教育学”的重点。

关键词：心理和教育活动，社会和教育活动，教师的专业活动，社会教师。

Annotation. *The article presents materials of a theoretical and applied nature related to the basics of forming the basic professional competence of a future specialist who is able to understand the high social significance and humanitarian specificity of the teacher's profession, responsibly and efficiently perform professional tasks in the field of psychological, educational and social and educational activities in the direction of training 44.03.02 "Psychological and pedagogical education", the focus of "Psychology and social pedagogy".*

Key words*: psychological and pedagogical activity, social and pedagogical activity, professional activity of a teacher, social teacher.*

In the new socio – economic conditions, when the quantitative indicators of the level of higher education do not correspond to the level of education, and the presence of several diplomas does not guarantee professional reliability, not only high professionally significant requirements are imposed on the competence of a specialist, but personal attitude to the world is taken into account.

The solution of the indicated problem, in our opinion, implies the implementation of such an approach that ensures the correlation of the personality, its status and field of opportunity. At the same time, from our point of view, designing a teacher's model makes sense in the following areas: 1) highlighting the status ideal to which the teacher is striving; 2) creating an educational environment conducive to the free recognition of the teaching purpose as a new special way with its ideals and values, 3) development of technologies that orient vocational education to the

development of the future specialist of the spiritual and moral values of a person of culture, professional skills, honor and dignity.

Such a direction of vocational education implies a change in the vector of formation of a personality capable of creative activity, with a high level of pedagogical culture and an individual style.

In this regard, in the basic professional educational program of higher education for the preparation of bachelors, according to the Federal State Educational Standard of Higher Education in the direction of 44.03.02. Psychological and pedagogical education, orientation Psychology and social pedagogy, the discipline "Introduction to psychological and pedagogical activity" is included in the basic part of B1 block "Disciplines (modules)" of the curriculum.

This discipline is included in the initial stage of mastering the main professional educational program, which solves the problem of strengthening students' interest in their chosen field of activity, ensuring awareness of the motives for choosing professional psycho-pedagogical activity along with such disciplines as “Professional activities of a social teacher in various spheres of society” Block B1 of the curriculum (basic and variable parts), representing a wide range of knowledge in psychol wow-pedagogical training of a future specialist.

The goal of mastering the “Introduction to psychological and pedagogical activity” discipline is to promote the development of basic professional competence of the student, who is able to understand the high social significance and humanitarian specificity of the social teacher's profession, responsibly and efficiently perform professional tasks in the field of psychological, educational, social and educational activities, observing the principles professional ethics.

Objectives of the discipline:

• formation of a system of basic psychological and pedagogical categories and concepts related to human nature;

• formation of basic ideas about the content of future professional activities; requirements that apply to the teacher, social teacher, educational psychologist;

• studying the characteristics of the system of psychological support of the educational process of the school; requirements for the quality of training of a teacher, a social teacher, a teacher-psychologist in new social conditions and processes occurring in modern society, adaptation mechanisms.

Requirements for the “input” knowledge, skills and readiness of students, necessary for the development of this discipline, are the following aspects:

Students should know:

- current trends in the education system in Russia and abroad;

- actual problems of the modern education system in the Russian Federation;

- psychological and pedagogical features of the educational environment of the school, which contribute to the development of the student's personality;

Students should be able to:

- understand the age characteristics of the child and his problems in the educational environment of the school;

- take into account individual, psychological, ethnocultural differences of participants in the educational process when building psychological, educational, social interactions;

Students must be prepared:

- create psychological and pedagogical conditions aimed at the development of the individual student at different levels of the educational system;

- to build a constructive dialogue with the subjects of the educational process;

- to organize events for the harmonization of the educational environment; development and social protection of students in school.

In turn, the process of studying the discipline is aimed at the formation of competencies OK-7, OPK-8:

OK-7 Ability to self-organization and self-education.

As a result of studying the discipline, the student must:

To know: the characteristics of the personal qualities of a teacher, social teacher, educational psychologist; the specifics of becoming a specialist as a professional; basic psychological mechanisms; management of mechanisms that determine personal development (self-organization, self-education, etc.); requirements for the personality and professional competence of the teacher, social teacher and educational psychologist;

To be able to: show the competence of the social teacher and the educational psychologist in the process of self-organization and self-education (depending on the main area of work); apply acquired knowledge in the process of self-organization and self-education of professional activities; to solve professional tasks related to the activities of the social teacher and educational psychologist;

Possess: modern approaches in the system of self-management (the organization of various types of pedagogical activity, allowing to build work qualitatively, based on the observance of the principles of professional ethics); methods of professional self-improvement.

OPK-8 The ability to understand the high social importance of the profession, responsibly and efficiently perform professional tasks, following the principles of professional ethics.

As a result of studying the discipline, the student must:

To know: the social nature and significance of the teaching profession, the principles of professional ethics, modern approaches to the qualitative performance of professional tasks; the main categories and concepts that reveal the essence of the system of pedagogical activity, features of the teacher's general and professional culture; bases of pedagogical, social-pedagogical and psychological-pedagogical

activity; content, main types and principles of professional activity of a teacher, social teacher and educational psychologist in collaboration with specialists from related professions; requirements for the personality and professional competence of a specialist;

Be able to: apply the knowledge gained in the implementation of their professional activities; work with scientific and methodological literature, systematize new material in comparison with existing knowledge; Express and justify their own opinions and thoughts; to assess the motives for choosing a profession; apply integrated psychological and pedagogical knowledge in solving problems of child development and upbringing;

Possess: modern methods of organizing various types of pedagogical activity, allowing to build work qualitatively, on the basis of compliance with the principles of professional ethics; the system of the main psychological and pedagogical categories and concepts related to human nature; standards of professional ethics.

To master the content of the discipline and the formation of these competencies, the program of the discipline includes the following types of organization of educational activities: lectures, practical classes, independent work, current and intermediate control of knowledge.

The scope of discipline and types of educational work:

Type of study	**Total hours / credits, Full-time education**	**Semesters**	
		1 sem full-time education	**1 sem extramural studies**
Classroom (total)	48	48	10
Lecture lessons (LC)	16	16	4
Practical classes (PZ)	32	32	6
Independent work (total)	60	60	94
Tasks for independent work	60	60	94
Type of intermediate certification (test, exam)	Credit	Credit	Credit 4h.
Contact work (total)	54	54	19
Total labor intensity hours	108	108	108
credits	3	3	3

The content of the sections and themes of the discipline:

Section 1. The education system of the Russian Federation

Topic 1. Essence, principles and structure of the education system

Topic 2. Psychological support of the education system.

Section 2. The essence and features of pedagogical activity.

Topic 1. Features of pedagogical activity. Functions of the teacher.

Topic 2. Requirements for the identity of the teacher. Pedagogical skill.

Section 3. The essence and features of the professional activity of the teacher-psychologist.

Topic 1. Types of professional activity of a social pedagogue, educational psychologist. Professional competence of a social teacher, educational psychologist.

Theme 2. The main methods of work of the educational psychologist.

Topic 3. Features of the personality of a social pedagogue, educational psychologist. Standards of professional ethics.

Section 4. Harmonization of the social environment of an educational institution.

Topic 1. Creating an educational environment and a field of child self-realization.

Topic 2. Social protection and self-defense of students.

The content of this discipline will contribute to the formation of a generalized image of a professional in psycho-pedagogical, pedagogical activity, an orientation towards professional self-improvement, as well as the deepening of professional knowledge in the field of social-pedagogical activity. In this regard, the discipline of the curriculum is highlighted, for which the subject “Introduction to psychological and pedagogical activity” is preceding: DV “Strategies for effective behavior in the labor market”, DV “Sanogenic reflection as a factor in teacher's self-development”, DV “Competence-based approach to stress tolerance teacher ", DV" Time Management for the teacher. "

In addition, the basic knowledge of the “Introduction to psychological and pedagogical activity” discipline and acquired skills will serve as the basis for the work of students with various social categories of schoolchildren during the period of training and work experience for 1-4 courses, one of the active forms of vocational training is the practice: industrial, educational, research. The analysis of the results is usually carried out in the form of conferences; at the same time, it becomes important to discuss individually with each student and outline his route to rectify the negative points.

Modern trends in the development of higher vocational education also determine a fundamental change in approaches to the organization of the educational process in higher education, with a positive hold. The introduction of a multi-level education system, the creation of a unified educational space, the implementation of a competence-based approach, the introduction of electronic technologies allows for a new, more flexible level of organizational learning processes in real time, taking into account students' needs for cognitive, research and creative activities.

An important focus of such a process in the structure of the “Introduction to

psychological and pedagogical activity" discipline becomes partnership, co-management, and the nature of the relationship between the teacher and students is defined as subject-subject. In this regard, active and interactive educational technologies based on motivational and value personal interest in professional self-development and taking into account the specifics of the pedagogical profile are becoming increasingly important in the structure of the educational environment of a university.

The structure of the content of the discipline provides for the use of the following educational technologies:

1. Technology information lecture-presentation using videos, a seminar on the synthesis and deepening of knowledge with elements of discussion.

2. Technology of problem-based learning: a problem lecture, a problem seminar.

3. Technology training in collaboration: a lecture for two, context-professional lecture.

4. Interactive technologies: problem lecture, lecture-dialogue, lecture-interview, problem seminar, pedagogical workshop, business game.

5. The technology of project training: problem workshop, workshop using the method of analysis of specific situations.

6. The technology of formation of educational and research activities of students: a practical lesson in the form of a presentation of the results of research activities.

The purpose of these types of educational technologies is the organizational, in various forms, educational activities of teachers and students using various methods of teaching, teaching and evaluating, aimed at achieving results and shaping competences based on them.

In this regard, it is necessary to disclose the principles of organization and interaction of the teacher - students at different stages of the learning process.

1) The principle of openness. Traditional, preparatory in order to realize the meaning of the program, its practical significance, the choice of goals of self-education, the rationale of the forms and business culture of interaction and co-operation.

2) The principle of consciousness. Coordination of the content of creative and self-educational activities, information on the types of intertechnologies, electronic communications and methods of self-presentation.

3) The principle of responsibility. Awareness of the importance of the competence-based approach, continuous self-monitoring of performance, the level of necessary professional skills, knowledge and skills on the profile of training.

In the transformation of the content of education (in the opinion of DV Chernilevsky), an important role belongs to the forms of training organization or

types of studies, which are new and already established stable ways of organizing the pedagogical process.

Speaking about the training technologies of the teacher-psychologist, social teacher, teacher-organizer, teacher of additional education, etc., we must not forget the practice-oriented direction: the direct involvement of the student in the educational process, where the opportunity is given to actively discuss the theory of the issue, practically substantiate its point of view and disclose your own vision of solving the problem, learn how to act professionally: to speak in front of an audience, to tell, explain, surprise, showing erudation in this or that matter.

From here and specificity of a choice of ways of the organization of educational process. Lectures can serve as models as a model of theoretical thinking, as a form of systematic, direct contact of consciousness, intuition, and conviction. The purpose of the classic lecture is to awaken a thought, “hook on a problem”, make you look for your arguments. The forms of communication at the lecture are very different: discussion, argumentation of the thesis, highlighting the point of disagreement, the final conclusions of the students on the topic, highlighting the lacuna of ignorance, recoding information, etc.

In the experience of high school didactics at the workshops, the method of living situation, dialogue, counseling, and sound evidence of knowledge of the issue and understanding of the problem, and "the discovery of a new, which was not yet in pedagogy." Interaction expands the ability to cooperate, the ability to "listen and hear".

The common form of the report will be interesting on condition that the group is ready for the debate, if the speaker has his own position, if there is new information. Modern technologies provide everyone with such a set of information that does not awaken a thought, does not cause controversy. Therefore, it is important to maintain interest in working with the original source, with book text.

Thus, the whole educational process involves the formation of the professional position of the future specialist through expanding the meaning of general cultural and professional competencies, developing cognitive, orientation and operational components in order to understand the personal value of the profession and self-assessment of the level of readiness for self-realization in it.

教学过程中的协同方法
SYNERGISTIC APPROACH IN THE PEDAGOGICAL PROCESS

Zamanova Melek Alıslam kızı
Candidate of Pedagogical Sciences
Azerbaijan State Pedagogical University

注解。 本文致力于将协同作用作为功能性现代教育系统新方法的基础。 这种方法的出现主要与协同学有关。 关于协同学的不同观点被认为是现代科学研究的方法论。

关键词：协同，自我教育，自组织，教育，培训

Annotation*. This article is devoted to the consideration of synergy as the basis for a new approach to a functionally modern educational system. The emergence of such an approach is primarily associated with synergetics. Different points of view on synergetics are considered as a methodology of modern scientific research.*

Keywords: *synergetic, self-education, self-organization, education, training*

Innovation processes are taking place in 21st century education, which create opportunities for introducing innovations, the content of pedagogical education itself and ways of organizing the educational process. There have been changes in society that have a significant impact on ideas about education, upbringing and education of the younger generation.

Pedagogy as a science of education can not remain the same, as it is morally obsolete in many ways. Pedagogy needs new ideas. the theory of personality "of a certain type" came into conflict with the new goals of social development; The authoritarian system of educational interaction between the teacher and the students has become unacceptable, the technological process of learning has become a brake on school solving new problems. Our society in this transitional period is in such a problematic situation, resolving which, it should change the philosophy of upbringing and education.

Solutions to this problem are discovered by synergetic (Greek. Sinergeia-joint action) —one of the leading scientific directions, designated in modern culture as the natural-scientific vector of the development of the theory of nonlinear dynamics (I. Prigozhin, G. Haken, G. Nikolis, J. Nikolis, I.Stengers, S.P.Kurdyumov, G.G. Malinetsky, S.P.Kapitsa, Yu.L.Klimontovich, etc.)

The role of synergy is twofold. We can talk about synergistic approaches to education, synergistic ways of organizing the process of training and education, as well as about education through synergetics. through the transfer and dissemination of synergistic knowledge. In the first case, synergetic acts as a method of education, and in the second, as its content.

Self-education. Self-organization is one of the key concepts of synergy. In terms of education, this means self-education.

Better governance is self management. Another Taoist said that the good ruler, who manages as little as possible. Formulating this wisdom of the East, we can say that the teacher is good, who teaches, or rather teaches, as little as possible. The main thing is not the transfer of knowledge (it is impossible to transfer everything!), But mastering the ways of knowledge replenishment and quick orientation in an extensive knowledge system, methods of self-education. And in the transfer of this know how the teacher can help. Nonlinear dialogue. The paradigm of self-organization or the synergistic paradigm entails a new dialogue between man and nature. It also leads to a new dialogue of the person with himself and with other people. The nonlinear situation, the situation of bifurcation of the paths of evolution or the state of instability of a nonlinear medium, its sensitivity to small influences, is associated with uncertainty and choice. Making a choice of a further path, the subject is guided by one of his own ways of evolution of a complex system with which he deals, as well as his value preferences. He chooses the most favorable path for himself, which at the same time is one of the spectrum of paths determined by the internal properties of this complex system, i.e. one of the ways implemented in it. Therefore, synergetics can be considered as an optimistic method of mastering, the method of communication between the student and the student. The teacher and the student can be presented as follows.

It is not shifting knowledge from one head to another, not enlightenment and not presenting ready-made truths.

The basic concepts of synergetics are openness, nonlinearity, nonequilibrium. The theory of self-organization operates with such concepts *as bifurcation points, fluctuations, dissipative structures, attractor, fractality*

The education system can be considered open since, firstly, it is constantly undergoing the process of information exchange (knowledge) between the teacher and the student (feedback), targeted information acquisition. During this process, new goals, methods and means of learning appear. Secondly, the content of education is changing, since it does not correspond to the system of students' knowledge and skills at the moment. There is a non-linearity of both the process and the result. The result of the educational process is always different from the intentions of its participants. Thirdly, the constantly increasing educational information space brings the system out of stable equilibrium.

As is known, synergetic proceeds from the principle of the evolution of the world around it according to nonlinear laws. In a broad sense, this idea can be expressed in multivariate or alternative choice.

In the education system, multivariance means creating in the educational environment conditions of choice and providing each subject with a chance of individual movement to success, stimulating the independence of choice and making responsible decisions, ensuring the development of an alternative and independent path. More specifically, this choice is the ability to determine the individual trajectory of education, the pace of learning, to achieve different levels of education, choose the type of educational institutions, academic disciplines and teachers, forms and methods of teaching, individual tools and techniques, creative tasks, etc.

The process of self-organization is a spontaneous emergence, relatively stable existence in open non-equilibrium systems of new structures. Self-organization in the pedagogical system presupposes the existence of a certain interaction between the student and the student, which corresponds to the requirements of the development of the pedagogical system and follows from the objective prerequisites for its self-movement. This allows us to understand the mechanism for the development of the pedagogical process.

Other major concepts of synergetics are also quite correctly correlated with the concepts of traditional pedagogy.

Thus, synergetic can act "as a methodological basis for prognostic and management activities in the modern world. Synergetic is focused on the search for some universal laws of evolution of open non-equilibrium systems of any nature." Using the ideas of synergetics, firstly, it becomes obvious that complexly organized systems cannot be imposed on the paths of their development; secondly, synergetic indicates that any complexly organized system has, as a rule, not the only, but many of its own, corresponding to its nature, development paths; thirdly, synergetic demonstrates that chaos can act as a mechanism for self-organization and self-development of structures, removal of excess.

From the position of synergetics in training, there is no absolute structurelessness, absolute disorder; even chaos becomes the subject of science. And chaos, and chance, and disorganization can be not only destructive, but in certain circumstances contain a constructive and constructive beginning.

The conceptual and methodological novelty of the ideas of self-organization is connected with the recognition of the ability of various systems to self-development not only due to the influx of energy, information, substance from the outside, but primarily through the use of its internal capabilities.

A new synergistic concept can contribute to a deep knowledge of such complex, nonlinear, evolving, open systems, such as society, its various subsystems, including the education system.

The pedagogical process, built on resonant teaching methods, highlights interactions studied by synergy - the modern theory of joint action.

(The term was introduced by G. Haken). According to this theory, any system, including pedagogical, you can not impose a way of behavior or development, but you can choose and stimulate one of the inherent conditions, hoping not to so much on the management, as on the self-governing process, not so strong, but coincident, resonant with the possible development of the impact.

The ideas of synergetics have become the banner of the scientific process today and are evaluated by foreign scientists in the highest possible way. P.V. Alekseev and A.V.Panin write: “The value of a synergistic approach to the study of natural processes is difficult to overestimate. This approach solves the question that “tormented” the founders of thermodynamics: why, contrary to the law of increasing entropy, which characterizes the natural tendency of material systems to a state of thermal equilibrium and disorder, the world around us demonstrates a high degree of organization and order ... scientific basis for speculative philosophical postulates about the internal activity of matter, its desire for self-organization "

Many scientists believe that synergy is the beginning of a new revolution in science.

文化背景下的游戏研究 和教皇
RESEARCH OF GAME IN THE CONTEXT HISTORY OF CULTURE AND PEDAGOGICS

Nadolinskaya Tatiana Vasilievna
Doctor of Pedagogic Sciences, Professor
Rostov State University of Economics (RINH)

抽象。 本文致力于在哲学和教育背景下对游戏现象的实际研究方面。给出了政治，文化社会方面对问题的哲学观点体系。 古代哲学家（柏拉图，亚里士多德，赫拉克利特），中世纪教会的牧师，文艺复兴和教育的教师和思想家表现出其教育，伦理和审美价值。 特别关注游戏和游戏活动的现代方法，在高职培训系统中为教师 – 音乐家准备游戏建模音乐课程的倾向，在戏剧化的基础上建立艺术综合课程的特点 综合学校的游戏（戏剧化），教学条件的发展是艺术游戏活动和教育游戏技术的现代教师。

关键词：游戏，文化，哲学家，教师 – 音乐家，人。

Abstract*. This article is devoted to actual research aspect of game phenomenon in a philosophical and pedagogical context. The system of philosophical views on the problem from political, cultural social aspects is given. Ancient philosophers (Plato, Aristotle, Heraclitus),priests of the church during the Middle Ages, teachers and thinkers of Renaissance and Education showed its educational, ethical and aesthetic value. The special attention is given to the modern approaches to game and game activity, a tendency in preparation of the teacher-musician for game modelling music lessons in system of the higher vocational training, feature of modelling integrative lessons of art on the basis of the dramatized game (dramatization) at comprehensive school, pedagogical conditions of development of is art-game activity and pedagogical game-technics the modern teacher.*

Keywords*: game, culture, the philosopher, the teacher-musician, the person.*

Game had been studied during a long period in development of a civilization by philosophers, culturologists, teachers, psychologists. In the history of culture there were eras (e.g., Antiquity and the Renaissance) when game penetrated all social processes of life. Ethnographers studied game in connection with spiritual culture of humanity.

Factually religious practice remained in the form of experiences in children's game. Participation of children in religious and ceremonial life is noted by many scientists, ethnographers and travelers [13]. In the ancient time there was a general idea about life as a game, discussed by Ancient Greek thinkers. Throughout the whole millennium (VI century BC – V century AD) usual human life and space is understood as game.

A. A. Takho-Godi emphasizes that during a Hellenism era "all human life is represented not simply as an unscrupulous game, but a game scenic, operated wisely" (the translated is ours, T. N.) [12, p. 310]. From this it is possible to draw a conclusion about proximity between art and game origins.

Antique thinkers characterized game from the Space point of view. The Ancient Greek philosopher Heraclitus was one of the first consider children's game as a peculiar model of the Universe: "The eternity – the child, amused of game of chess, a kingdom [over the world] belongs to the child" (the translated is ours, T. N.) [8, page 46]. At the same time this game of world forces is no other than natural state of a universum. According to Losev, the world chaos "is, in fact, only lovely and innocent entertainments of child" (the translated is ours, T. N.) [7, page 365].

In our opinion, in this situation philosophers emphasize universal essence of game activity, its polysemy, drawing analogies to Space, the Universe and surrounding reality. In Ancient Greek literature there are no special compositions according to the education theory. Nevertheless in Platon's and Aristotle's works there are a lot of thoughts and a practical advice for education in which reasoning and childish sports met [1]. Platon highly appreciated game, but treated it idealistically, as game of gods with people: "We, living beings, are the wonderful dolls of gods made by them either for an entertainment, or with any serious purpose" (the translated is ours, T. N.) [10, T. 4, page 283].

Platon connected game practically with all forms of human activity. About value of children's game he writes in several works, e.g. "Republic", "Laws" and "Policy". The philosopher recognizes need in initial education, and is convinced that games here are especially important. In a fragment from dialogue between Socrates and Adimont is social value of games is indicated: "If children start playing early and as it befits, learn correctly to use music, which showed be known by the society" (the translated is ours, T. N.) [10, T keeps. 1, page 214].

Unlike Platon Aristotle treated game as entertainment. In his opinion, the game phenomenon isn't of independent value, and serves only as a condition of success to be engaged in serious deal. At the same time Aristotle considers game absolutely necessary for the education of child as it in a free form can teach and improve skills which are important in adult life.

The philosopher believed that game gradually had to pass into the doctrine and

work [10, T. 2, 87]. Modern thought is: game is not only an important form of children's life, but also means of preparation for life.

In Ancient Rome people also loved festivals and representations which occupied, as well as in Ancient Greece, considerable part of public and private life. In all games there was a usefulness element, and any game had bigger educational value (e.g., “Trojan games”).

The word ludus Romans designated not only game, but also exercises which were carried out for physical and spiritual development. They also understood school as the around us word and teachers were called magister ludi [3].

The Roman philosopher, the teacher, theorist of oratory Mark Faby Kvintilian is considered to be the first professional teacher who opened a public school. Kvintilian's work "About education of the speaker" is a detailed course of antique rhetoric with digression to history of the Greek and Roman literature. The philosopher notes the importance of music education for the speaker as music develops keenness to a graceful arrangement of words and the correct modulation of a voice, cultivates grace and rhythm which are so necessary for the speaker.

In medieval literature children's game is presented poorely. Games were ranked as such things against which it is necessary to fight. In the Middle Ages game dramatization (or a performance, school didactic theater), arisen as means of studying of Latin and education in countries of Western Europe.

In the XIII century in some abbeys school students were recruited in theatrical representations. They played mysteries in Latin. In the XIV-XV centuries school students took part in farces, jokes and comedies which were staged in colleges and in squares. Since 1402 the performance of mysteries was provided in the form of privileges of the Brotherhoods of Christ's Passions Company. We could add that pupils, which couldn't reconcile to such privilege, began to play "moralities". It’s so called plays of the allegorical contents which have arisen from mysteries [9].

Renaissance affected all spheres of life. The Netherlands humanist, philosopher, philologist and teacher Erasmus Rotterdam’s wrote about medieval school: "Greeks called it leisure, rest, Romans called it ludus that is what game means; nowadays it all has the meaning of general rest and game, but not school. Aristophanes designated it as "a place of grief and tortures" (the translated is ours, T. N.) [2, page 92].

Gradually at school were punishment methods dominated, game methods started appearing. The games taking such huge place in the Greek-Roman life, again received former value at celebrations and public shows. The proof to that is the books created during that period. There are "The treatise about game" Antonio Skeno’s (Venice, 1555)", “Hundred again opened games of free arts and the mind concern to them, described in ten books” Ringiyerna’s (Bologna, 1551), "Speaking about games" Intronato (Girolamo Bergali) (Siena, 1582), "Entertainments"

Stsipion Bergali's (Venice, 1587) [3].

In Kolozz D. A.'s book "Childish sports, their psychological and pedagogical value" the author writes that teachers saw again an effective factor of development of child at game. The first place in this process belongs to Italy, other people began to introduce game into training much later. D. A. Kolozza emphasizes that in Italy da Feltre contemporaries called him "the first school teacher of new type" as he used game and entertainments as educational method. Vittorino da Feltre attached great value to game as the method promoting not only spiritual, but also physical development of child [5].

In France the humanist writer Francois Rabelais published the novel "Life of Gargantua and of Pantagruel". It is an encyclopedic monument of culture of the French Renaissance. In chapter twenty two there are more than 200 various games by means of which the young hero has to have a good time and thus occupied the mind and body. Rabelais pointed that any game has to be carried out voluntary and stopped at the request of child.

Transitional nature of culture of Renaissance generated new style of behavior and thinking. An attempt of the embodiment of the game principle of which Platon dreamed, was realized by the Italian humanists. Need of the ripened changes, search of new ways of society development was reflected in it. For example, Leon Battista Alberti criticized "game style" lives, characteristic for this era because he saw disappearance of the true values in it. Unlike it P. Verdzherio, B. Kastilyone and E. Pikkolomini saw possibility in formation moral qualities of the personality and a development tool of physical abilities in game.

The pedagogics of the XVI-XVIII centuries apprehended ideas of Renaissance about efficiency of a game method in the course of education. E.g., in the middle of the XVI century the French philosopher humanist Michel de Montaigne publishes essay "Experiences". In this he described a peculiar skeptical humanity that was against scholasticism and dogmatism [11].

The valuable ideas of game were introduced by M. Luther and Ya. A. Komensky. Martin Luther, the figure of the Reformation in Germany claimed that fun (game) and pleasure were as necessary for the child, as food and drink. Jan Amos Komensky, speaking about parent school and initial training listed advantages of a place to games and explained their need. He recommended game as the main method in personality's formation, and gave theoretical justification of those reasons which put game in training in the forefront.

Ya. A. Komensky processed in a theatrical form all training material not only in the book "An open door to languages", but also in various sketches from the material and spiritual life, described in "The world of sensual things in pictures" [6]. Two plays were devoted to schools and their devices from the first class to academy to other dramatized text about human advantages and defects in real life. One more dra-

matized text showed society, beginning with a family and finishing with the country. The systematic course of training was reflected in "A threshold to languages", "An open door to languages" and "School game", which allowed to increase gradually the knowledge of the and their message on the complicated steps of difficulty. It was also a problem to which Komensky and his followers paid much attention.

Further the theory of game was developed by the English philosopher and the teacher in the field of the knowledge theory John Locke. Pedagogical ideas of the outstanding figure of English Education played a noticeable role in development of pedagogics of the XVIII-XIX centuries, and also in Anglo-Saxon philosophical tradition (including development of analytical philosophy in the XX century) and philosophical works. He reflected huge value of education in the pedagogical treatise "Thoughts of Education", considering that the person at the birth represents a pure board on which subsequently education puts the letters [9].

F. Keira's book "Child's games" is still relevant even to this day. There the author explores activity in different games, which is closely connected with the child's creativity. He offers us the two classifications of games: by origin and by goal. The researcher believes that games, in which the imagination is clearly manifested, depend, to some extent, on heredity. The child's individuality can also be revealed by them [4].

The essential contribution to further development of the theory of game activity was made by scientific researches of the second half of the XX century. N. P. Anikeeva, Yu. P. Azarov, O. S. Gazman, M. V. Klarin, S. A. Smirnov, N. A. Terentyeva, S. A. Shmakov, D.B. Elkonin's etc. Their works diseased the essence of this concept, defined structure of various games and their classification. Nowadays specifics, functions, technology of the dramatized game (dramatization) in the maintenance of the general and higher music education are developed insufficiently.

Today teachers of music understand possible benefits of this method and use it in the learning of art music. In our opinion, the dramatized game gets the general scientific status of a source and method of cultural formation and a reflection of the child. In addition it is a special method of familiarizing of pupils of various age groups to art and search activity at integrative lessons of music. Game modeling works in quality: first, means of formation of art and game activity as component of professional skill of future teacher-musician; second, universal method of art and creative development of school students applicable to subjects of an art cycle (music, world art culture, etc.); third, forms of an integrative lesson of music.

The essence of art and game activity of a teacher-musician is defined by us as establishment corresponding to specifics of an integrative lesson of creative music communications and game relationship between all participants of educational process. It is caused by features and regularities of integrative development of the art, its game pedagogical style influencing formation and communication.

During the past three decades treatment methods of art education are connected with concepts of programmed teaching. The theory of stage-by-stage formation of intellectual actions of Galperin is an interesting field for many teachers.

Five stages of formation intellectual actions are widly recognized.

1. Stage of creation of the scheme of an orientation basis of activity.
2 . Stage of implementation of action in a material activity.
3 . Stage of the external speech.
4 . Stage of the internal speech.
5. At an intellectual stage pupils already carry out and control actions in the course of game dramatization.

The dramatized game (dramatization) acts as game model of an integrative music lesson and a universal method of general, art and music education, reflects and models surrounding reality, covers all parts of development of the personality of pupils. The educational effect on the dramatized game is defined by pedagogical conditions in which there are participants of art-creative process. There is systematic and regular introduction of games, creation of the art and game environment, freedom in the choice of art and creative activity.

For a long time, when studying and describing the experience of the best music teachers, artistry did not attract much attention of researchers, and, at best, was interpreted as a phenomenon, inherent with the theory of education. This important side of creativity has not been fully revealed in the courses of universities of theory of education and the teachers and musician's system of professional development.

In comparing the professions of the actor and teacher-musician we can see that the teacher's work is more difficult than the actor's, as he is acreator of a lesson, a director, and a leading actor. However, with all the specify of the actor and teacher-musician's activities, a lot of common features can be found in them. First of all, both of them are communicative creative processes, which arebased on the process of communication. Second, their goal is to make an impact on a person and to cause certain empathy. Third, the creative process is carried out in an atmosphere of publicity and at a certain period of time, which requires the ability to mobilize yourselves, to manage your creative self-perception. The music teacher, as well as the actor, touches the feelings, thoughts, imagination, and attention of his students through various psychophysical means,

Acting manifestations in the teacher-musician activity represents by the fact that he does not change each time into a new person. He always remains himself, and his mind is the main force of activity. In other words, his transformationoccurs in the inner plane. Pedagogical artifice is manifested by the fact that the teacher plays the position of a student or becomes an active participant in theatrical games.

Comparing the mechanisms of preparation for a specific role or for an integrative music lesson, we should note some differences: for an actor it is a transformation, but for a teacher it is designing an integrative music lesson. The actor

presents himself in a situation of a certain role. At the same time the music teacher presents himself as a leader of a lesson or performer of a particular role (depending on the level of complexity of drama or the degree of theatralization).

There are some differences in the specifics of the "creative sense" of the actor and teacher-musician. The actor's stage sense is different from the vital one in its origin, for it, unlike the teacher's creative self-feeling, arises on the basis of emotional memory. It is not forming in real circumstances. At the same time, actors have got time to"enter the role" before their performance, while the teacher-musician often does not have enough time for "psychological adjustment" and preparation before the lesson.

In our opinion, it is necessary to distinguish three stages of work on the integrated lesson of music or the role that the actor is playing.

The first stage, the pre-rehearsal one, contains an analysis of the artistic material, the birth of the idea. An artistic image is created by the imagination: the actor has the image of a hero, character; the teacher - the image of a lesson.

The second stage, the technical one, works with artistic and musical material, plays a role in rehearsals, plays a music lesson, directs and rehearses music, clarifies the artistic and pedagogical ideas, draws up a plan.

The third stage, the procedural,is the embodiment of the creative intent of the actor at a performance or concert. As for the teacher it is at an integrative music lesson or extracurricular eventin the classroom.

According to each stage of work we can distinguish the qualities that the future teacher-musician should possess:

• for the first stage - the feeling of novelty, self-criticism, an ability to experience internal struggle, a tendency of creative doubt;

• for the second stage - creative imagination, a sense of beauty, an ability to draw analogies;

• for the third stage - self-criticism, substantiation of creative results, an ability to analyze, a breadth and a depth of knowledge, an intelligence and skills.

In conclusion we point out that a game represents conditional model of world around and possesses a sufficient measure of generality to reality reflected by it. The dramatized game (dramatization) gets the general scientific status of a source and method of culture formation and a reflection of the personality. It is a special method of formation of professional skill of the teacher-musician and familiarizing of various age groups with art activity at integrative lessons of art.

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教育创新
INNOVATION IN EDUCATION

Mamedova Gunel Nureddin kızı
Candidate of Pedagogical Sciences, Teacher
Azerbaijan State Pedagogical University

注解。 文章涉及“创新”一词，在教育方面，意味着教育系统的更新和新技术的引入。 当然，一个人为此目的而开发的一切主要是为了提高培训的有效性和效率。

关键词：复古创新，模拟创新，组合创新

Annotation*. The article deals with the term “innovations”, with regards to education, implies the renewal of the educational system and the introduction of new technologies. And, of course, everything that a person develops for this purpose is aimed mainly at improving the effectiveness and efficiency of training.*

Keywords: *Retro Innovation, Analog Innovation, Combinatorial Innovation*

Currently, the term innovation, having moved into the social sphere, has lost its original clear meaning. Economists who introduced this term into practice understood by innovation the embodiment of a scientific discovery in a particular technology or product. The main measure of the effectiveness of innovation changes was the profit. In the social sphere, and even more so in the education sector, this indicator does not work, at least, so unequivocally, as in the economy and material production.

Then, considering innovations in the social sphere and in education, apparently, it is necessary to consider the question of how much they improve the quality of life. Only the concept of quality of life itself or the quality of education that is closer to the topic of pedagogical innovation is multidimensional and therefore does not have an unambiguous definition. The presence of a positive or negative result from pedagogical innovations is difficult to determine for another reason. The effect of the introduction is sometimes detected after quite a long time. These circumstances make pedagogical innovation a highly risky area.

In the education standard of the last generation, another approach was made that could help in assessing the innovations introduced. It lies in the fact that for the

first time in domestic practice in the draft standard an attempt was made to describe the planned result and to evaluate the conditions necessary for its achievement.

But there is another approach. It is that innovation is caused by the crisis of education and is a reaction to this crisis. In this logic, innovations are designed to solve the accumulated problems and suggest ways to solve them. It is possible to single out a number of specific contradictions, which are inherent in national education and up to the present time are not only not resolved, but also exacerbated. These include such contradictions as:

- between the standardized training of all students and their individual abilities and interests;
- between the rapid development of science and the real cognitive abilities of students;
- between the trends towards specialization of learning and the task of diversifying the personality;
- between the dominant school reproductive education and the needs of society for people with developed creative abilities.

This approach does not contradict the first, since solving problems, getting out of a crisis can improve both the quality of life and the quality of education, as its component and the expected result of the educational process.

So, innovations in pedagogy, on the one hand, have become a necessity, and on the other, an extremely risky area due to the lack of simple and clear evaluation criteria. They require, as a rule, a complex examination, which today is equated with the type of research activity and which is extremely dependent on the subjective experience of the expert. Innovations suggest the formation of new pedagogical realities and the emergence of a new cultural tradition.

Another difficulty relates to the technology of innovation. In this context, one can agree that the full-fledged innovation process consists in the formation and development of the content and organization of the new. It is a set of procedures and means by which a scientific discovery or idea is transformed into a social, including educational, innovation. Innovation with such consideration is understood as the result of innovation, and the innovation process, in its most general form, is considered as the development of three main stages: the generation of an idea (in a certain case, a scientific discovery), the development of an idea in the applied aspect and the implementation of innovation in practice. In this regard, the innovation process can be viewed as a process of bringing the idea to the stage of practical use and the implementation of related changes in the social and pedagogical environment. Activities that transform ideas into innovation and form a system for managing this process can be defined as innovative activities.

This activity can be more detailed and then it highlights the following actions:

• determining the need for change;
• collection of information and analysis of the situation;
• pre-selection or self-development of innovation;
• decision making on implementation (mastering);
• the actual implementation itself, including trial use of the innovation;
• long-term use of innovation, during which it becomes an element of everyday practice.

So, according to the degree of novelty, we proposed to highlight the following types of innovations:

1. **Retroinnovation,** when it is transferred to a modern practice in a somewhat modified form already existing in the past, but due to historical circumstances, the phenomenon that has ceased to apply, such as gymnasium, lyceum, specialized training, etc.

2. **Analog innovation**, when a well-known approach is taken and a private modification is made, for example, in the framework of the rating score, a 1000-point scale is used or the modular system is supplemented with a modular block.

3. **Combinatorial innovation,** when from several well-known blocks as a result of their combination a qualitatively new product is obtained.

4**. Essential innovation**, when there really is a new move, for example, the "school of dialogue of cultures".

Fully innovation can only be called the last two types, which imply the emergence of new essential characteristics for the subjects of the innovation process and for its results.

According to the distribution area, innovations can be divided into innovations:

• in training;
• in education;
• in management;
• in personnel retraining.

Based on this typology, it is possible to describe the innovative field of national education, and, therefore, to determine the type of proposed innovation, having decided, at least, the question of its authenticity.

For example, it is proposed to understand new teaching methods, new ways of organizing classes, innovations in the organization of educational content (integration (interdisciplinary) programs), methods of evaluating educational results. The most well-known innovations in this field include:

1. Organization of classes (without destroying the classroom system)

- the creation of homogeneous classes with the right to go to classes of another level;

- the creation of specialized classes;
- methods of collective studies with the creation of a situation of mutual learning;
- game techniques (quizzes, debates).

Organization of classes (with the destruction of the classroom system):
- project method
- school - park,
- creation of network interaction schemes (maybe, it goes both with destruction and without destruction of the class-lesson system).
- individual educational trajectories;
- tutoring.

2. Presentation and transmission of educational content
- reference signals;
- organization of interdisciplinary lessons with the presentation of interdisciplinary connections;
- construction of the educational process in areas of human activity or historical eras;
- creation of computerized courses;
- technologies created on the basis of the principle of complete assimilation;
- immersion method;
- Selection as a specialized national, cultural or cultural aspect of education;
- software training;
- problem learning;
- organization of research activities with the acquisition of new knowledge for students.

3. Methods for evaluating the educational result:
- expansion of the point scale (for fixing the creative advancement);
- rating score;
- creating a portfolio.

By **innovations in education**, it is proposed to understand systems or long-term initiatives based on the use of new educational tools that contribute to the socialization of children and adolescents and allow leveling anti-social phenomena in children and youth:
- the creation of various options for the full-time school;
- the creation of psychological and pedagogical centers and school units;
- creation of a tutorial service inside the school;
- creation of parent-child associations around the school;
- creation of a comprehensive system of additional education within the school;
- creation of systems of additional motivation to socially useful activities.

Innovations in management should be understood as innovations aimed at

attracting representatives of society to the management of educational institutions, as well as original schemes for organizing management and business activities:

- marketing research in the practice of schools;
- creation of school management automation systems;
- the creation of problem groups and departments within the school;
- creation of trusteeship and governing boards with real functions;
- creation of network interaction and structure of interaction of schools (as a rule, in the countryside);
- introduction of vouchers in the advanced training system.

It should also be noted that the majority of innovations, which are now widely implemented by the Ministry of Education, were more concerned not with the content of the educational process, but with the principles of its management. These innovations include:

- regulatory per capita financing;
- transfer of educational institutions to the status of autonomous non-profit organization;
- reforming the wage system.

Under **innovations in the training and retraining of education personnel**, we should consider new teaching methods, new ways of organizing classes, as well as new retraining programs aimed at changing the requirements for the quality of education:

- distance learning;
- creation of network structures;
- tutoring;
- creation of integrated interdisciplinary courses for training new professional groups (education managers, experts, teachers of the specialized school).

现代教师交际能力的本质
THE ESSENCE OF COMMUNICATIVE COMPETENCE OF A MODERN TEACHER

Sulimova Alexandra Valerievna
Senior Lecturer
Bryansk state University named after academician I. G. Petrovsky

注解。 目前，社会对高等教育机构的学生，包括未来教师的学生，提出了越来越多的要求。 “交际能力”的概念与专业技能直接相关，是实现教学技能的一种手段。 本文是在信息检索和理解教育能力方法本质的基础上撰写的。 从不同作者的立场考虑能力，沟通，沟通技巧的概念。

关键词：教育能力方法，交际能力，能力，专业教育活动。

Annotation*. Currently, more and more requirements are imposed by society to students of higher educational institutions, including students of future teachers. The concept of "communicative competence" is directly related to professional skills and is a means of achieving pedagogical skills. The article is written on the basis of information search and understanding of the essence of competence approach in education. The concepts of competence, communication, communication skills from the position of different authors are considered.*

Keywords*: competence approach in education, communicative competence, competence, professional pedagogical activity.*

The education system in the Russian Federation is one of the most influential social institutions, which is organically linked to the foundations of social order. Education on the basis of freedom of choice, intellectual tension in the life of educational institutions, spiritual health of young people and the ability to navigate in changing social conditions are the most important factors in the development of a democratic state. These conditions objectively give rise to the need to solve the problem of professional training of teachers in the context of personal activity paradigm of their self - determination in General and professional culture.

The concept of modernization of Russian vocational education has set a number of challenges for higher education institutions, one of which is the formation of universal competencies that determine the modern quality of the content of

education. At the same time, universal competencies mean "an integral system of universal knowledge, skills, as well as experience of independent activity and personal responsibility of students".

This provision requires the teacher and the student to have a deep understanding of what universal and General professional competences are necessary for the graduate in his / her further professional activity. This, in turn, implies that the University teacher has a high level of competence and relevant competencies for professional orientation in the totality of competencies for the pedagogical activity of the school teacher.

D. I. Feldstein, revealing the role of education in solving the problems of transition of Russian society to another level of development, correctly notes that "... the aging of new historical systems occurs in the conditions of change of values, norms, goals, bases, and in the formation of the information society it is education and science that act not only as a real productive force, but acquire a particularly significant "social force", regulating human activity in search of a way out of objectively created crisis, in search of ways of active and productive development of society. ".

It is known that students are a special socio-psychological group, which is characterized by a specific set of values, the system of interpersonal relationships, the predominant activities. Student period of life, characterized by active socialization-one of the most important stages of formation of professional self-determination. The acquired social experience forms an adequate view of the chosen pedagogical profession in the student, which is reflected in strengthening or changing the motives of her choice, ideas about the professional and personal qualities and competencies necessary for the teacher, in particular, the most important for the modern teacher communicative competence that accompanies the pedagogical process in any form and content.

Research on the problem of competence and competencies dedicated to the work of our scientists and researchers baidenko, L. Grebnev, E. F. Zeer, I. A. Winter, N. In. Kuzmina, A. K. Markova, R. P. Milrud, E. I. Passov, V. Pershin, Yu. G. Bega, Yu. V. Frolova, N. Gridino, A.V. Khutorskoy, V. D. Shadrikova etc. and foreign L. Bachman, C. Velde, B. Oskarsson, D. Raven, D. Hymes, and V. Hutmacher, S. Shaw, and others.

Under the competence of the Winter understands the actual, formable personal quality, as based on knowledge, intellectual and personal due to the socio-professional characteristics of man, his personal quality [5].

According to G. Tatura, competence is the quality of a person who has completed the formation of a certain stage, expressed in the readiness (ability) on its basis to successful (productive, effective) activities, taking into account its social significance and social risks that may be associated with it [11].

E. Symanyuk defines competence as a complex set of characteristics, including a set of theoretical and applied knowledge and skills, value orientation system, habits, etc. [4]. it is defined as a complex set of characteristics, which include the following: operational-technological, motivational, emotional-volitional, ethical, social components, as well as learning outcomes in the form of theoretical and applied knowledge and skills. That is, competence is a set of knowledge in action. At the same time, competence is not limited to a set of competencies.

Pedagogical communication is primarily communication-the transfer of information, the exchange of information between the teacher and students. This is the most difficult aspect of teaching, especially for a novice teacher. To arouse interest in joint communication, it is necessary to be able to draw students ' attention to this process (communication process).

From the positions of different approaches the structural elements of pedagogical communication are singled out. From the positions of the system approach to Bodalev [2],. Leontiev [7], A.V. Petrovsky [9] defined the structural elements of pedagogical communication:

- communication (exchange of information on verbal and nonverbal levels, as well as understanding of information, formation of attitude to it, mutual understanding of communication participants);
- interactivity (planning of common activities at the level of interaction and mutual understanding of communication participants);
- perceptivity (perception and knowledge of each other by people).

The existence of human civilization is impossible without communication between people. Analyzing the problem of communication in the works of outstanding scientists (Ananiev, A. A. Bodalev, A. N. Leontyeva, B. R. Lomova, V. N. Myasishchev et al.), we can conclude that communication is the ability of the individual to establish relationships with others, a special form of activity of the subject. According to the opinion of Bodalev, it is in communication that people reveal their personal qualities, features of their character. B. G. Ananieva we read :" in the process of communication is important not only to demonstrate the personal qualities of the individual, but also their further development in the process of communication, which is due to its ability in the process of communication to learn the human experience that during communication a person learns universal values, knowledge, skills and methods of communication activities..... and then, a person is formed as a person and as a subject of activity, so communication is an important factor and a condition for the development of personality." [1; P. 118].

After analyzing the definitions of communication skills offered by different authors, we offer the following working definition: communication skills – the ability to receive and transmit information with the presentation of speech and non-speech means of contact.

In pedagogical science there are two large groups of means of communication.

Verbal communication (talking) and noverbal means of communication (non-verbal means).

Verbal communication is divided into external and internal, external in turn is divided into oral and written, and oral into monological (oral speech used in the form of lectures, reports, etc.) and dialogical (speech communication of two or more persons).

External communication is information transfer to partners communication; internal communication is communication with yourself [10, p. 178].

Verbal communication is inherent only to man and as a prerequisite involves the assimilation of language, oral and written speech. Communication through the word strengthens and preserves the experience of mankind, cultural and moral values, passing them from generation to generation.

Nonverbal (wordless) communication does not involve the use of spoken language as a means of communication. This communication via looks, gestures, facial expressions and other nonverbal signals [6, p. 48].

In fact, in pedagogical education for professionals working with groups of people, communicative competence is the basis of professional activity. The concept of “communicative competence " is directly related to professional skills and is a means of achieving pedagogical skills. "Communicative competence includes versatile communicative knowledge and skills, which are a psychological tool for achieving the goals of education in full" [8, p. 18].

From the scientific point of view, there are several grounds for the allocation of competencies (and corresponding models of their nomenclature). So Ermakov D. S. distinguishes five such bases – models: socially - oriented, culturological,

personality-oriented, personality-activity and problem-oriented. For example, "... socially – oriented model allocates the competencies spheres of social life: educational, civil, labor, household, leisure" [3, p. 11].

In this classification we were interested in the question of the presence of communicative competence. It turned out that the term "communication" permeates almost all models. So in the cultural model of the components of social experience recorded: "communicative competence". In student-centered model recorded: "competence in communication" and "information competence" [3, pp. 11 - 12].

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UDC 159.9 (075.8)

俄罗斯侨民新疆的民族认同是一个研究问题
ETHNO-IDENTITY OF THE RUSSIAN DIASPORA XUAR AS A PROBLEM OF RESEARCH

Sobolnikov Valery Vasilyevich
Doctor of Psychological Sciences, Professor
Novosibirsk State Pedagogical University
Novosibirsk, Russia

注解。 本文致力于研究俄罗斯“幻影”散居新疆成员对民族认同的影响问题。 概述了俄罗斯人在中国条件下同化时的民族认同状况。 该研究基于L.N.概念框架内对民族的社会生物学理解。Gumilev。 作为专家调查的结果，确定了俄罗斯侨民成员民族认同发展的主要趋势。 已经准备好了对未来分配的特遣队进行研究的基础。

关键词：民族认同，民族发生，民族认同品牌，俄罗斯社区，同化。

Annotation*. The article is devoted to the research of the problem of the influence on the ethnic identity of the members of the Russian "phantom" Diaspora of Xinjiang. A conceptual view of the state of the ethnic identity of Russians during assimilation under the conditions of China is presented. The research was based on the socio-biological understanding of the ethnos within the framework of the concept of L.N. Gumilev. As a result of the expert survey, the main trends in the development of the ethnic identity of the members of the Russian diaspora are identified. The basis for conducting research of the allocated contingent in the future has been prepared.*

Keywords*: ethno-identity, ethnogenesis, ethno-identity brands, Russian community, assimilation.*

China’s entry into global leaders has led, on the one hand, to the complex process of transformation and the fragmentary influence of liberal Western culture, and the other to the emergence of problems of interethnic communication within its ethno-confessional system. In this regard, the problems of the ethnic identity of Russian “Chinese” who are Chinese citizens and permanently reside on its ter-

ritory are of particular interest. The official statistics of China shows the number of the rooted Russian minority for 2017 within 13393 people. The ethnogenesis of the Russian minority proceeded in difficult and dramatic conditions, thereby causing a certain set of problems associated with ethnic identity. As a result, at the present time, the main place of compact residence is formed - Xinjiang Uygur Autonomous Region (XUAR). An analysis of the available literature on the history of Russians in China shows a deep psychological trauma they received, associated with the fear of reprisals. In the context of the above and taking into account ethnic expansion, the problem of the genesis of the ethno-identity of people from Russia who are citizens of China is being actualized.

The definition of "ethnic identity" "is an emotional-cognitive process of the subject uniting itself with other members of the same ethnic group as well as its positive value attitude to history, culture, national traditions and customs of its people, its ideals, feelings and interests, folklore and the language [13, p.298], etc", Consequently, ethno-identity, acquiring the status of an analytical tool, allows you to form an ethnic self-consciousness. A certain system of behavioral and typical personal distinctive features formed as a result of ethnogenesis allows an individual to define another as a member of an ethnos [4, p.340] Among the ethno-defining features, most researchers include ways of perception and thinking, the peculiarity of communication and behavior, as well as a number of other attributive manifestations. Structurally, ethno-identity includes two main components: cognitive (knowledge of the peculiarities of one's group and awareness of one's own member based on ethno-identifying features: language, customs, religion, historical memory, national character, folk art) and affective (sense of belonging to a group, assessment of its qualities, attitude to membership in it) [13, p.301]. It is obvious that ethnogenesis occurs in accordance with the rules of biological evolution, since its structure allows one to establish the limits of the range of variations within which an organism operates with such a genetic code [14, p.17].

However, evolution selects for survival either genes or individual organisms, but not groups as a whole, which is especially revealing in the Russian diaspora in China. So, as a general rule, as the inertial energy of an ethnos gradually died away and completely dissolved in other ethnic groups, an ethnos dies as a result of natural or social disasters, leaving traces in the form of monuments of architecture and cultural artifacts [3, p.121- 122.]. As a result of transformation into a marginal group, ethnos was subjected to complete assimilation. Something similar happened, obviously, with the Russian diaspora in China. The modern understanding of this complex ethnopsychological phenomenon makes it possible to prepare on this foundation a factual basis for further research.

A statement of the presence of Russians in China before the 1917 revolution (representatives of government, industry, etc.), and then a massive influx of mi-

grants from 1918 to 1921 and later, gave rise to the structuring of the Russian diaspora and the formation of the community mentality. This was preceded by the decision of the Government of the New Russia in the waiver of the rights of extraterritoriality and the granting of the right of choice to the Russian population: Soviet citizenship or emigration [8, p.194-201]. The defeat of Japan after the Second World War and the end of the Chinese civil war with the victory of the CCP led to the final liquidation of the organizational structures of the Russian diaspora. In the period from 1949 to the mid-50s of the XX century, the departure of Russians to other countries took place (Australia, Canada, USA, etc.) and mass repatriation to the USSR. Most researchers believe that this is the end of the history of the Russian diaspora in China.

However, the analysis of this process reveals the entire range of collisions at the epicenter, which the Russian community turned out to be. A number of researchers believe that the Russian diaspora in China did not receive the necessary opportunity to go through its evolutionary path [1, p.39]. The absence of China and Russia in common in history, culture, religion and psychology deprived the Russian community of the prospect of its becoming an ethno-cultural group that is an organic part of the country of residence [9, pp.15-17]. In this case, it is necessary to take into account a significant degree of the probability of assimilation of a certain part of representatives of the second and subsequent generations of emigrants by the formula in favor of the “big neighbor”.

An analysis of the available literature makes it possible to single out a fundamentally significant position related to the fact that any diaspora, including the Russian one, has its own development history, distinct from others. The absence of any universal content in the term “diaspora” [6, pp.24-25] allows us to consider the process of probabilistic formation of awareness of the ethno-cultural development of members of the diaspora. At the core of this process was the objective factor of the movement of their ancestors from Russia to China and the preservation of a special sense of affection for the “historical homeland”. Time has shaped the group myth of the diaspora about their homeland, which was transmitted through the next generations through historical memory and archetypes. Dominated by the understanding that in this capacity they will not be accepted by the community of residence. The arising sense of alienation and loneliness was associated with ethnic discrimination and low status. The manifestation of nostalgia was combined with faith in the Motherland as a sacred place and an ideal home, where they will return in any case.

In the context of the above, formed a distinctive Russian community with a specific manifestation and system of internal relations was formed on the basis of a newly constructed collective connection, group solidarity and style of life behavior. Considering, the Russian community in China should consider its complete

isolation over a long period of time, considerable loss of life (emigration, repression, etc.), as well as susceptibility to local integration of assimilation. Vendina T.I. in this regard, notes the gradual disappearance of the specifically "peasant", spirit and language, typical of Russians [2, pp.189-191] in China. Actualization of the problem of studying the Russian community is currently determined by the degree of their integration into Chinese society, deep knowledge of the mentality and psychology of the Chinese, as well as the specifics of communication processes. However, the modern life of Russians (the cartography of ethno-identity, features of the transformation of ethnicity, the process of applying the second, third and other generations to Russian culture and language, etc.) in China remains outside the scope of the interests of domestic and foreign researchers. Here one can agree with the opinion of a number of researchers that many aspects of the life of the Russian diaspora remain virtually unknown to the scientific community [5, pp.23-24].

It should be emphasized that the authorities of China consider the problems of national minorities, as a rule, from the standpoint of the quality of economic and legal supervision. As a result, the degree of adaptability of members of the Russian diaspora of Xinjiang is significantly reduced. Possessing a certain uniqueness, for example, the lack of intelligentsia, representatives of creative and humanitarian professions, they, as a rule, had a low educational level of representatives of the working population. At the same time, the degree of their politicization was determined by the activity of the spiritual center - the Orthodox Russian Church. Therefore, at the stage of the collapse of the Russian diaspora in Xinjiang there was no national majority. The ethnic system at that time included, along with the Russians, representatives of other nationalities — the Chinese, the Uygur, the Dungans, the Tatars, who provided for trilingualism. Uygur, Chinese and Russian were the means of international communication and, in fact, pushed their representatives to the process of assimilation.

The ethnopsycholinguistic norm developed in the process of ethnocontact communication, which exists simultaneously for both Chinese and Russians, began to play a definite role in this process. It should be noted that this norm represented a definite set of auto-stereotypes of the social, ethnocultural and speech behavior of the individual [10, p.54-67]. Evidence of this can be detected sufficiently, for example, the intelligence of the Chinese is revealed in hard work, diligence, responsibility towards the family, imitation, which is simultaneously seen in the activities and behavior of members of the Russian community [9, p.13-14]. Obviously, this can be quite a powerful unifying start. The presence of common preferences really ensured not only their convergence, but also launched assimilation mechanisms. An important factor in assimilation was security issues, especially during the years of Japanese colonization, the end of the Second World War, the “cultural revolution”, etc. On the whole, the polyfactory nature of the causes and

conditions prompted the Russians to become aware of their commonality, to support the collective myth about the historical motherland and its ministry, which was manifested in the phenomenon of the “phantom diaspora”. “The Russians in Xinjiang, rightly believes A.V. Popov, through painless adaptation, made their entry into a new foreign language environment in the complete absence of assimilation” [8, p. 194-201].

In order to determine the ethnic identity of the Russian Chinese, we conducted an expert survey. The selection of experts was carried out from among persons with independent judgment, capable of creatively solving non-obvious tasks, possessing intuition. There were 12 experts who are experts in China in the humanities, 40% of whom have an academic degree or title. The preliminary work was related to the development of a questionnaire to identify ethno-identity, determine the methods, procedure and algorithm for conducting an in-person interview of experts and analyzing the data obtained. A free expert interview, for us, was a diagnostic goal - to determine the ethnic identity of Russians in Xinjiang, in order to more accurately formulate the subject of further research. The method of M. Price was used as the methodological basis [11]. The research was based on the assumption that the current situation of the Russian community in China is specific and the ethno-identity of its members is “phantom” in nature. Therefore, the goal was to study, through an expert survey, their ethnic identity.

The results of the expert survey show the inevitable influence of China on the Russians and their descendants living in Xinjiang. The degree of such influence in the area of functioning of the two cultures transformed Russian culture, causing, in some cases, signs of opposition to this process. In their minds revealed the presence of two peoples. In particular, in the process of communication they use everything Chinese: the mentality, psychology of communication, etc. At the same time, internal cognitive processes occur close to those models that were used by their Russian ancestors. In the total number of semantic structures, they often distinguish the concepts of Russia and China, but all these manifestations are recorded within the framework of the XUAR. Among the "indigenous peoples" of China, they listed the Uighurs and the Chinese, and they consider themselves to be the last. However, at the same time, they show the territory of residence of their ancestors and highlight the "phantom" connection and community with Russia. Up to 65% of their number indicates the presence of significant problems associated with such phenomena as: extinction, discrimination, and oppression. At the same time, the old Russian population clearly defines its membership in Russia. However, the content of youth’s ethno-identity is excellent and consists in a sufficiently developed reflection formed on the idea of oneself and belonging to an ethnic community. In the process of an expert survey, no predisposition to ethnonegativism was found among them. Moreover, regional and religious

ethno-identity was revealed, with a positive tint to their attitude towards both Chinese and Russians. In some cases, recorded multiple ethno-identity in the form of attributing themselves to two or more ethnic cultures. Moreover, its individual representatives have several types of ethnic identity: "norm" and "ethnic indifference", which may indicate the vagueness of ethnic identity.

The scope of this article does not sufficiently reflect the various aspects of the ethnic identity of the Russian community in Xinjiang. In general, along with the involvement in the ethnocommunication of the established ethnic system of China, a certain influence of religious, national and traditionalist attitudes that form a specific type of discourse in the Russian environment is seen.

An analysis of the state of the Russian "phantom diaspora" convinces us that, along with non-assimilated Russians, it includes descendants from mixed marriages of Russians with Chinese in the second, third and fourth generations. At the same time, people who speak Russian and who are familiar with Russian traditions are not enough. At the same time, certain representatives of the community, fluent in Chinese and Russian, work quite successfully as translators of various companies, including in Russia (Chita, Blagoveshchensk, Khabarovsk, Vladivostok, etc.). In modern conditions, the younger generation of Russian Chinese are discovering their belonging to the ethnic group, to the Russian super-ethnos. There is a significant increase in interest in Russian history, culture and language, the shortage of which they fill with the help of the Internet. At the same time, the older generation is nostalgic and expresses the desire to preserve the elements of the Russian way of life in everyday life. Under these conditions, the definition of the subject for further research of Russians living in Xinjiang remains extremely important in all respects. The expansion of contacts between our countries will contribute to the spiritual rapprochement of culture and the enrichment of nations, transforming the habits and behavior of people, affecting their value orientations. At the same time, the loss of the spiritual values of the Russian diaspora in China can lead to the disappearance of a powerful layer of Russian culture.

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成功的加油站运营商个人能力模型的标准
CRITERIA OF SUCCESSFUL PERSONAL MODEL OF COMPETENCE OF GAS STATION OPERATORS

Fedotova Irina Viktorovna
Doctor of Medical Sciences, Head of the Department
Vasilyeva Tatiana Nikolaevna
Candidate of Biological Sciences, Researcher,
Nizhny Novgorod Scientific Research Institute of Hygiene and Professional Pathology
Nizhny Novgorod, Russia

关键词：加油站操作员；压力因素；个人能力模型；专业健身。
Keywords: *gas station operator; stress factors; personal competence model; professional fitness.*

The “Profession of the Century” or operator activity is not only massive and dynamically developing, but also has a long-term development perspective in the information society [1-7]. It is known that the human operator takes the leading place in the “human-machine” system, controlling technical devices, he is responsible for the successful outcome of the impact on the object and the normal operation of the technical device [3-5].

The specificity of operator activity is that it is carried out in conditions of an endless stream of incoming tasks, lack of time and overflow of the operational memory of a person. Information about an unfavorable, dangerous event is a starting point, determining the threat of its occurrence and forming an operator’s sense of anxiety, its functional intensity based on updating the mental image of the situation of professional activity. The response of the organism to the flows of various modal information is the occurrence of informational stress [4-6].

Mental health and resistance to the information stress of operators determines their performance and professional reliability. There is a group of operator specialties in which both the risk for the operator’s own health and the health of other people are combined, which increases the emotional burden on the worker [3, 4, 6, 7]. The important characteristics of the operator activity are the monotony of the

load (it can also be observed with light labor) and the duration of the working day. The researchers note that the longer the actual working hours (from 6 to 12 hours), shift work with the presence of night shifts, the higher the labor intensity of the operator [4, 7]. The operator is required to have a high level of development of various professional qualities and features - psycho-physiological, neurodynamic and psychological. The latter include probabilistic forecasting, monotonous and stress tolerance, the presence of a motive for achieving success, responsibility, installation on the accuracy and accuracy of actions, the ability to act urgently in an emergency, etc. [3, 4].

The purpose of this work was to study individual indicators of the personal sphere of typical representatives of the camera profession - gas station operators (petrol stations) and the definition of the criteria for the personal model of their competence, determining career growth.

Material and research methods

The study involved 25 petrol station operators aged from 21 to 43 years and work experience from 1 to 6 years. Two groups of subjects were identified - 15 low-level operators (group A) and 10 senior operators (group B).

Psychodiagnostics of individual indicators of the personal sphere was performed using the following set of standard techniques: 1) J. Holland's typological questionnaire; 2) questionnaire "Anchors career"; 3) test; 4) the method of “Motivation for success” (T. Ehlers); 5) test K. Thomas, U. Kilmenna; 6) SACS scale.

Psychodiagnostic complex is used to determine a number of indicators of the personal sphere necessary for the successful implementation of professional activities: professional types; career orientations; communicative and organizational inclinations; motivational orientation of the person to achieve success; preferred behavior strategies in conflict situations; coping strategies and coping patterns. For processing the results used methods of variation statistics, Student's t-criterion.

Results and its discussion

The petrol station is designed for receiving, storing and issuing automotive fuel, oils, lubricants, spare parts and special fluids for vehicles and their maintenance, as well as providing services to owners and passengers of vehicles. Petrol station operators can be attributed to a mixed style of operator-dispatching work, they work mainly in the mode of immediate service, perform mainly performing actions, guided by clearly regulating instructions [7, 8].

The operator of the gas station provides maintenance of an automated system for filling fuel and lubricants on credit cards, in cash, using an electronic input and display device, a hardware unit and a cash register; checks the accuracy and controls the fuel delivery of the fuel station, the correctness of the information on the scoreboard; in case of malfunction of the serviced equipment informs the master about the damage, etc. [eight]. One of the main duties of a gas station operator is

compliance with safety rules, so he periodically checks the operability of fire extinguishing agents, controls possible actions by customers who may contribute to fire [8]. Standardly, the working day at the gas station can last 12 hours, the time of day alternates. The main professional-important qualities of the petrol station operator, along with those typical for the representatives of the operator's professions, include: stress tolerance, the motivational orientation of the individual to achieve success and communicative competence [3, 4, 8]. The results of the study of two groups of operators, using a set of techniques aimed at studying the indicators of the personal sphere, are presented in the table.

The table shows that when all subjects take the preference of the professional type Realistic, the senior operators are distinguished by the choice of the types Intellectual ($t = 2.55$; $P < 0.05$) and Conventional ($t = 4.67$; $P < 0.001$) and the denial of "Social" ($t = 3.75$; $P < 0.01$). Operators of group B show rationality, prefer to work according to instructions and certain algorithms (in accordance with the "information model" of the operator's activities). The operators of this group, in contrast to the operators of Group A, who are inclined to the "Social" professional type, do not want to teach and educate those around them, but they also do not seek to demonstrate sympathy and empathy.

The choice of professional types is also due to the predominance of value orientations in a career: for operators of group B, such are "Professional competence" ($t = 3.56$; $P < 0.01$), "Stability of work" ($t = 2.31$; $P < 0, 05$) and Call ($t = 4.07$; $P < 0.001$). Although they control others within their competence, they may consider this function as a necessary condition for advancement in their careers, which is typical of representatives of the "Intellectual" professional type.

People with a career value orientation "Stability of work" value social guarantees, a stable position of the company in the market. As a rule, this orientation is combined with a low level of claims, and employees shift the responsibility for managing their careers to the employer, thereby limiting their mobility.

Table

The results of comparative psychodiagnostics of individual indicators of the personal sphere of the operators of the two groups (in points)

The studied indicators of the personal sphere of operators	**Group A**	**Group Б**
Professional personality types (J. Holland)		
1. Realistic type	8,7±0,51	9,9±0,47
2. Intellectual type	6,5±0,57	8,5±0,54*
3. Social type	9,3±0,83	5,8±0,43*
4. Conventional type	5,9±0,38	8,0±0,25*

5. Adventurous type	4,8±0,64	4,7±0,46
6. Artistic type	6,8±0,91	5,1±0,71
Career Value Orientations (Career Anchors)		
1.Professional competence	4,9±0,44	6,9±0,35*
2. Management	5,7±0,59	6,4±0,36
3. Autonomy	6,6±0,27	7,0±0,37
4. Stability of workplace	6,9±0,33	7,8±0,2*
5. Stability of residence	6,8±0,34	7,3±0,21
6. Ministry	6,8±0,4	6,2±0,57
7. Call	4,9±0,38	7,1±0,39*
8. Integration of life styles	6,7±0,3	7,1±0,46
9. Entrepreneurship	4,3±0,38	4,7±0,33
Conflict behavior strategies (K. Thomas, U. Kilmenn)		
1. Rivalry	2,7±0,27	3,8±0,35*
2. Collaboration	4,8±0,4	6,9±0,54*
3. Compromise	7,7±0,24	7,6±0,59
4. Avoidance	7,1±0,3	5,4±0,45*
5. Fitting	7,2±0,38	5,7±0,48*
Communicative and organizational propensity (CBS)		
Communicative inclinations	3,1±0,19	3,0±0,25
Organizational leanings	2,3±0,16	3,4±0,25*
Motivation for success (T. Ehlers)		
Motivational orientation of the person to achieve success	16,9±0,73	19,5±0,63*
Survival Models (SACS)		
1. Assertive actions	18,7±0,55	20,5±0,63*
2. Joining social contact	25,8±0,74	28,3±0,48*
3. Search for social support	25,2±0,91	28,0±0,67*
4. Cautious actions	20,9±0,73	21,5±0,88
5. Impulsive actions	16,5±0,73	16,6±0,75
6. Avoidance	17,1±0,77	16,5±0,63
7. Manipulative actions	18,1±0,81	20,6±0,59*
8. Asocial actions	16,1±0,96	13,7±0,6*
9. Aggressive actions	16,0±0,67	16,1±0,8

Note: * - the difference in performance of the two groups of operators is statistically significant (P <0.05).

Senior gas station operators, who consider the Challenge to be a career value, prefer to solve complex tasks, they are seized by the struggle for the sake of victory, their motto is “novelty, diversity and challenge.” It is natural that, in conflict situations, they, unlike group A operators, prefer two strategies of behavior - “Competition” ($t = 2.49$; $P < 0.05$) and “Cooperation” ($t = 3.13$; $P < 0.01$), and reject - “Avoidance” ($t = 3.14$; $P < 0.01$) and “Adaptation” ($t = 2.45$; $P < 0.05$). It can be assumed that if in critical situations the senior operators demonstrate an authoritarian style, i.e. prefer their own solution to the problem (“Rivalry”), then in everyday conditions they are able to explain their desires and listen to the other side, which allows them to work out a long-term mutually beneficial cooperation (“Cooperation”).

Senior gas station operators, as managers, demonstrate a higher level of organizational inclinations ($t = 3.7$; $P < 0.01$) as compared with operators of lower categories (see table), which is typical for individuals who prefer career value orientation "Professional competence."

The results of psychodiagnostics of the motivational orientation of the individual to achieve success indicate a moderately high level of motivation in the subjects of both groups, which indicates that these specialists prefer an average level of risk.

Job satisfaction for a working person is associated with the need to find new and new meanings in their work, the motivational orientation of the individual to achieve success. The value of the indicator of the motivational orientation of the individual to achieve success among the operators of Group B is higher compared to Group A ($t = 2.71$; $P < 0.05$), which is natural for persons with a behavior strategy in conflict situations "Rival" and value career orientation. Call".

To compile a full-fledged personal model of competence of gas station operators, assessing the level of stress tolerance, it is of interest to characterize coping strategies and patterns of overcoming behavior. The results indicate that the operators of both groups exhibit medium severity of active ("Assertive actions") and indirect ("Manipulative actions") coping strategies, high severity of pro-social coping strategies ("Entering into social contact", "Search for social support "). Operators of group B tend to resort to four models of coping behavior - “Assertive actions” ($t = 2.15$; $P < 0.05$), “Entering into social contact” ($t = 2.83$; $P < 0.01$), “ Search for social support "($t = 2.28$; $P < 0.05$)," Manipulative (indirect) actions "($t = 2.5$; $P < 0.05$), while the subjects of group A choose a coping model - “Asocial actions” ($t = 2.12$; $P < 0.05$).

The research results allowed to develop a competence model for a successful gas station operator (Fig.). It was found that “successful” specialists differ from “unsuccessful” preferences of “healthy” models for overcoming difficult situations, which is expressed in higher rates of assertiveness (confidence) of be-

havior, entering into social contacts, seeking social support and in lower rates of aggressive and asocial action. “Successful” specialists often use indirect actions (“manipulative actions”), rationalization and the search for positive in emotionally intense business communication situations as compared to “unsuccessful ones”.

Fig. *Competence model of a successful gas station operator*

Crisis situations “successful” are considered as new experience, useful for the future life and professional career. On the contrary, the “unsuccessful” are characterized by an asocial (rigid, dogmatic, cynical, inhumane actions) or aggressive strategy, which can be explained by a compensatory mechanism for overcoming internal discomfort (a complex of self-doubt) or negativism with respect to the surrounding. Thus, the “successful” behavior patterns are characterized by activity, prosociality, and flexibility. Consequently, senior gas station operators use “healthy” models for coping with stressful situations.

Conclusion

Comparative psychodiagnostics of professional indicators of the operators of gas stations of two groups showed that senior operators differ from operators of a lower professional level: the choice of "Intellectual" and "Conventional" professional personal types and rejection of "Social"; the preference of three value career orientations - "Professional competence", "Stability of work" and "Challenge".

Senior operators are characterized by the presence of organizational tendencies and motivational orientation of a person to achieve success; in conflict situations, they prefer to use two strategies of behavior - "Competition", "Cooperation", refusing strategies "Avoidance" and "Adjustment". They are characterized by healthy patterns of coping behavior - "Assertive actions", "Entry into social contact", "Search for social support" and "Manipulative (indirect) actions".

The results of the study can be used to assess the level of personal competence and professional competence of gas station operators, psychological support for the professional development of the operator at different stages of professionalization (adaptation, professionalization and skill); in determining the professional and psychological potential of the employee; professional suitability of candidates for the position of senior gas station operator; personnel reserve training; psychodiagnostics and psychocorrection of professional destructions, etc. Psychological support of the professional development of the operator can include both group and individual forms of psychological professional counseling.

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UDC 165.19

应用框架理论解决前提知识问题
APPLYING OF THE THEORY OF FRAMES TO SOLVE THE PROBLEMS OF PREMISED KNOWLEDGE

Nikolina Nadezhda Valeryevna
Candidate of Philosophical Sciences
College of Food, Commerce and Services,
Tomsk, Russia

注解。 文章揭示了前提知识的定义，结构和基本特征，提出了解决前提知识问题的方案。 分析了框架理论的社会心理学，控制论和语言学方面。 框架理论被提出作为现代哲学中先决条件知识问题的可能解决方案。

关键词：框架，先决条件知识，条件，依据。

Annotation. *The article reveals the definition, structure and basic characteristics of prerequisite knowledge, presented options for solving the problem of prerequisite knowledge. The socio-psychological, cybernetic and linguistic aspects of the theory of frames are analyzed. Frame theory is presented as a possible solution to the problem of prerequisite knowledge in modern philosophy..*

Keywords*:* frame, prerequisite knowledge, condition, basis.

1. The Problem of prerequisite of Knowledge

The problem of prerequisite knowledge 10–15 years ago was not as relevant for philosophical studies as it is in modern Russian philosophy. In philosophical literature it is increasingly possible to find attempts of definition the prerequisite knowledge, search for solutions to its problems. We give examples of definitions:

• “Today, philosophical principles, ideals and norms, general scientific methodological regulatives, as well as the scientific picture of the world, thinking style and common sense concepts are considered as prerequisites for scientific knowledge. Their theoretical, conceptual and sub-conceptual forms are identified, the role at different stages of cognition and justification, in various cognitive procedures, as well as their introduction methods and forms of presence in

scientific knowledge are explored. It seems that it is this kind of prerequisites and, accordingly, the form of knowledge and cognitive activity should be included in the content of the term "prerequisite knowledge" [1, p. 318-319].

• "Since it [prerequisite of knowledge] is in many cases characterized as a form of unconscious knowledge, close to the threshold of so-called conscious thinking, it can be designated by the Freudian term "preconscious" located in the "target" between "unconscious" and "conscious"" [2, p. 174]

• "Premisability necessarily indicates the conditions for accomplishment of the subsequent parcel, but not the parcel itself, which is related in its sense to the category of the base. The premise itself can be realized, and maybe not. That is, premisability is the possibility of sending. Reasonableness always implies the existence of specific grounds. Premisability is not a connection between premises, since it only presumes them "[3, P. 25].

• "Prerequisite knowledge is called so because it precedes the real empirical and theoretical activity of a scientist" [4, p. 52].

Based on these definitions, one can say that prerequisite knowledge is a condition that determines the basis of any knowledge, participates in its formation, performs a constructive-creative function and can be represented by various forms (depending on the type of knowledge).

Among the forms of prerequisite knowledge, conceptual ones are distinguished: paradigm, style of scientific thinking, scientific picture of the world, episteme, and preconceptual ones: a priori forms, ordinary ideas, prejudices, etc. The identification of forms of prerequisite knowledge allows not only to consider prerequisite knowledge from different sides, but also to reveal the problem of prerequisite knowledge. The problem is that there is no concrete, single example of prerequisite knowledge. For example, the phrases "solid table", "soft pillow", "red rose" can be defined as sensory knowledge or "the morning is wiser than the evening" - as ordinary knowledge. Prerequisite knowledge exists in a given context, so researchers tend to call such knowledge inferential, aimed at the result. The above examples, if they are the conditions of another knowledge, can be defined as prerequisites. The search for theoretical constructs that help solve the problem of prerequisite knowledge becomes the main task of researchers. The transition from the abstract to the concrete understanding of what prerequisite knowledge is through the disclosure of its forms.

In modern philosophy, attempts were made to solve the problem of prerequisite knowledge. Select the following options:

1. Understanding the *prerequisites* of knowledge as a universal, but hidden condition for the emergence of knowledge. Such variants were presented in Western philosophical concepts until the end of the 19th – beginning of the 20th centuries: "inborn" ideas, a priori principles, an absolute idea. In Russian philosophy,

they include the "incomprehensible." They are not conditions of a certain kind of knowledge, therefore they are thought of as universal. However, they are implicit, hidden in knowledge, in some cases characterized as external to it [knowledge]..

2. Understanding the *prerequisites* of knowledge as a contextual and open condition for the emergence of knowledge. Such options include scientific concepts: paradigm, scientific picture of the world, style of scientific thinking, research program. They are contextual conditions for obtaining knowledge in a particular historical era. This approach to understanding prerequisite knowledge and solutions to its problems is built on the position of internalism. The change of scientific pictures of the world or paradigms affects not only the emergence and development of scientific knowledge, but also extra-scientific. The proposed options are explicit, open to the analysis of changes occurring in the process of cognition.

3. Understanding *the prerequisites* of knowledge as a contextual, but open and at the same time latent condition for the emergence of knowledge. Such options include sociocultural concepts: ideals, principles, norms, personal sense data. For example, I. R. Gabdullin solves the problem of prerequisite knowledge by introducing the concept of “prejudice” into the field of research of prerequisite knowledge. This approach is based on the position of externalism, solutions to the problem are limited to a specific context. Changing conditions (personal preferences, social attitudes) affects the context and changes it. On the one hand, they are explicit, open for revealing the dynamics of knowledge, on the other hand, implicit, hidden from the observer (when it comes to personal motives).

Designation of approaches to the understanding of the premisability of knowledge allows us to form the structure of the prerequisite knowledge. The structure can be represented as the interaction of the absolute (universal), scientific and sociocultural prerequisites of knowledge. In addition, there are two types: universal and contextual prerequisites of knowledge, the latter are divided into scientific and socio-cultural.

Based on the definitions, approaches and structure, the basic characteristics of the prerequisite knowledge are formed: the first, independent, chronologically localized, represented by various forms, explicit and / or implicit.

2. Theory of frames and its application

Frame theory is one of the rather deeply developed theories in modern philosophy. In modern literature, you can find research, articles on the theory of frames in the field of philosophy, linguistics, cybernetics, sociology, etc. This article discusses the use of the theory of frames from various fields of knowledge to solve the problem of prerequisite knowledge.

I. Hoffman is defined as the founder of the socio-psychological theory of frames. In his research "Analysis of frames: an essay on the organization of everyday experience," he wrote that a person recognizes an event in accordance with the

interpretation schemes or frames that are observed in any perception. “I am talking about primary frames, because the use of a scheme or perspective by a person does not depend on any other basic or“ real ”interpretation and goes back to them; undoubtedly, the primary frame system is just that which reveals something meaningful in those features of the scene that otherwise would have no meaning ”[5, p. 81]. Frame systems are divided according to the degree of organization, which can be called structural and spontaneous. Structural frames have a developed system of principles, beliefs, norms, spontaneous - without a clear system, they set the surface understanding, the possibility of an event. Despite the degree of organization, the frame system, according to I. Hoffman, allows “to localize, perceive, determine a virtually infinite number of single events and assign them names” [5, p. 81]. For the subject of perception, the frame structure remains implicit, which does not prevent the subject from using it. However, this does not mean that the subject or (as I. Hoffman later wrote) the social agent does not realize the presence of frame systems, only the structure remains implicit for him. “It is not true that the primary frame systems are invented, in a certain sense they correspond to the way the organization of this activity - especially the activity that considers social agents in itself. It's about organizational prerequisites of something that human knowledge masters, to which comes and what it cannot create only through its own creative efforts. If acting individuals understand what works here, they adapt their actions to this understanding and usually find that the world in motion helps such adaptation ”[5, p. 320] Such prerequisites that rely on consciousness and activity, I. Hoffman calls the "activity" frame.

Based on the definition of the I. Hoffman frame system, the following characteristics can be distinguished, similar to the characteristics of prerequisites knowledge (in the following examples, emphasis is placed on differences, since the characteristics are repeated):

- primary system - it is a condition for understanding the event and a condition for activity;
- independent system - has the structure, definition, characteristics;
- chronologically localized system - frames as a system of beliefs, norms and principles of a certain culture (most reflected in the research of I. Hoffman, “Representing oneself to others in everyday life”);
- explicit and / or implicit system - depending on the event, frames are recognized and used in organized activities or are not recognized by the social agent.

Considering the result obtained, it is not necessary, however, to make hasty conclusions and identify the frame system with prerequisite knowledge. This definition of frame system allows you to uncover social conditions for understanding events. Frames, in the interpretation of I. Hoffman, can be included in the third version of the solution of the problem of prerequisite knowledge, that is, an un-

derstanding of the prerequisites of knowledge as a contextual, but open and / or hidden condition of knowledge. The main argument in favor of such a decision: I. Hoffman developed ideas about the frame system based on observation of the relationship between people in society. Personal beliefs, norms, principles, as well as prejudices (they can be scientific and unscientific) influence the development of scientific and sociocultural knowledge.

M. Minsky is considered a supporter of the cybernetic frame system. In his work "Frames for the representation of knowledge," he defines a frame "in the form of a network consisting of nodes and connections between them" [6, p. 3]. A frame is a program, a set of semantic and structural elements. The subject, like a machine, has a system of codes and uses them depending on the event. It offers 4 levels of frames:

1. "*Surface syntactic frames* are mainly structures with verbs and nouns" [6, p. 31]. For this level, you must follow the order of words in the sentence. English, the author wrote, is distinguished by strict adherence to the rule of putting words in a sentence, deviations in the rules were allowed only if necessary to emphasize a particular semantic coloring.

2. "*Surface semantic frames* are groups of words united around actions" [6, p. 31]. For this level, it is necessary to define and establish relations for the subjects involved in the activities (performers, customers), the tools of activities, goals and objectives, projects, strategies, models, as well as possible positive and negative consequences, i.e., semantic and structural frames for descriptions of any activity.

3. "*Thematic frames* are scenarios for activities" [6, p. 31]. For this level, it is necessary to have or create a scenario in which external and internal circumstances will be taken into account, including environmental conditions, actors, the most significant problems. All elements of the script must be associated with a given topic.

4. «*Narrative frames* are skeletal forms for typical stories, explanations and argumentation" [6, p. 31]. For this level, it is necessary to establish whether all the elements of the narration are in the agreement: the forms of construction, the course of development of the action, the actors, the events. Compliance with the rules of constructing stories, taking into account important structural elements helps to build new thematic frames.

The frame system helps to create and understand the event. Frame - the structure of the necessary elements, without which the event does not take place. The subject sequentially forms the stages (levels) and fixes them. The frame, M. Minsky wrote, is a set of questions that need to be asked about the intended situation; on their basis, the list of topics to be considered is clarified and the methods required for these purposes are defined" [6, p. 32].

As in the example of the I. Hoffman frame system, in the system of M. Minsky,

it is possible to distinguish characteristics similar to such characteristics of prerequisite knowledge as: the primary system — the frame system determines the development of the situation; independent; chronologically localized; explicit - the formation of an event involves the presence of conscious stages. The cybernetic frame system is included in the second solution to the problem of prerequisite knowledge, i.e. understanding of the premise of knowledge as a contextual and open knowledge condition. M. Minsky applied the scientific or, one might say, cybernetic (computer) approach to the disclosure of the notion "frame".

The supporter of the linguistic theory of frames is considered Ch. Fillmore. In the article "Frames and Semantics of Understanding", he wrote: "although in the semantics of frames we are really studying the ability to understand the conditions necessary to be performed in any situation or in any" world "in which or for which a given language text can be considered" justified ", this ability does not require the ability to decide when individual sentences can be called" true ". The semantics of frames requires an explanation of the ability of a native speaker to "recreate" the "world" of a text, based on the interpretation of its elements "[7]. Developing the idea of frame semantics, Charles Fillmore shares the semantics of understanding (U-semantics) and the semantics of truth (T-semantics). He explained T-semantics with the example of the correspondent theory of truth, indicating that the following sentence is true if it is true:

«My dad wasted most of the morning on the bus» [7]

The task of U-semantics, which the author describes as empirical, rather than formal, is the full understanding of the message or event. For P-semantics, it is important to understand every word in a sentence, for example, using "my dad", not "father" or simply "dad", using the word "wasted", not "spent", etc. The research of such sentences within the framework of the semantics of understanding is aimed at reconstructing from the words of a sentence a more complete picture of the events taking place, which can be said that it exists if the speaker's goal is to convey the true meaning. The semantics of frames is a system of meanings of expressions, with the help of which it becomes possible to understand the conditions for the formation of knowledge or an event.

The characteristics of the C. Fillmore frame system include: the primary system - reveals the conditions for understanding sentences; independent; chronologically localized - depends on the situation; explicit - the formation of the statement and its understanding involves the conscious use of some words instead of others. Given the characteristics, the linguistic frame system can be included in the second solution to the problem of prerequisite knowledge. The frame, from this point of view, is a structure of interdependent words used to adequately understand the event.

3. Conclusion

The most generalized study of the theory of frames was presented by V. S. Vakhshtayn. In his work "The Sociology of Everyday Life and the Theory of Frames," he outlined the general characteristics found in all concepts: "What does the cybernetic, linguistic, psychological and sociological definition of a frame have in common? They all define a frame as:

- structure, stable and relatively static;
- cognitive education, elements of which are cognitions (knowledge) and extraction (expectations);
- the representation scheme, that is, the representative and meaningful form "[8, p. 42].

Based on these definitions, the question arises: what is different from the frame and the prerequisite knowledge. Prerequisite of knowledge can be defined as a stable and relatively static structure; as cognitive education with the same elements; as a representation scheme. At the same time, a frame is defined as a condition; frame interpretations are aimed at explaining the process of understanding from different angles. Frame theory becomes a "successful" example of explaining the essence of prerequisite knowledge, a solution to the problem of prerequisite knowledge, but it would be a mistake to identify the frame system with prerequisite knowledge. The frame system, like prerequisite knowledge, is an independent system, having structure, definitions, concepts and characteristics. Taking into account the definitions existing in philosophical research, it can be concluded that prerequisite knowledge is an aggregate of those knowledge that are the conditions for the emergence of other knowledge. There are many, as different types of knowledge, and their conditions. The designation of forms of prerequisite knowledge helps to indicate the conditions that were necessary for the emergence of specific knowledge. The frame, in all its interpretations, is characterized as an installation, a ready-made pattern or condition of knowledge or an event, therefore the frame should be singled out as a form of prerequisite knowledge, through the understanding of which we come to understand the nature of this knowledge.

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改进环境保护控制系统
IMPROVEMENT OF A CONTROL SYSTEM OF ENVIRONMENTAL PROTECTION

Galanina Tatyana Vadimovna
PhD, Associate Professor
Baumgarten Mikhail Itsekovich
Ph.D., Associate Professor
Koroleva Tatiana Gennadyevna
Ph.D., Associate Professor, Head of the departmen
Kuzbass T. Gorbachev State Technical University,
Kemerovo, Russia

抽象。 考虑到俄罗斯联邦的立法框架，本文分析了环境保护领域的管理活动。 展示了进一步完善自然保护管理系统的方法。

关键词：管理，环境保护，改进。

Annotation*. Management activities in the field of environmental protection are analyzed in the article taking into account the legislative framework of the Russian Federation. The way of further improvement of nature conservation management system is shown.*

Keywords: *management, environmental protection, improvement.*

1. Introduction

Nature conservation management today is a set of measures aimed at the rational use of natural resources and environmental protection. Today, it is increasingly said that nature conservation management is an integrated system, which is why legislation in this area has its own specifics [1].

First of all, this concerns a broad regulatory and legal framework that should cover all possible issues.

2. Result and discussion

Speaking about the functions in the field of nature conservation management, the following areas can be distinguished:

1. Organization. Financing projects, planning their implementation, creating a licensing base.

2. Monitoring. Supervision in the field of environment and maintenance of environmental legislation in the course of activities.

3. Lawmaking. Development of the regulatory framework for nature conservation management purposes. It is law-making activity that plays a decisive role in the organization of effective nature conservation management for today, because it sets the norms and standards by which it is implemented.

The first law, which included the key provisions of the issues of ecology, environmental protection and nature conservation management, was the Russian Soviet Federated Socialistic Republic Law No. 2060-1 dated 19.12.1991 (as amended on 10.01.2002) "On the Protection of the Environment". In the following years, other legal acts were added to this law many times, which regulated the issues of nature management in different directions. Among the key of these laws are: "The Constitution of the Russian Federation" (taking into account the amendments introduced by the Laws of the Russian Federation on Amendments to the Constitution of the Russian Federation No.6-FKZ dated December 30, 2008, No.7-FKZ dated December 30, 2008, No.2-FKZ dated February5, 2014, No.11-FKZdated July 21, 2014).

One of the most important items that are prescribed in the Constitution of the Russian Federation regarding environmental management is Article 72, which states that "environmental management, environmental protection, environmental security, specially protected natural areas, protection of historical and cultural monuments are jointly managed by the Russian Federation and its subjects - republics, territories, regions, autonomous entities, Moscow and St. Petersburg ". This approach allows us to create a more comprehensive regulatory and legal basis for environmental legislation in our country.

The next was Federal Law No.7-FZ dated 10.01.2002 (as amended on 03.07.2016) "On Environmental Protection" (with amendments and additions, effective from 01.03.2017). This law is the basis of environmental legislation and is the starting point for all subsequent regulations and operations in the field of ecology, land use, etc.

Federal Law No.174-FZ dated 23.11.1995 (amended on December 29, 2015) "On Environmental Expertise" guarantees the exercise of citizens' right to a favorable environment by preventing the emergence of conditions that could violate it.

The Federal Law "On Specially Protected Natural Territories" No.33-FZ dated 03.03.1995 (amended and supplemented on 01.03.2017) is aimed at solving the problems of maintaining and preserving unique natural complexes for the functioning of which special protected natural areas are created.

A separate group of normative legal acts in the field of effective solution of environmental management issues, as an integrated management system, are industry codes. In particular, they include:

- The Land Code of the Russian Federation, which regulates the protection of lands and protection of the natural environment from possible harmful effects when using land.

- The Water Code of the Russian Federation, which regulates legal relations in the field of use and protection of water bodies and is aimed at protecting water from pollution, debris and depletion.

- The Forest Code of the Russian Federation, which establishes the legal basis for the rational use, protection and reproduction of forests, increasing their ecological and resource potential.

One of the most important tools of the modern environmental management mechanism is environmental regulation, which creates a stable base of requirements for nature users. This method is one of the integrated monitoring and control formats, because it is used simultaneously in various fields of activity [2].

To date, environmental regulation in the nature conservation management as an integrated system is divided into the following areas:

- environmental quality standards;
- environmental impact standards;
- product quality standards;
- standards of technological processes;
- organizational and management standards.

Speaking about the developed systems for increasing the efficiency of nature management, we cannot fail to mention the experience of Western countries in this direction.

One of the most advanced in this regard is the experience of the United States, in which the system for the development of environmental management is much differentiated. In solving problems of environment, land management, environment protection and environmental management, more than 40 departments, services and units are involved, each of which performs its tasks in a specific, narrow direction. As, for example, the service of protection of fish and wild animals, the service of national parks, the federal service of the Geological Survey of the USA, etc.

For our country, the ability to delegate authority to resolve environmental issues from ministries to services and agencies could greatly simplify the transition to the green economy format.

A good example is also the Council on the Quality of the Environment of the Presidential Administration of the United States, which was created as a subsidiary and advisory body and which is part of the President's Executive Office. The structural and functional independence of the Council from economic bodies helps to overcome a purely economic, departmental approach to the use of natural resources and contributes to greater objectivity in making decisions.

The diversity of approaches and the interaction of executive, judicial and legislative bodies, based on the developments of our western neighbors, will help to create a breakthrough in achieving many goals. European experience in environmental management is centered around the policy of the European Union (EU) on this issue. The ability to resolve many issues through collegial bodies of the legislature makes their implementation more effective.

Touching upon the issue of the legislative framework for the implementation of the EU's "green" policy, the following areas can be singled out:

1. Regulations describing the administrative structure (mechanisms for the establishment of committees and structures, for the conduction of uniform procedures).

2. Regulations transforming the provisions of international conventions on environmental protection in the EU acts. Their goal is to promote international trade; therefore there are no separate regulations for the protection of water, air, soil.

3. Directives - their goal is to ensure environmental protection and environmental management in the EU.

4. Decisions are documents of environmental policy. Usually they are taken in connection with the establishment of committees or organizations.

5. The recommendations of the Commission are used in the work of international organizations (UN, OECD, Council of Europe), but they do not have binding force.

6. Environmental action programs of the EU. Their main effect, first of all, is political, therefore they include legal provisions containing objectives, tasks, measures for their solution and the period of time during which the measures developed should be implemented. From 1973 to the present, five environmental action programs have been approved in the EU.

It should also be noted that the protection of the natural environment is formed not only from the legal side of this issue, but also an obligatory financial component. The need to materially stimulate the environmental activities of any user of the resources of the country and a particular region is explained in stimulating an interest in meeting all these requirements and making the solution of this task economically profitable for any constituent entity of the Russian Federation; here, the scientific and technical side is also important.

The need for continuous implementation of engineering developments on this issue, which will create the basis for environmental and resource-saving technologies using the latest achievements in the world of scientific research, also requires financial investments. And here, obviously, there is a direct correlation in the regulation of the rational use of the state's natural resources and the huge environmental protection system.

Normal and sufficient financing of this sphere is the most important condition

for solving all real environmental problems. The protection of the environment of the state as a whole is the most costly and financially dependent direction of human activity. For example, the cost of compulsory treatment facilities in the design of a new enterprise can reach up to 45% of the total cost of the enterprise itself. Therefore, it is obvious that financing of any environmental protection measures, according to the so-called residual principle in our country, is one of the important reasons why nature in our state is in the most critical condition.

The most important elements of the economic mechanism of nature management and environmental protection now include: a clear planning of the system of nature management and environmental protection, sufficient stage-based funding for environmental protection, the introduction and attraction of payments for any use of natural resources, environmental insurance and the development of state economic incentives for solving environmental problems [3,4].

Lately there have been huge changes in the mechanism for financing environmental protection activities in the Russian Federation. The inefficiency of the previous system has been proved practically. For a long time, only the state budget of the country remained the main source of cash infusion. In addition, the enterprises did not try to invest their own accumulated money, which was simply necessary mainly for the modernization of production and major repairs of nature conservation facilities. They simply carried small current costs associated with the continued operation of water treatment plants, air purification filters and other similar facilities, which at the same time tried to reduce. These factors - the limited possibilities of the state budget and the so-called depersonalization of cash infusions - could not solve the growing problems in the huge environmental protection system. The volume of these investments depended only on the situation in the economy of the state at the moment and was in no way linked with the specific needs of each nature user in the environment protection [5,6].

The purpose of the new, developed mechanism for financing human nature conservation activities is the development of direct and indirect methods of state and legal regulation for the necessary environmental goals, using not only funds from the federal budget, but with the involvement of the budgets of the constituent entities of the Russian Federation, as well as the local budget. However, this was not enough to solve such an important state problem, and therefore the problem of finding additional sources of funding arose. It should be noted that numerous international economic projects require thorough and costly environmental expertise, which has long acquired foreign policy significance, required not only complex technical approvals, but also serious international negotiations.

The introduction of such a concept as the payment of all the natural resources used is one of the main elements of this new mechanism of environment protection financing that will focus on possible market reforms.

Until a certain time in the Russian Federation, environmental funds that existed in the 90s of the 20th century were also involved. The formation of such modern funds with the support of the state was a completely new direction for Russian environmental law in the large-scale regulation of financing environmental protection measures. However, in the 90s which were difficult the Russian Federation the mechanism of spending money itself did not justify itself and the funds in the overwhelming majority ceased to exist. But in the new realities, it is possible that such funds could take place while improving nature conservation activities.

Environmental insurance as a new element of the economic development of the environmental protection system is a way to protect the financial and property interests of not only individuals and legal entities, but also the state as a whole, in the event of large-scale adverse environmental consequences arising from monetary funds created by policyholders. This is another source of replenishment of sources of funding for environmental programs.

3.Conclusion

As shown above, it is necessary to form a sustainable system for financing nature conservation sphere and creating a single working mechanism for general regulation of the use of natural resources of the country and environmental protection measures that will include the main links:

- financing of various vital environmental programs and nature conservation measures from the budgets of various levels;
- development of a functional system of nature conservation funds in each territorial unit of the Russian Federation, with the involvement of innovative environmental funds of the entity and nature conservation funds of the enterprise (for example [7]);
- development of systems of new ecological banks;
- development of methods for attracting funds from environmental insurance funds;
- attraction of international funds from the World Bank and the European Bank for Reconstruction and Development, as well as any foreign funds, organizations and firms that are associated with the environmental financing program;
- adjustment of the mechanism of compulsory use of enterprises' own funds for nature conservation activities.

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УДК 575.1:576.312:635:655

种间杂交作为选择和研究大豆（GLYCINE）基因组关系的方法
INTERSPECIFIC HYBRIDIZATION AS A METHOD OF SELECTION AND STUDY OF SOYBEAN (GLYCINE) GENOMIC RELATIONSHIPS

Kozak Margarita Fedorovna
Doctor of Biological Sciences, Professor
Astrakhan State University,
Astrakhan, Russia

抽象。在大豆种间杂种分离[Glycine max（G. hispida（Moench。）Max。×G。soja（Glycine ussuriensis Regl et Maack。）]的过程中，几乎所有已知的甘氨酸属的遗传基因座和确定不同类型的种皮着色，表现在表型中。在F1 - F6中，抑制基因（Ss因子）的作用，即对黑色基因的上位性，清楚地表现出来了.Beltskaya 636，大豆品种，在研究的组合中发现了该基因的载体。发现了种皮绿色的复杂遗传测定。杂种分离表明，一对字符 - 绿色和黄色 - 不是单一遗传的。但是由至少两对互补的PH-基因决定。在F6-F8中，杂交系后代逐渐消除了种皮的多种颜色，并恢复了原始亲本种的两种主要表型。 ，whi在混合动力车中保留新的人物组合。考虑到种子颜色在选择具有栽培种类表型的种子颜色时，一般的灌木习性 - 直茎灌木和类似于野生品种的缠绕灌木 - 结果证明是相关的。已经证明有利的是选择具有高产性，抗病虫害的纯合形式，并且在第四代，第五代和第六代种间杂种中具有理想的培养特征（直茎，种皮的黄色）的组合。 。种子杂种后代中广泛而长期的分离过程与甘氨酸属物种的多倍体起源相关，不仅表明了与历史上长期相关的密切进化联系，而且表现出相当大的分离。

关键词：Glycine max，G。soja（G。ussuriensis），种间大豆杂交种（F1 - F8），种子颜色遗传，遗传决定，基因组关系。

Abstract: *In the process of soybean interspecific hybrids segregation [Glycine max (G. hispida (Moench.) Max. × G. soja (Glycine ussuriensis Regl et Maack.)], almost all the genetic loci that are known for the genus Glycine L. and that determine different types of the seed coat coloring, manifested themselves in the phenotype. In F_1 - F_6, an effect of the inhibitor gene (Ss - factor), that is epistatic to the black-colour gene, was clearly manifested. Beltskaya 636, a soybean variety,*

turned out a carrier of this gene in the studied combination. A complex genetic determination of a green color of the seed coat was discovered. The hybrids segregation showed that a pair of characters – green and yellow colors – are not inherited monogenically but are determined by at least two pairs of complementary P-H- genes. In F_6 - F_8, there is a gradual elimination of many types of colors of the seed coat in the hybrid line progeny and a return to two main phenotypes of the original parental species, while new combinations of characters remain in the hybrids. Taking into account the seeds color during the selection of forms with a cultivated species phenotype by a general habitus of bush – a straight-stem bush and a twining bush similar to wild varieties – turned out to be relevant. It was proved expedient to select homozygous forms that are highly productive, resistant to diseases and pests and have a combination of desirable cultural characteristics (straight stems, a yellow color of the seed coat), in the fourth, fifth and sixth generations of interspecific hybrids. A wide and long process of segregation in the progeny of interspecific hybrids, associated with the polyploidy origin of species of the genus Glycine L., is an indication not only of close evolutionary links but also of very considerable isolation over a historically long period.

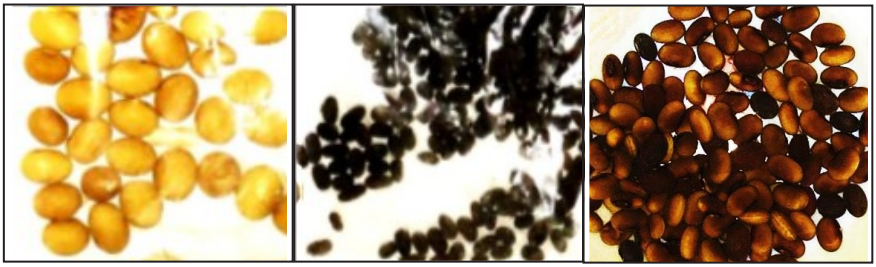
Keywords: *Glycine max, G. soja (G. ussuriensis), interspecific soybean hybrids (F_1 — F_8), seed colour inheritance, genetic determination, genomic relationships.*

Introduction. The efficiency of the modern system of plant selection primarily depends on the world resources mobilization, based on N.I. Vavilov general biological, evolutionary and genetic concepts – the law of homologous series in hereditary variation and the doctrines on cultivated plants origin centers and regularities of geographical range of genes [3. 4]. N.I. Vavilov believed that genetics and selection lacked for a principle of evolutionary comparative analysis of the system of species hereditary variation that manifests itself not only during the analysis of population polymorphism but also in hybridization. The Far East of Russia is rich in a variety of valuable natural populations of a wild-growing soybean *Glycine soja* Sieb. & Zucc. that is called "Glycine ussuriensis" by Russian researchers: *G. ussuriensis* Reg. & Maack.: [6, 7, 18, 20, 23, 24 et al]. *Glycine max* and *G. soja* specimens have different phenotypes but cross *"relatively easily"* with each other, generating fertile hybrids [6,7, 8, 9, 10, 31 and others]. *Glycine max* and *G. soja* specimens are characterized by homology of the mitosis circadian rhythm [13, 14,] and homology of the stem anatomy structure [17]. It indicates their genetic affinity and generates different populations of *G. soja* Sieb. & Zucc. that are notable for an extremely high adaptive capacity, resistance to diseases and pests and high fertility, and it is also a promising source of new valuable genes for improving and enriching the genome of G. *max*. (L.) Merr by means of crossing. At the present time, the cultivated soybean genome structure is deciphered and published [27, 28, 29, 30 et al], which characterizes a

new stage in the functional and comparative genomics of soybean. Further research of the comparative genomics of the genus *G. max.* (L.) Merr., including its wild congeners, can considerably extend the understanding of feasibility and limitations of using wild "congeners" for breeding and improving the soybean varieties. We have already identified differences between the genome structural organization of *G. max.* and *G. soja* (with the coincidence of their basic numbers of chromosomes, 2n = 40 [8] by applying cytological methods [11, 15, and others]. During the process of studying meiosis in the microsporogenesis of F_1 (and F_2 as well) of the interspecific hybrids from the crossing of the cultivated soybean and the wild soybean [(♀ *Glycine max* (L) Merr. × ♂ *G. soja* Sieb. Et Zucc. (*G. ussuriensis* Reg. & Maack.)], we identified deviations from a normal process of meiosis, associated with asynaptic phenomena. Since the synaptonemal complex is an indicator of the meiosis dynamics and chromosome variability, the chromosome conjugation distortions were accompanied by the pollen decreased fertility and variability of its sizes. As a result, there was a process of *gene homeologous recombination* in the meiosis instead of a homologous one. The isolation of chromosome complements of the crossed species in circles and groups inside each genome, observed during the process of the chromosome conjugation, reproduce the images of autotetraploid meiosis [2, 11, 15, 22, and 25]. The paper objective: to study genetic determination of the characters on the basis of a form-building process of interspecific hybrids of the cultivated soybean and the wild soybean on the example of the analysis of genetic determination of the seed coat colour; to explore the possibilities of combining this identification character with others during the segregation process.

Materials and methods. The author produced the interspecific hybrids bythe crossing of the cultivated soya (sort Beltskaya 636) and the wild growing Glycine soja gathered in the Amur region (the Far East of Russia). The paper presents a genetic analysis of the segregation process in the line of generations of interspecific hybrids of soybean ($F_1 \rightarrow F_8$) by seed coat colour that is extremely wide due to the soybean polyploidy origin and covers all the system of a certain genetic determination of a character of the crossed species for manifestation in the plants phenotype. A vegetative period of the wild soybean, used for the crossing, lasts 100-140 days; these plants ripen at the same time, their phenotype is similar, they had no signs of disease or damage by pests. The wild soybean plants had small plain beans, a black dull colour (with unclear variegation) of the seed coat and a twining stem. The wild soybean can produce several hundreds or even thousands of seeds. Belskaya 636 is a cultivated variety of soybean used as a female parent; it has yellow seeds and a black cicatrix with a white stripe. The seeds are round and convex. 1000 seeds weigh 100-120g. According to the classification [6], this variety is a part of the Slavic subspecies of the cultivated soybean. A pod contains from 3 to 6 beans. Its vegetative period lasts 103-118 days.

*Results and discussion***.** Studying genetic determination of the seed coat colour is urgent not only for theory but also for practical needs, as this character is connected (linked) with many other characters that are important for selection – general habitus of a bush, stem top twining, branchiness, stem type (straight or twining), etc. – and can be one of the main characters for selection. The papers [3, 23] and others show that "phylogenetically old" forms of soybean are characterized by a dark colour of the seed coat, while "young" forms have light-coloured seeds.



♀ Cultivated variety of soybean Beltskaya 636 | ♂ Wild soybean (Glycine ussuriensis) | Brown colour of the first generation hybrid seeds F_1

Fig. 1. *Seeds of the initial parents for crossing and the first generation hybrid seeds* F_1

Seed coat colour inheritance in F_1 *-* F_2. As a black-colour gene (and character) of the soybean seeds is dominant in relation to other colour types, F_1 plants were supposed to have black seeds. However, all the seeds of the first generation *of this combination* appeared to be brown. Starting from the second generation (F_2), the hybrid population divided into phenotypic groups with different colours of seeds. The segregation was registered separately by each plant (line). Hybrid lines with black seed coats were unexpectedly (at first sight) observed in the progeny of lines with light-coloured seeds. In F_2 - F_3 - F_6, the "phenomena" of black seeds in the light line progeny was identified during the analysis of the segregation in the group of plants grown from the seeds with green and yellow coat. The frequency of the "black seed phenomena" appearance in the progeny of light-seed plants was 0.09% in F_4. As we, along with other authors (*Note**), identified dominant inheritance of a black seed colour, we should state the presence of a dominant inhibitor gene (suppressor), epistatic in relation to the *R* factor, in the genotype of certain forms of the cultivated soybean; we designated it as *SS(ss)* [10]. In this case, the colour-inhibiting gene is presented in the genotype of the cultivated soybean Beltskaya 636 – locus (*SS*), excluding a complementary interaction of the *TTRR* genes. The presence of the locus (SS) in the genotype of Beltskaya 636 inhibits the effect of the RR gene, impedes complementary interaction of the TTRR

genes and anthocyanin pigmentation in Beltskaya 636 and also in those lines of the interspecific hybrids that contain this gene (S). The manifestation of the "black seeds phenomena" in the progeny of light-seed plants of the soybean interspecific hybrids F_3 - F_6 is regular because of the continuous process of segregation by the pair of alleles *S- ss* (of the inhibitor gene)*.----------

Notes. Inheritance of seed colour by soybean and interspecific soybean hybrid: Fucuda, Y. 1933; Kawahara, E.; Nagai, J., 1921; Terao, H, 1918; Williams. L.F 1948, 1952; Woodworth, C.M. 1932; et al: Kozak, M. F. // Genetics. M. 1978. v. XIV. №1. P.36 - 43. ISSN: 0016 – 6758. [10, 31].*

Therefore, the main differences in the seed colour of the crossed parents will be designated in the following way: black seed coat of the wild soybean – *TTRRssGG* (*G* is a gene of a green colour of the seed coat), a yellow colour of the Beltskaya 636 seeds – by the *ttrrSSgg* genes. As the *S* inhibitor gene is *epistatic in relation to the R factor*, the hybrids F_+ (♀ Beltskaya 636 × ♂ wild soybean) with the *TrRrSsGg* genotype have brown colour. A dominant black colour of the seeds in the second generation hybrids appears in the progeny of the plants with brown seed coat as a result of "segregation" of plants with the *T — R — ss* genotype. In this case, a dominant *R* gene gets out if the inhibitor gene (*S*) control. There were fewer plants with black seeds than those with brown seeds in the second generation. The segregation ratio "*9 brown seeds*: *7 black seeds*" was observed in F_2 and the subsequent generations by this pair of characters. A monogenic nature of inheriting green and yellow colours of seed coat was proved. Interspecific hybrids *(ISH)* of the first generation (F_1), obtained by us in another cross combination (♀ Amur brown 57 × ♂ wild soybean), had a dominant black colour of the seeds with variegation, peculiar to a wild variety of soybean, i.e. the variety Amur brown 57 has a recessive allele of the gene, inhibiting the seed coat colour (locus – *ss*) in its genotype.

Inheritance of the seed coat colour in the F_3 — F_4 interspecific soybean hybrids. Each phenotypic group, revealed in F_2, had a significant segregation in the third generation again. The segregation analysis showed that apart from the *T — R —* factors, the genotype of the black-seed plants contains (*G — g*, *Ci — ci*, G_1 — g_1) genes, G_1 and G_2 genes that determine a bright green colour of seeds, W_1w_1 and other genes that modify actions of the seed coat pigmentation genes. The genotype of black-seed plants always contains a recessive allele of the *ss* inhibitor gene; in the genotype of brown-seed plants, the dominant allele of this gene is (*T — R — S —)*. A brown colour can be determined by the (*T-rrss)* genes. An olive (bright green) seed colour is determined by the G_1 - G_2- complementary genes (Kawahara, 1963) that modify manifestation of the pair *G-gg*. In the homozygous state, the recessive alleles (g_1g_2) determine a slightly brown colour of yellow seeds. A light brown colour of the seed coat is a result of simultaneous presence of the factors *G* — and *Ci* — in the genotype. Participating in the control over the *G* gene action, the *Ci* factor

gives a light brown or bronze (*ci*) colour of the seed coat. Though the *G(g)* locus is always presented in a genotype along with one of the alleles of *Ci — ci*, green seeds do not always have a yellow tint, as the *Ci —ci* factors manifest their action (Kawahara, 1963) only in the presence of complementary factors of the seed coat colour (B_1 -B_2 -B_3 -). In the progeny of light-seed plants, plants with black seed coat appeared again. In F_3, this phenomenon was revealed during the analysis of segregation in the group of plants grown from green seeds, in the 4th generation – under the segregation of plants with green and yellow seeds. The probability of such plants appearance was 0.09% in F_4. The appearance of this phenotypic group is regular because of the continuous process of segregation by the pair of alleles *S — s* of the inhibitor gene and segregation of plants with the genotype *t – R- s - G* - (*t - R - s –g-*), where the R gene gets out of the inhibitor gene (*S*) control.

Table 1. *Scheme of segregation of interspecific soybean hybrids (ISH) by the seed coat color:*

♀ Beltskaya 636 *(yellow seeds)* × ♂ wild soybean *(black seeds)*

F_1	F_2	F_3	F_4
F_1 Brown seeds 100%	lack- 33.2 %	Black	Black. Brown.
		Brown	Black. Brown. Green. Olive. Yellow-green. Green. Yellow.
		Green	Black. Green of different tints. Olive. Yellow. Light brown.
		Olive	Olive (bright) Yellow-green.
		Yellow	Green Yellow
		Yellow-green.	Yellow Green

F_1 Brown seeds 100%	Green (15 %)	Green	Green. Yellow
		Yellow	Green. Yellow Olive. Black. Brown
		Olive	Olive. Yellow-green.
		Yellow Green	Yellow Green.
		Black	Black. Brown.
	Yellow (8.8 %)	Yellow	Yellow Black Olive Light brown
		Olive	Olive
			Yellow-green.
	Brown (43.0 %)	Brown	Black Brown Green Olive Yellow-green. Green Yellow
		Black	Black Brown
		Olive	Olive Yellow-green.
		Green	Black Green Olive Yellow Light brown
		Yellow	Yellow + Green

Note: Kozak, M.F: 1978, 2004, 2018 [10,19, 31, etc.]

In the third generation of hybrids (F_3), we marked out 7-8 groups of hybrids by seed coat colour; however, there are far more allele pairs that participate in determination of this character. The segregation by separate pairs of alternative characters (in general) corresponds to theoretically expected formulas. An exception

is the segregation by pair "green-yellow seeds" as a result of a green-colour character modification by genes of other allele pairs. However, uniting all the seeds with different tints of green in one group gives the ratio (497 green seeds : 143 yellow seeds, which corresponds to the ratio of 3:1). The analysis of seed colour inheritance revealed a clear dominant-recessive nature of colour inheritance of one more pair of characters – presence and absence of seed coat gloss (under domination of the G_{l-} dull gene). Both F_2 and F_3 had the proved segregation by this pair of alternative characters in the ratio of 3:1. Glossy-seed plants give only a glossy progeny in subsequent generations. Dull surface of seeds is inherited dominantly and, in most cases, together with phylogenetically "old" characters – black and brown colours of seeds. As a rule, phylogenetically "young" characters of green and yellow colours of seeds are inherited together with glossy surface, which indicates a linkage between the genes determining these characters. The frequency of their crossing is about 3-4%. Taking into account the seeds colour during the selection of forms with a certain phenotype from the ISH population by a general plant habitus turned out to be relevant. As a rule, black-seed plants were closer to a wild type by certain characters. In F_4 (ISH), the segregation spectrum remained wide, which still indicates a high degree of heterozygosity. However, no new phenotypic groups in F_4, as compared to F_3, were obtained. Hybrids of the third generation with black seeds in F_4 had relatively limited segregation, which may indicate an increase in the homozygosity of this group of plants. Plants with an erect form of a stem were discovered by us only in the fourth and subsequent generations among hybrids that have a yellow and light green seed coat color. Some of them had up to 330 - 400 fruits (beans) per plant. *Seed coat color is the most important marker* while selecting forms with an erect stem in the fourth, fifth and subsequent generations of interspecific soybean hybrids. The appearance of forms with an erect stem form in the progeny of lines obtained from seeds with yellow and green seed color is evidence of the linkage of seed color genes and a stem form, as well as the inhibitor gene S, the epistatic in relation to R gene (black seed coat color).

Fig. 2. *The main phenotypes of seeds in F_7 and the appearance of lines with yellow dull "large" seeds of a cultivated type of soybean*

In F_4, there appeared a significant number of lines which didn't have segregation in seed color: among the hybrids obtained from black seeds, 54.1% of the lines, from brown seeds - 45%, from green - 47%. Hybrids obtained from seeds with a yellow recessive type of coloring, again had significant segregation into forms with dominant and recessive. Plants with a light brown colouring contain genes of a yellow colour in the genotype, as during the segregation of such hybrids there are two phenotypic groups: with light brown seeds (p = 0.571) and with yellow seeds (p = 0.429). An olive green colour (a bright deep green colour) appears (F^4) and disappears (F_5) in the progeny of hybrids with a yellow colour, depending on the presence or absence of complementarity of loci G_1 - G_2. Hybrids with an olive green colouring of seeds are also gradually eliminated in the process of segregation (in F_4: p = 0.126, in F_5: p = 0.021, in F_6 - do not occur). A yellow green colouring is due to the modification of the G_1 - G_2 - factor manifestation by the allelic pairs *Ci-ci* (a light brown colour) and *rr* (a brown colour), since during segregation of hybrids with a yellow green colouring no more than four phenotypic groups of progenies are formed: olive green, brown, light brown and yellow, which appear due to the presence of recessive alleles of a yellow colour under the cover of others. Hybrids with a black seed colouring in F_5 had a limited spectrum of segregation. Only the tendency towards segregation into four groups was observed here: black (62.1%), brown (22.3%), light brown (5.5%), and yellow (10.0%). In F_6, the segregation process continued in this group, while the same segregation classes as in F_5 were retained, except the hybrids with a light brown seed colour. This phenotypic group disappeared in F_6. In F_5-F_6, during the segregation of hybrids with a black colouring of seeds, the proportion of hybrids with a brown colour continued to decrease. In F_6, the segregation of a part of the plants (23%) with a black colour of seeds continued into three groups, but the proportion of seeds with a brown colour decreased once again. Reduction of the proportion of seeds with a brown colour (from the fourth generation) indicates the release of a black colouring (*R*) gene from the control of the inhibitor gene (*S*), its transition into a homozygous state. Elimination of this and many other characters (green, light brown, olive green and other seed colourings) in F_6 indicates a decrease in the proportion of heterozygotes and a return to the initial parent types (with the exception of recombinant forms). In the fifth and sixth generations (F_5 - F_6) of hybrids, a yellow colour of the seeds in 85% of cases is inherited along with the straight stem. Plants with black seeds are just as likely to be of wild type: they have a twining stem and heavily ramify. The remaining 8-15% of hybrids with black seeds are close to the cultivated type, they have large seeds. A group of plants with brown seeds in F_5 - F_6 comprised forms of various habitus, mostly deviating towards the phenotype of the wild type of soybean.

Conclusion. Interspecific hybridization of soybean makes it possible to re-

veal the genetic potential of determining the characters of representatives of the crossed species. The spectrum of segregation by the colour of the seed coat of interspecific soybean hybrids by the combination ♀ *Beltskaya 636* × ♂ *wild soybean* was unusually wide. In the progeny of interspecific hybrids, almost all known genetic loci for the genus *Glycine* L. appeared in the phenotype; these loci determine the variety of seed colouring types. Moreover, in case with F_1 to F_6, the effect of the *Ss factor*, that is epistatic in relation to the gene of a black colouring, has clearly manifested itself. The carrier of the dominant allele of this gene in the examined combination was the variety of cultivated soybean Beltskaya 636. By the sixth generation (F_6), gradual elimination of many types of seed peel colours and a return to the two main initial phenotypes of a seed, colouring of representatives of parental forms in combinations with other characters (*recombinant forms, valuable for breeding*). The significance of taking into account the colour of the seeds in the selection of forms with a certain phenotype by a general habitus is found: close to wild species, to a cultivated species, species with straight stems, species with twining stems. It was found that the selection of homozygous forms with the desired characters for practical breeding purposes, as well as recurrent crossings, is expedient in the fourth and fifth generations of interspecific hybrids. Selection of highly productive hybrid forms is more expedient to carry out in F_7-F_8, when there are recombinant forms combining any characters of the wild soybean together with the compressed and half-compressed form of the bush and the multi-flowering apex of the stem. Continuous and effective measures are required to conserve the natural gene pool of the wild soybean: collection of seed samples, herbarium, introduction, creation of protected areas, and inclusion in real breeding programs for hybridization with representatives of cultivated soybean to transfer of disease-resistant genes, pest-resistant genes, and high productivity genes on varieties of cultivated soybean. Effective measures are required to protect the gene pool of the wild soybean from the introduction of alien mobile genetic elements, bearing in mind that soybean is a natural self-pollinating agent, nevertheless cross-pollination may take place. Data on the wide and long-lasting segregation in the progeny of interspecific hybrids, peculiarities of combining genes and characters in progeny suggest the possibility of transferring new valuable genes and alleles during crossing in order to improve and enrich the structure of soybean *G. max. (L.) Merr*. genome with wild populations of the wild soybean. The wide and long process of segregation in the progeny of interspecific hybrids indicates not only close evolutionary links, but also a very significant disconnection in the historically long time for the genus *Glycine L*.

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基于Eu2 +和Eu3 +磷酸盐的纳米发光体的低温合成和发光性质

LOW-TEMPERATURE SYNTHESIS AND LUMINESCENT PROPERTIES OF NANOLUMINOPHORS BASED ON EU^{2+} AND EU^{3+} PHOSPHATES

Steblevskaya Nadezhda Ivanovna
Doctor of Chemical Sciences, Leading Researcher

Belobeletskaya Margarita Vitalyevna
Candidate of Chemical Sciences, Senior Researcher

Medkov Mikhail Azaryevich
Doctor of Chemical Sciences, Head of laboratory
Institute of Chemistry, Far-East Branch
Russian Academy of Sciences, Vladivostok, Russia

注解。 通过低温萃取 – 热解法制备了纳米级铕磷酸盐$EuPO_4$, Eu_3PO_7, $Eu(PO_3)_3$, 和$Eu(PO_3)_3$: Eu^{2+}。 测定了前体热解的最佳时间和温度，以获得含有不同氧化态的铕的一个阶段的发光体。 基于Eu^{3+} 的磷酸盐发光体显示出强烈的红色发光，λ_{max}≈600-650nm. $Eu(PO_3)_3$: Eu^{2+} 的发光光谱的特征在于Eu^{3+} （$^5D_0$-^7F_j 的带（j=0,1,2,3,4,5）的典型发射带在 400 至 700 nm 的宽范围内。 ）过渡）和Eu^{2+}（$4f^65d\ ^8S_{7/2} \rightarrow {}^8S_{7/2}$过渡带）。 在这种情况下，激发波长对$Eu^{2+}$和$Eu^{3+}$的辐射强度贡献的影响是不同的。

关键词：低温合成； $Eu(PO_3)_3$: Eu^{2+};纳米材料;发光

Annotation. *Nanoscale europium phosphates $EuPO_4$, Eu_3PO_7, $Eu(PO_3)_3$, and $Eu(PO_3)_3$: Eu^{2+} have been prepared by the low-temperature extraction-pyrolytic method. The optimal time and the temperature of precursors pyrolysis for obtaining the luminophor containing europium in different oxidation states for one stage were determined. Phosphate luminophors based on Eu^{3+} display intensive red luminescence with λ_{max}≈600-650nm. The luminescence spectra of $Eu(PO_3)_3$: Eu^{2+} are characterized by the emission bands in the wide range from 400 to 700 nm typical for both Eu^{3+} (bands of $^5D_0$-^7F_j (j=0,1,2,3,4,5) transitions) and Eu^{2+} (bands of $4f^65d\ ^8S_{7/2} \rightarrow {}^8S_{7/2}$ transition). In this case, influence of the exciting wavelengthes on contribution of radiation intensity is different for Eu^{2+} and Eu^{3+}.*

Keywords: *low-temperature synthesis; $Eu(PO_3)_3$: Eu^{2+}; nanomaterial; luminescence*

Unremitting interest to the rare-earth elements and their compounds is connected with variety of their properties and widening of their application in the chemical industry, optics, medicine, atomic, semiconductor, laser, magnetic and luminophors technics. In particular, rare-earth phosphates and solid solutions on their basis are widely used as converters of ultraviolet, X-ray, and gamma-radiation into visible light: materials for plasma displays, highly efficient energy saving light sources, coatings for X-ray screens, materials for optics and electronics [1]. In such inorganic luminophors, Eu^{3+} [2] or Eu^{2+} ions [3] having high quantum luminescence yield are often used as activators.

For obtaining luminophors based on Eu^{3+} phosphates, traditional solid-phase methods which consist in protracted high-temperature treatment of stoichiometric mixtures of initial components are usually used [1]. In the process of synthesis, because of its high temperatures some by-products may be obtained and a certain chemical and granulometric heterogeneity of the final products arises. It results in nonreproductivity of the properties of the materials obtained. Achievement of homogeneity of the chemical, phase composition, and morphologic structure of the final products is the condition which determine high functional features of the materials based on the rare-earth. One can improve homogeneity of the products when carrying out their synthesis by the sol-gel or the hydrothermal methods [2,3] using complex mixtures of the initial components, controlling pH values of the solutions or adding organic solvents.

Luminophors based on Eu^{2+} can be prepared, first, by analogous methods using the same initial components in the stoichiometric ratios but in this case syntheses would be carried out in reducing atmosphere [3]. Secondly, Eu^{2+} phosphates are obtained in two stages. At first, luminophor samples containing Eu^{3+} ion are obtained by one of the above-mentioned method - the solid phase or sol-gel and then, after cooling and grinding, the samples are annealed at the temperature 1050-1150°C in reducing atmosphere [1,4,5]. The gas mixtures $N_2 + H_2$ or $Ar + CH_4$ are used as reducing agents. Annealing can be also carried out under charcoal layer.

Some medical preparations require luminophors which radiate in the "red" range [2] while for treatment of oncological diseases with use of photodynamic therapy nano-luminophors radiating in the visible range with λ~650nm or λ~400 nm are necessary [6]. One of the directions of the modern material science consists in development of luminophors which radiate in the wide range of visible light, e.g. for the white light sources [1]. It should be noted that Eu^{3+}- containing luminophors based on phosphates display intensive red luminescence in the range 600-700 nm [1] while those activated by Eu^{2+} show blue luminescence in the range 400-500 nm [5].

The technologies used for obtaining luminophors, including the solution methods which are being developed at present, are not universal. In this connection, the prob-

lem of working out of new, efficient methods securing obtaining luminophors with necessary functional physical parameters, including nano-scale ones, is still topical.

The extraction-pyrolytic method was shown to be promising for synthesis of some functional materials with useful properties [7,8]. In the last case, it is possible to prepare various types of simple and complex composites based on the rare-earths as the both powders (including nano-scale ones) and thin-film coatings on various substrates by low-temperature pyrolysis of organic extracts.

This paper describes the low-temperature one-stage method for synthesis of luminophors based on Eu^{3+} and Eu^{2+} phosphates and results of investigation of their luminescent properties.

The experimental investigation of the optimal extragent concentrations in organic phase and compositions of aqueous solutions showed [8] that in order to obtain saturated extracts for their following use in synthesis of functional materials – luminofors based on the rare-earth phosphates – by pyrolytic method one can successfully use metal extraction with acetylacetone in the presence of neutral organo-phosphorous ligands – triphenil-phosphineoxide (TPhPhO) or tributylphosphate (TBPh), including the presence of tris-(hydroxymethyl)-aminomethane for achievement of a necessary pH value of aqueous phase. The final products prepared by low-temperature pyrolysis of such precursors are characterized by high homogeneity. Moreover, their obtaining requires less energy due to decrease of duration and the temperature of the procedure as compared to the known methods, e.g. solid-phase synthesis.

Coexistance of Eu^{3+} and Eu^{2+} ions was revealed in various crystal phosphors, glasses, and films in the process of their preparation in reducing atmosphere and sometimes in vacuum without a reducing agent [9,10]. It was noted above that the luminophores containing Eu^{2+} ions was usually obtained by solid-phase synthesis at the temperature >1000°C in reducing atmosphere or in two stages. In the latter case, the Eu^{3+} -containing luminophor prepared by the solid-phase or sol-gel methods was exposed to grinding and then reduced at the same temperature using a reducing agent [3-5]. However, preparation of Eu^{2+} - containing materials in air is more preferable than creation of a special reducing atmosphere. Moreover, decrease of the number of the stages and the temperature is also important because it enables to obtain nano-scale forms.

Eu^{2+} - doped luminophor sample $Eu(PO_3)_3$:Eu^{2+} was prepared by the extraction-pyrolytic method after annealing the precursors at the ratio Eu:TBPh (TPhPhO) = 1:7 in a crucible at 700-750°C for an hour or at 600°C for 6 hours. In the process of pyrolysis of the above-mentioned mixture the reducing atmosphere arises as a result of burning out of the organic components and trivalent europium is reduced to divalent. Substitution of TBPh by TPhPhO results in formation of nano-dispersed polyphosphate $Eu(PO_3)_3$:Eu^{2+} at a lower temperature for the same time (750°C for

TBPh and 700°C for TPhPhO). The paste prepared from europium saturated extracts after the solvent removal and containing respective stoichiometric amounts of the main components was used as a precursor.

According to the AFM data the powders of the phosphate luminophor doped with Eu^{2+} consist of spherical particles assembled in agglomerates (Fig. 1,a). After dispersion in ethanol or acetone the sizes of these particles in the luminophor samples were less than 100nm (Fig. 1,b).

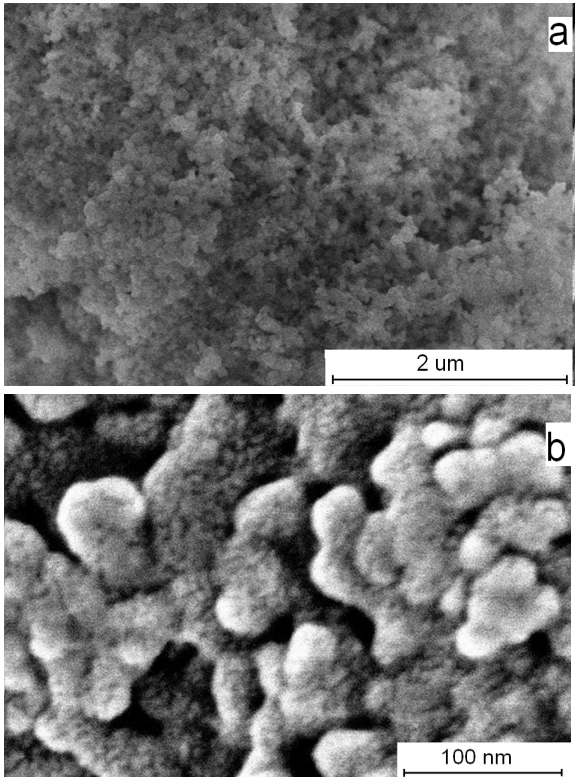

Fig.1 *Microphoto of* $Eu(PO_3)_3:Eu^{2+}$ *sample*

The data of the X-ray and chemical analyses show that change of the ratio of the main components, viz. europium and TBPH or TPhPhO, in the precursor influences on the phase composition and, respectively, on the luminescent properties of the pyrolysis products. E.g., pyrolysis of the precursors containing europium and TBPh at the ratios Eu:TBPh = 3-1 : 1-7 in the organic phase in all cases results in formation of various phosphates in the final products (Table 1). In the case of

change of the ratio Eu:TBPh from 3:1 to 2:1 the sample contains an insignificant amount of Eu_2O_3 together with the main phase Eu_3PO_7. Subsequent increase of TBPh concentration in the precursor to Eu:TBPh = 1:1 results in formation of $EuPO_4$ as the main phase and a small amount of Eu_3PO_7. At the ratios Eu:TBPh equaled 1:5 and 1:7 $Eu(PO_3)_3$:Eu^{2+} is formed, however, at Eu:TBPH = 1:5 the sample contains $EuPO_4$ as an admixture. The presence of the mixed-valent europium ions in $Eu(PO_3)_3$:Eu^{2+} is confirmed by the both X-ray photoelectron and luminescence spectroscopy data. As for the X-ray photoelectron spectra of the compounds having the same ions in the near environment, the more the oxidation state of the element the more the shift of the internal levels of the studying atom towards increase of the bond energy E_b [11]. One can see from the X-ray photoelectron spectra Eu 4d (Fig.2) that in $Eu(PO_3)_3$ europium exists the two oxidation states - Eu^{3+} and Eu^{2+} . The luminescent features of the various phosphate samples prepared were estimated by their luminescence and luminescence excitation spectra at 300°C recorded under identical conditions. The choice of the luminescence excitation wavelength was made according to the most intensive line after registration of the luminescence excitation spectra of the compounds. For all Eu^{3+} phosphates prepared λ_{ex} equaled 395 nm. In the range 550-700 nm, the phosphate luminophors based on Eu^{3+} obtained at various Eu:TBPh ratios display red luminescence with λ_{max} ≈600-650nm (Fig.3-4).

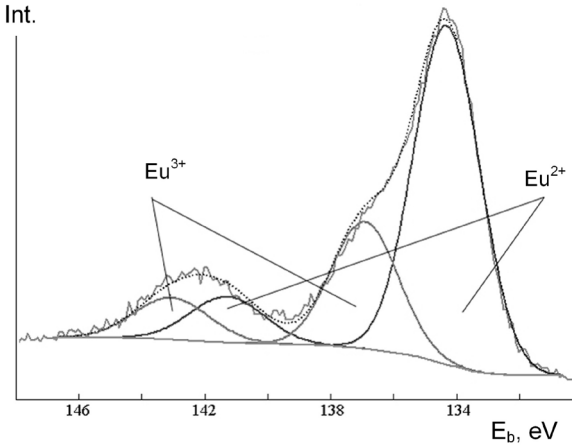

Fig.2 *X-ray photoelectron spectrum Eu 4d*

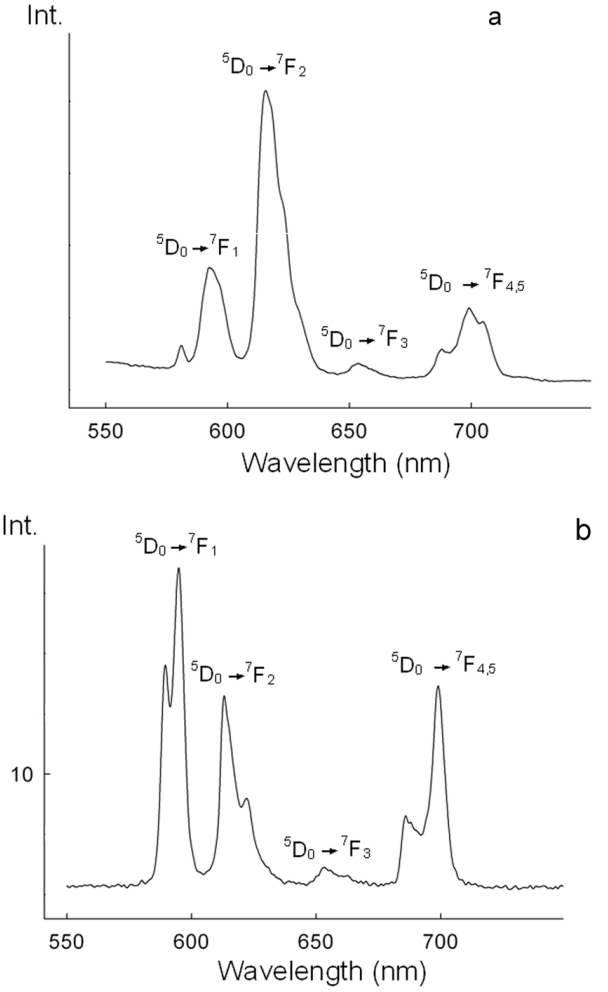

Fig.3. *Luminescence spectra (λ_{ex}=395 nm) of Eu_3PO_7 (a) and $Eu(PO_3)_3$ (b); 300K*

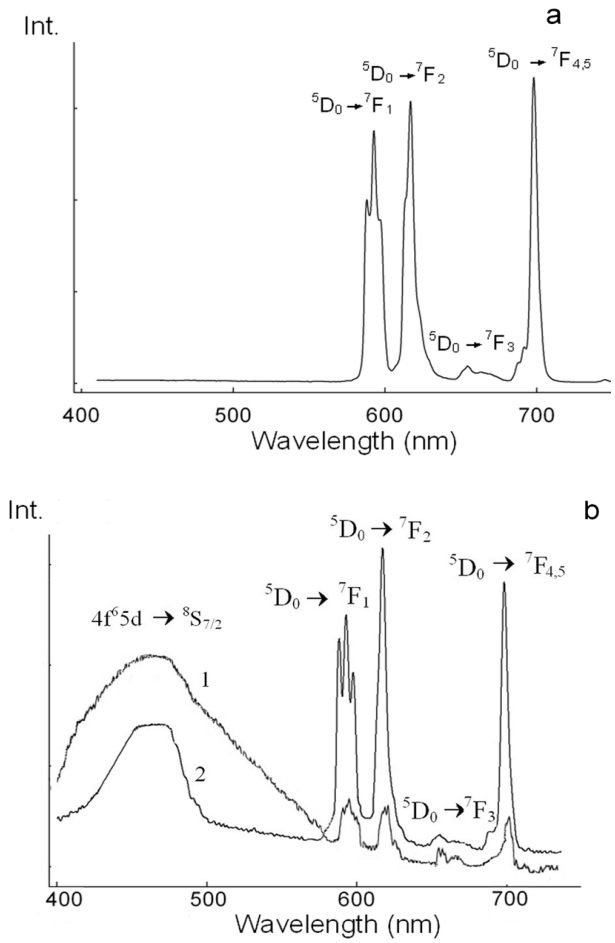

Fig. 4. *Luminescence spectra of Eu(PO3)3:Eu2+: a - λex=395 nm; b - λex=335 nm (curve1) and λex=353 nm (curve 2); 300 K*

The luminescence spectra of the phosphates (λ_{ex} = 395 nm) consist of the series of the bands respective to the transitions between $^5D_0 - {}^7F_j$ and typical for Eu^{3+} ion [12]. In this case, in the luminescence spectra of the phosphates with different phase compositions, viz. Eu_3PO_7 (Fig. 3,a; Table 1), $EuPO_4$ (Table 1), and $Eu(PO_3)_3$ (Fig. 4, a), one can observe change in redistribution of the intensities of $^5D_0 - {}^7F_j$ transitions typical for Eu^{3+} ion and a displacement of their bands.

Table 1 *Wavelengthes and relative intensities (I, rel.) of bands of $^5D_0 - {}^7F_j$ (j=1, 2, 3, 4, 5) transitions of Eu^{3+} ion in luminescence spectra of europium phosphates at 300k. λ_{ex} = 395 nm*

Composition	$^5D_0 - {}^7F_1$ 580-600 nm		$^5D_0 - {}^7F_2$ 600-640 nm		$^5D_0 - {}^7F_3$ 640-675 nm		$^5D_0 - {}^7F_{4,5}$ 675-720 nm	
	λ, nm	I, rel.	λ, nm	I, rel.	λ, nm	I, rel.	λ, nm	I, rel.
Eu : TBPh = 3-2:1 Eu_3PO_7	581	7.07	616	100	653	3.72	688	9.64
	593	34.92					699	25.11
Eu: TBPh =1:1 $EuPO_4$	580	17.42	615	100	655	8.88	686	22.66
	589	58.50	625	81.96			700	42.40
	595	67.34						
Eu: TBPh =1:3-$Eu(PO_3)_3$	589	64.78	613	57.41	653	4.59	686	20.44
	595	100	622	25.85			699	60.44
	emission Eu^{2+} ion: $4f^65d \rightarrow {}^8S_{7/2} \sim$ 400-500 nm (λ_{ex} =353 nm)							
Eu: TBPh =1:7 $Eu(PO_3)_3$:Eu^{2+}	588	65.36	617	100	654	6.21	692	12.74
	593	88.89					698	91.6
	597	58.17						

Thus, in the luminescence spectra of Eu_3PO_7 (Fig.3, a: Table 1) and $EuPO_4$ (Table 1), the bands relative to $^5D_0 - {}^7F_2$ electrodipole transition (λ ≈625 nm) predominate while in that of $Eu(PO_3)_3$ (Fig.4, a; Table 1) the band respective to $^5D_0 - {}^7F_1$ magnetodipole transition (λ≈595 nm) is the most intensive. In the case of high cetrosymmetric surroundings of Eu^{3+} ion, the band of $^5D_0 - {}^7F_1$ transition is more intensive; for the low symmetry the band of $^5D_0 - {}^7F_2$ transition has the maximum intensity [13].

Among the phosphates $Ln(PO_3)_3$, europium forms the two modifications [14]. According to the X-ray diffraction data $Eu(PO_3)_3$ is isostructural to the modification having the rhombic unit cell with the following parameters: a=11.037; b=8.437; c=7.199. The framework of this structural type [14] consists of infinite chains of PO_4 tertahedra bonded through the common oxygen apexes. Europium atoms contain the eight oxygen atoms in the nearest surroundings. EuO_8 polyhedra are connected through the common edges into infinite chains directed to the phosphate groups. It should be noted that the conclusion on isostructurality was made on the basis of the power data.

The luminescence excitation spectra (λ_{em}=615 nm) of the Eu(III) phosphates including $Eu(PO_3)_3$:Eu^{2+} are similar to each other. As an example, the luminescence excitation spectrum of the latter compound is presented in Fig.5.

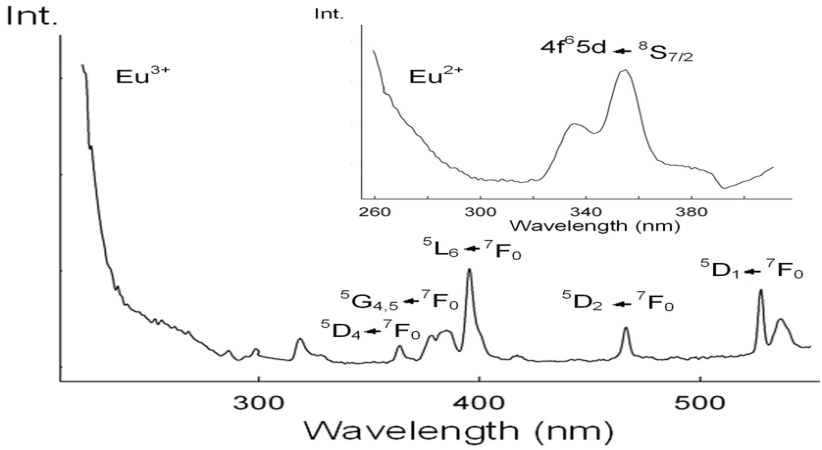

Fig. 5 *Luminescence excitation spectra of Eu^{3+} (λ_{em}=615 nm) and Eu^{2+} (λ_{em}=480 nm) in $Eu(PO_3)_3$:Eu^{2+}; 300 K*

In the short-wave region of the spectra (Fig.5) one can see the intensive band of the charge transfer ($\lambda_{max}\approx$250 nm) indicated to the presence of the channel of excitation energy transmission to Eu^{3+} ion – O^{2-} [13,15]. In the long-wave region at 350-550 nm, the narrow bands respective to transitions from the basic state of Eu^{3+} ion $^7F_0$ into $^5D_1$, $^5D_2$, $^5D_4$, $^5L_6$, $^5G_{4,5}$ excited levels present [15].

The bands observed in the excitation spectrum of $Eu(PO_3)_3$:Eu^{2+} (λ_{em}=480 nm) (Fig.5, insert) related to $^8S_{7/2}\rightarrow 4f^65d$ transition in Eu^{2+} ion consists of the two components at 334 nm and 355 nm splitted by the crystal field of the ligands which surround Eu^{2+} ion [3]. Moreover, the shape and large width of the excitation band at 320-400 nm may indicate to presence of europium with different crystallographic positions and coordination environment [5]. The presence of the weak bands at 320-420 nm in the luminescence excitation spectrum of Eu^{2+} (Fig.5) as well as overlap of the wide band of Eu^{2+} emission Fig. 4, b) and several luminescence excitation bands of Eu^{3+} may result in energy transfer from 5d level of Eu^{2+} ion into 4f levels of Eu^{3+} ion [16].

In the luminescence spectrum of $Eu(PO_3)_3$:Eu^{2+} (Fig.4, b; λ_{ex}=350 nm) the both wide emission band of Eu^{2+} ion with $\lambda_{max}\approx$466 nm [2] and the bands of $^5D_0 - {}^7F_j$ (j=1, 2, 3, 4, 5) transitions typical for Eu^{3+}[3,12] present. Moreover, the luminescence spectra of $Eu(PO_3)_3$ (Fig. 4,a) and $Eu(PO_3)_3$:Eu^{2+} (Fig.4, b) have essential differences in distribution of emission energy between $^5D_0 - {}^7F_{1,2,3,4,5}$ transitions of Eu^{3+} ion and in splitting of the transition bands (Table 1). Thus, in the luminescence spectrum of $Eu(PO_3)_3$:Eu^{2+} the band of $^5D_0 - {}^7F_2$ electrodipole transi-

tion (λ=620 nm) is the most intensive while in that of $Eu(PO_3)_3$ the main share of emission relates to $^5D_0 - {}^7F_1$ magnetodipole transition. Such redistribution of intensities within $^5D_0 - {}^7F_{1,2}$ transitions as well as increase of intensity of the band of $^5D_0 - {}^7F_4$ transition indicates to lowering of symmetry of the nearest surrounding of Eu^{3+} ion – the luminescence centre [13,14] in case of transition from $Eu(PO_3)_3$ to $Eu(PO_3)_3:Eu^{2+}$. It should be noted that influence of the exiting wavelengths on the contribution of the emission intensity of Eu^{2+} and Eu^{3+} differs (Fig. 4, a, b). The luminescence spectrum of $Eu(PO_3)_3:Eu^{2+}$ at excitation with λ_{ex}=335 nm and λ_{ex}=353 nm (intensive bands in Eu^{2+} excitation spectrum, Fig. 5, insert) displays the wide band of Eu^{2+} emission in the blue range. In the first case (λ_{ex}=335 nm) Eu^{3+} emission is almost absent (Fig. 4, b, curve1). Intensity of Eu^{3+} ion emission in the red range rises with excitation with λ_{ex}=353 nm while that of Eu^{2+} emission in the blue range slightly decreases (Fig. 4, b - curve 2). Excitation with λ=395 nm results in considerable rise of intensity of $^5D_0 - {}^7F_j$ transitions while luminescence of Eu^{2+} ion is not observed (Fig. 4, a).

Possibility of obtaining various nano-scale europium phosphates including those containing europium in the two oxidation states at the same time – Eu^{3+} and Eu^{2+} by low-temperature pyrolysis of precursors at various ratios of europium and organo-phosphorus compound contents in one stage was shown and their luminescent properties were studied. Europium (III) phosphates Eu_3PO_7, $EuPO_4$, and $Eu(PO_3)_3$ display red luminescence in the range 550-700 nm with λ_{max}~620 nm. The luminescence spectrum of $Eu(PO_3)_3:Eu^{2+}$ (λ_{ex}=350 nm) has the both wide emission band with λ_{max}~466 nm of Eu^{2+} ion and the bands of $^5D_0 - {}^7F_j$ (j=1, 2, 3, 4, 5) transitions typical for Eu^{3+} ion. Moreover, in the luminescence spectra of $Eu(PO_3)_3$ and $Eu(PO_3)_3:Eu^{2+}$ one can observe some essential differences in distribution of the emission energy within $^5D_0 - {}^7F_{1,2,3,4,5}$ transitions of Eu^{3+} ion and splitting of the transition bands.

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UDC: 616.71; 617-089.844

不透射线的生物活性玻璃：制备和性能
RADIOPAQUE BIOACTIVE GLASSES: PREPARATION AND PROPERTIES

Medkov Mihail Azarievich
Doctor of Chemical Sciences, Head of Laboratory
Grishchenko Dina Nikolaevna
Candidate of Chemical Sciences, Researcher
Institute of Chemistry, Far Eastern Branch of the Russian Academy of Sciences

注解。 本文提出了一种通过热解有机溶液获得不透射线生物玻璃的方法。 有机溶液含有松节油中的四乙氧基硅烷，磷酸三丁酯，油酸钠和油酸钙，以及三辛胺的苯溶液中的铋，钨或钽提取物。 该方法允许获得粉末形式的生物活性射线不透性玻璃，并且在各种多孔载体上以涂层的形式获得。
关键词：不透射线生物玻璃，生物活性涂层，有机溶液热解。

Annotation*. In this paper, a method for obtaining a radiopaque bioglass by the pyrolysis of organic solutions is proposed. The organic solution contains tetraethoxysilane, tributyl phosphate, sodium oleate and calcium oleate in turpentine, as well as bismuth, tungsten or tantalum extracts in a benzene solution of trioctylamine. The method allows to obtain bioactive radiopaque glass in the form of powders, and in the form of coatings on various porous carriers.*
Keywords*: radiopaque bioglass, bioactive coatings, pyrolysis of organic solutions.*

In traumatology and maxillofacial surgery, calcium-phosphate biocompatible materials are used as materials that can replace damaged areas of bone tissue. They are similar in composition to the natural bone tissue, and therefore do not cause negative allergic reactions, do not possess carcinogenic and mutagenic properties, and are well integrated into the process of bone formation. Such materials can be represented by bioglass, bioceramics, glass ceramics and composites [1-3].

Bioglass has a special place among these materials [4]. Known bioglass "Bioglass 45S5" has a composition, wt. %: 45 SiO_2; 24.5 Na_2O; 24.5 CaO; 6 P_2O_5.

It has good osteoconduction, biological activity and is biodegradable. This glass forms on the surface of the material a layer of hydroxylated apatite carbonate, similar to the bone mineral phase, this supports the biological activity of the material upon implantation. Glass "Bioglass 45S5" due to its properties can be used as materials for the restoration of bone. The mechanisms that allow such glasses to be used in tissue engineering have been investigated by Larry Hench [5, 6].

It is possible to control the process of recovery of bone tissue due to the introduction of radiopaque substances (RPS) into the glass. As a rule, these are elements with a large atomic mass, preferably more than 85. Preference is given to the following metals: tungsten, tantalum, silver, bismuth, holmium, niobium, barium and strontium [7–9]. Tungsten, bismuth and tantalum are promising as RPS in combination with bioactive calcium phosphates in the glass composition. In medicine, bismuth compounds are part of the disinfecting, drying, astringent and antiseptic preparations. They treat many non-specific inflammatory processes [10]. The use of tantalum in medicine is due to unique properties: it is compatible with living tissue, does not oxidize in the body, does not cause irritation or rejection. Tungsten oxide has good antimicrobial properties, especially when illuminated, due to its high photocatalytic activity. Tungsten is believed to be non-carcinogenic, teratogenic or metabolic in relation to animals and humans [11].

The purpose of this work is to study the conditions of production and some properties of bioactive glasses containing compounds of bismuth, tungsten and tantalum as an RPS.

Experimental part

To obtain a radiopaque bioglass, a solution containing tetraethoxysilane, tributyl phosphate, sodium oleate and calcium oleate in turpentine, as well as bismuth, tungsten and tantalum extracts in a benzene solution of trioctylamine (TOA) was used. Solutions of tetraethoxysilane, tributyl phosphate, sodium oleate and calcium oleate in turpentine were mixed in the ratios of the components corresponding to the composition of the glass "Bioglass 45S5". Then bismuth, tungsten or tantalum extracts were added to the organic solution in the calculated volume. Glasses containing 0 - 10 wt.% Bi_2O_3, 0 - 10 wt.% WO_3 or 0 - 4 wt.% Ta_2O_5 were obtained.

Bismuth extract. The initial aqueous phase is a solution containing 40 g/l Bi, 200 g/l H_2SO_4 and 80 g/l NaCl. Extractant - 10% benzene solution TOA.

Tungsten extract. The original aqueous phase is a solution of sodium tungstate containing 20 g/l W and 3.2 g/l HCl. The extractant is a 20% benzene solution of tri-n-octylamine, pre-treated with an aqueous solution of HCl, having a concentration of 3.2 g/l.

Tantalum extract The initial aqueous phase was prepared by fusing 0.13 g of Ta_2O_5 and 6g of $K_2S_2O_7$ at 800 °C, followed by leaching the alloy with a 6% solu-

tion of $H_2C_2O_4 \cdot 2H_2O$ when heated. The extractant is a 20% benzene solution of TOA, pretreated with a 10% aqueous solution of H_2SO_4.

The organic and aqueous phases, mixed in equal volumes, were contacted for 30 minutes. with vigorous stirring. After phase separation, extracts were obtained: 33 g/l bismuth, 14 g/l tungsten, 1.7 g/l tantalum. The extract in a certain amount was added to an organic solution containing calcium, phosphorus, silicon and sodium. After mixing all the components, the solvent was distilled off at a temperature of 150–200 °C. The resulting mass (precursor) was transferred to the crucible, subjected to pyrolysis, heating up to 1300 °C in a muffle furnace at a speed of 7 °/min, and kept at this temperature for 20 minutes.

The in vitro bioactivity of materials was evaluated using a model medium: a solution emitting an interstitial body fluid (SBF solution). The procedure for preparing an SBF solution is similar to the method proposed in [12]. It is obtained by dissolving the corresponding reagents in distilled water (Table 1) and adjusted to a pH of 7.4 with a solution of HCl at a temperature of 37° C. The mineral composition of the solution is identical to the blood plasma. Samples were kept in solution for 14 days in a thermostat at 37° C. The solution was updated daily.

Table 1.

The composition of the SBF-solution.

Reagents	**Quantity, g/l**
NaCl	6,547
$NaHCO_3$	2,268
KCl	0,373
$Na_2HPO_4 \cdot 2H_2O$	0,178
$MgCl_2 \cdot 6H_2O$	0,305
$CaCl_2 \cdot 2H_2O$	0,368
Na_2SO_4	0,071
$(CH_2OH)_3CNH_2$	6,057

Diffractograms of the samples were taken on a DK ADVANCE diffractometer in CuKα radiation with a graphite monochromator. The composition was determined by X-ray phase analysis using an EVA search program with a powder data bank PDF-2. Scanning electron microscopy (EFM) was used to study the morphology of the samples. The SEM images of the samples were obtained on a Hitachi S5500 electron scanning microscope.

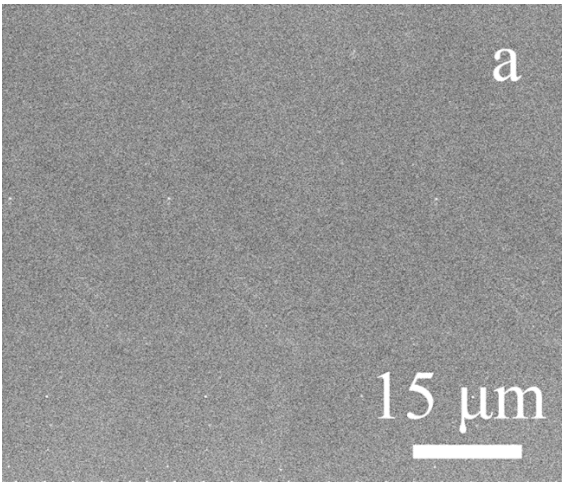
X-ray contrast of the samples was determined in terms of Hounsfield units (HU) using Toshiba Aquilion RXL multislice computed tomograph, 16 sectional. Radiocontrast was calculated as the average of ten measurements taken at random points. The thickness of the scanned sample is 0.5 mm.

Results and its discussion

For bioglass often use the sol-gel methods. But the process of preparing a sol from the initial reagents is quite long, up to 5 days [13]. The preparation of bioglass by the pyrolysis of solutions containing tetraethoxysilane, tributyl phosphate, sodium oleate and calcium oleate in an organic solvent takes 4 hours. This is a simple and convenient method of obtaining bioglass. In addition, such solutions, unlike the charge or sol, easily penetrate into the pores of the bioinert carrier, and during firing they form thin films that repeat the shape of its pores [14]. To make the bioactive glass radiopaque properties in their composition, you can enter heavy metal compounds. As precursors soluble in organic solvents, tantalum alcoholate or organo-organic compounds can be used. However, the preparation of such precursors is associated with the imperfection of their synthesis: the difficulty of carrying out reactions and purification of the final products. To obtain organic solutions of these metals, it is much more convenient and easier to use the extraction-pyrolytic method (EPM) [15].

In this work, the conditions for the production and bioactivity of X-ray contrast glasses obtained by EPM and containing bismuth, tungsten and tantalum as RPS are investigated. X-ray phase analysis data show that burning samples at 600-1000 ºC leads to the formation of a mixture of x-ray amorphous phase with crystalline phases. At 1300 °C, all the studied samples become X-ray amorphous.

As a result of tests carried out in vitro with the help of the SBF solution, it was confirmed that the resulting glasses have a bioactivity. In fig. Figures 1 and 2 show micrographs of 45S5 bioglass obtained by EPM, as well as its energy dispersion spectra before and after being in the SBF solution.



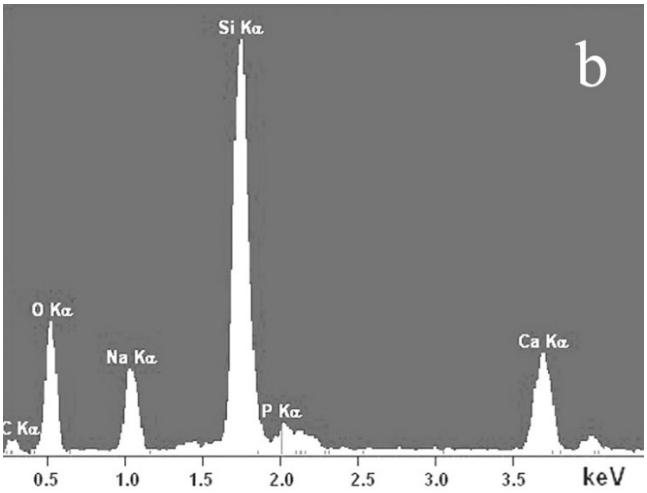
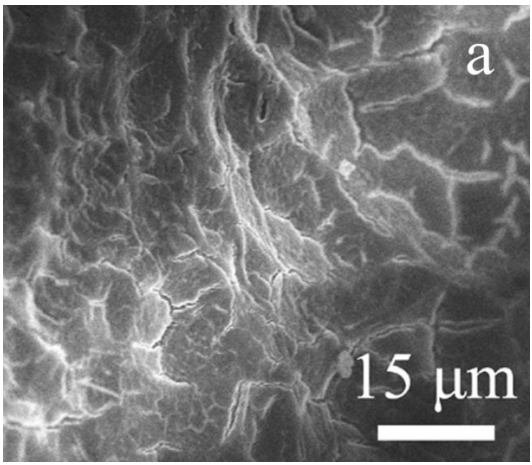


Fig. 1. *Micrographs of the bio-glass composition 45S5 (a) and its energy dispersive spectrum (b).*



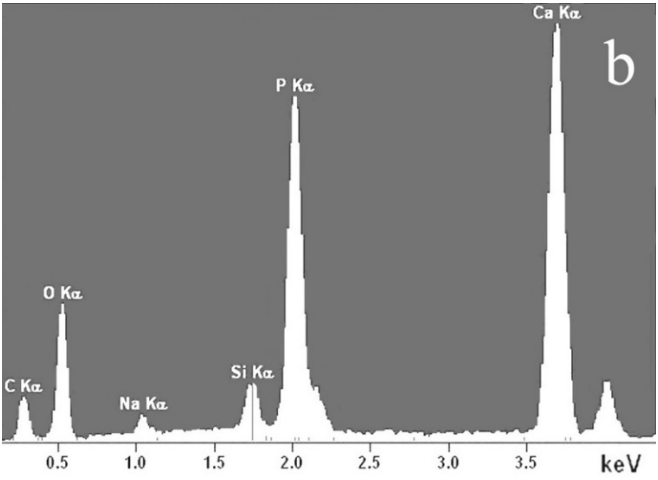


Fig. 2. *Micrographs of the 45S5 bio-glass after being in the SBF solution (a) and its energy dispersion spectrum (b)*

The calcium phosphate layer formed on the sample completely covers its surface. In fig. 3 shows micrographs of radiopaque glasses after being in a SBF solution.

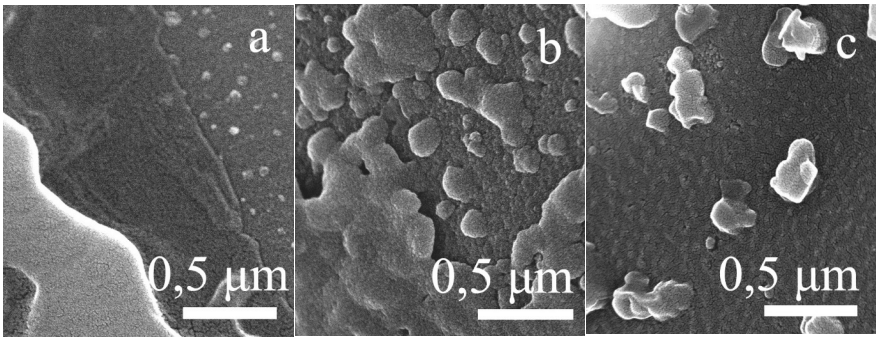


Fig. 3. *Micrographs of glass containing 3% Ta2O5 (a), 5% Bi2O3 (b), 7% WO3 (c), after the SBF solution*

The coatings formed on the radiopaque glasses are loose, have the appearance of islands of different sizes. Energy dispersive spectra of coatings indicate that their compositions correspond to calcium phosphates. The smaller the RPS in the sample, the larger the area occupied by the coating on its surface. For samples with

a 7% RPS content, the coating has the appearance of individual particles of different diameters. Samples with a 10% content of Bi_2O_3 or WO_3 do not have a calcium phosphate coating after 14 days in a SBF solution. The results show that the bioactivity of the samples decreases with an increase in the number of additional components in the 45S5 bioglass composition. This is consistent with studies [16], where bismuth oxide was used as a dopant. Bioactivity was manifested in glasses with the addition of Bi_2O_3 less than 8 wt.%.

Biostekola mechanical properties inferior bone tissue. For bone arthroplasty, more often use durable porous bioinert ceramics impregnated with a mixture containing bioactive components, which is burned to obtain a bioactive calcium phosphate layer. This should contribute to osseointegration, which is the occurrence of the anatomical connection between the bone and the surface of the implant. After calcination, our organic solutions form a thin bioactive glass layer on the surface of the bioinert carrier. Thus, EPM makes it possible to obtain both powder materials and coatings on various porous supports. Radiocontrast properties are necessary to control implant insertion processes and further bone tissue repair.

Bone tissues have their own radiocontrast. It varies in the range from 350 to 1250 HU (Hounsfield units) depending on the shape, structure, function, and development of the bone tissue (C. Mish classification). X-ray contrast 45S5 bioglass thickness of 0.5 mm is an average of 1100-1200 HU. The X-ray contrast ratio of 1% bismuth-, tungsten- and tantalum-containing biograms is about 1500 HU, 3% - about 3000 HU, 5% - about 4300 HU, 10% - about 7500 HU. An X-ray contrast study showed that glasses with a RPS content of 1–4% possess sufficient X-ray aging and bioactivity to control implant insertion processes and further bone tissue repair.

Conclusion

A method has been developed for obtaining X-ray contrast bioactive glasses by the pyrolysis of organic solutions. It allows to obtain bio-glasses in the form of powders for various biomaterials, as well as in the form of thin bioactive coatings that create layers on porous materials that repeat the shape of the pores of the carrier. The radiopaque substance in the biomaterial composition makes it possible to control the process of bone tissue regeneration.

EPM has advantages over the method of obtaining from aqueous solutions, as well as over the sol-gel method. In the first case, EPM allows to avoid fractional crystallization during evaporation. In the second, there is no need to homogenize the initial mixture, since true solutions easily penetrate into the pores of the bioinert carriers.

The method allows to obtain glass of various compositions. By changing the composition, you can give the materials the necessary properties.

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氟化技术处理数据矿石
PROCESSING OF DATOLITE ORE BY FLUORIDE TECHNOLOGY

Medkov Mihail Azarievich
Doctor of Chemical Sciences, Head of Laboratory
Krysenko Galina Filippovna
Candidate of Chemical Sciences, Researcher
Epov Dantiy Grigorievich
Candidate of Chemical Sciences, Leading Engineer
Institute of Chemistry, Far Eastern Branch of the Russian Academy of Sciences

注解。 本文介绍了用二氟化铵处理数据矿石的可能性的研究结果，绕过了获得浓缩物的阶段。 已确定用二氟化氢铵开放矿物原料，形成硼，硅，铁和CaF2的复合氟铵盐，并且表明加工阶段的温度间隔不依赖于 矿石中的石英含量。 为了防止在矿石氟化期间剧烈的气体逸出，建议将混合物预先保持在室温直至完全氟化CaC03。 提出了用二氟化铵加工数据石矿石以生产商品的主要流程图。

关键词：数据矿石，氢氟酸铵，氟化，浸出，升华，氟硼酸铵，六氟硅酸铵。

Annotation*. The article presents the results of a study of the possibility of processing datolite ore with ammonium difluoride, bypassing the stage of obtaining the concentrate. It is established that the opening of mineral raw materials with ammonium hydrogen difluoride proceeds with the formation of complex fluorine-ammonium salts of boron, silicon, iron and CaF_2, and it is shown that the temperature intervals of the processing stages do not depend on the content of datolite in the ore. To prevent intense gas evolution during fluoridation of ore, it was suggested to preliminarily maintain the mixture at room temperature until complete fluorination of $CaCO_3$. A principle flow chart for the processing of datolite ore with ammonium difluoride to produce commercial products is proposed.*

Keywords*: datolite ore, ammonium hydrodifluoride, fluorination, leaching, sublimation, ammonium fluoroborate, ammonium hexafluorosilicate.*

The largest boron deposit in Russia is located in Primorsky Krai and is mainly represented by borosilicate mineral datolite. The mining and chemical company «Bor» develops this deposit, carrying out all the work on preparing the extracted ore mass for enrichment and chemical processing of the concentrate obtained. The processing plant severely restricts the regulated indicators of the quality of mineral raw materials and thus has a great influence on the amount of reserves involved in processing and on the choice of development systems, which negatively affects the economy of the mining enterprise. For example, in 2014, when processing 800 thousand tons of datolite ore, 300 thousand tons of datolite concentrate were obtained, the boron content of which was only two times higher than the boron content in the original ore.

In this regard, the development of such a method for the processing of boron-containing mineral raw materials, which bypasses the stage of concentrate production, will allow expanding the capabilities of mining enterprises to engage in the development of poorer ores.

This paper presents the results of a study of the possibility of hydrodifluoride processing of datolite ore from the Primorsky borosilicate deposit (Dalnegorsk) with the extraction of all valuable components in the form of commercial products.

Methods of processing mineral raw materials using ammonium hydrodifluoride have recently attracted increasing attention [1, 2]. Ammonium hydrodifluoride NH_4HF_2 is a crystalline substance having a high chemical activity and a complex of technologically favorable physicochemical properties: melting point 126.2 °C, boiling point 238 °C (boiling is accompanied by decomposition into NH_3 and HF), good solubility in water (434 g/l). The physico-chemical basis of the process of fluorination with ammonium hydrogen difluoride is that oxygen-containing compounds of transition and many non-transition elements, when interacting with NH_4HF_2, form very convenient for processing ammonium fluoride or oxofluorometallate [3], which, due to their physical and chemical properties, provide the solubility of products and the possibility separation of mixtures by sublimation. The release of NH_4F from the hydrolysis of the fluoroammonium salts or NH_3 and HF upon the thermal decomposition of these substances creates favorable conditions for the regeneration of NH_4HF_2 and the creation of closed and environmentally safe technological schemes.

The sample of boron-containing ore according to X-ray analysis was presented by datolite $CaBSiO_4(OH)$, calcite $CaCO_3$, quartz SiO_2, and the mineral andradite $Ca_3Fe_2(SiO_4)_3$. There is no data on fluorination of ammonium hydrodifluoride andradite in the literature, while fluoridation of the datolite mineral and crystalline quartz has been studied in detail previously [4, 5] and can be represented by equations (1) and (2):

$$CaBSiO_4(OH) + 6\ NH_4HF_2 = CaF_2 + NH_4BF_4 + (NH_4)_2SiF_6 + 3\ NH_3\uparrow + 5\ H_2O; \quad (1)$$

$$SiO_2 + 3{,}5\ NH_4HF_2 = (NH_4)_3SiF_7 + 0{,}5\ NH_3\uparrow + 2\ H_2O. \quad (2)$$

The study showed that when mixing datolite ore with NH_4HF_2 and aging at room temperature, after 1 day, reflections of the fluoroammonium salts of silicon $(NH_4)_3SiF_7$ and iron $(NH_4)_3FeF_6$ and NH_4F, formed as a result of the absorption of ammonia by ammonium ammonia released in interaction of ore components with NH_4HF_2. It should be noted that the release of ammonia into the atmosphere is not observed, it is all captured by NH_4HF_2, and the external change is only a slight moistening of the charge. After 5 days, the reflexes of $CaCO_3$ present in the ore disappear on the x-ray of the charge and the CaF_2 reflexes appear. Thus, fluorination with ammonium hydrodifluoride of calcite and andradite can be represented by equations (3) and (4):

$$CaCO_3 + NH_4HF_2 = CaF_2 + CO_2\uparrow + NH_3\uparrow + H_2O. \quad (3)$$

$$Ca_3Fe_2(SiO_4)_3 + 18\ NH_4HF_2 = 3\ CaF_2 + 2\ (NH_4)_3FeF_6 + 3\ (NH_4)_2SiF_6 + 6\ NH_3\uparrow + 12\ H_2O; \quad (4)$$

A thermogravimetric study (Fig. 1) showed that datolite ore interacts with NH_4HF_2 in a dry mixture at a temperature of ~ 85 °C with heat, and after melting the fluorinating reagent proceeds with heat absorption and a maximum speed at 145 °C. According to X-ray phase analysis, the product isolated at 200 °C is a mixture of complex fluorine-ammonium salts of boron, silicon, iron and calcium fluoride, while the freshly routed product contains the fluoride-ammonium salt of boron in the X-ray amorphous form, which crystallizes in 2-3 days as NH_4BF_4.

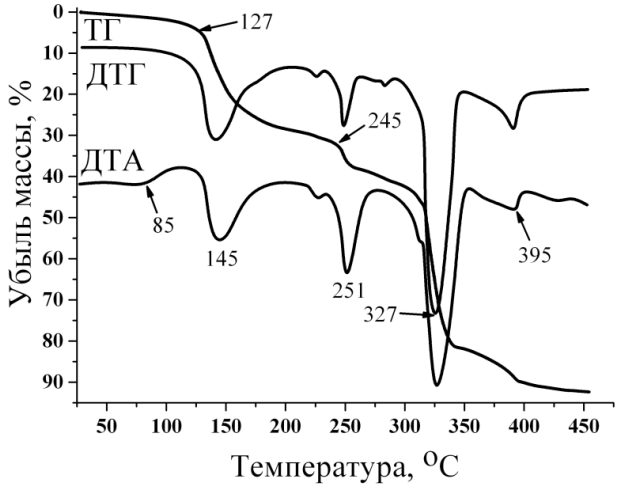

Figure 1. *Thermogravimetric analysis of the charge datolite ore + NH_4HF_2*

The endothermic effect with a maximum at 251 °C corresponds to the decomposition of liquid NH_4HF_2 taken to carry out the fluorination reaction of datolite ore with a small excess, which is consistent with the data of [3], for which the boiling point of NH_4HF_2 is 239.5 °C, the boiling proceeds with decomposition, and the "pair" NH_4HF_2 composed of HF and NH_3. Endothermic effects with maxima at 327 and 395 °C correspond to the transition to the gas phase $(NH_4)_2SiF_6$ and NH_4BF_4, the decomposition pressure of which reaches atmospheric, respectively, at 319 and 354 °C [3]. The product isolated at 400 °C, according to X-ray phase analysis, is mainly CaF_2.

Thermogravimetric study shows that the processes occurring during hydrodifluoride opening of datolite ore and datolite concentrate are of a similar nature and almost coincide in temperature ranges (Fig. 2). The only difference is in the amount of mass loss at similar stages, which is understandable and is associated with different content of the corresponding phases in the ore and concentrate.

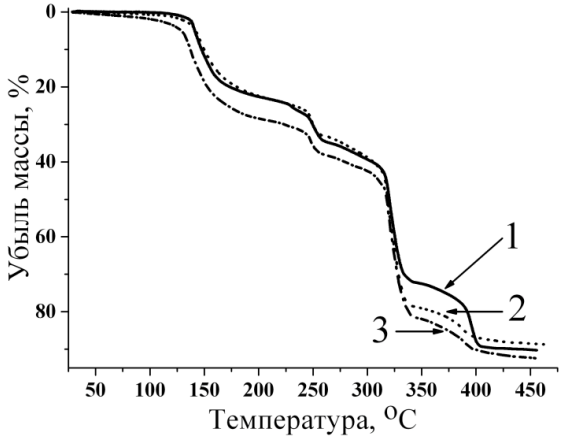

Figure 2 - *Curves of the mass loss of fluorination with ammonium difluoride: 1 - datolite concentrate; 2 - datolite ore; 3 - datolite ore after 5 days of aging the mixture at room temperature*

The process of fluorination at a temperature of 150-160 °C allows you to completely open the ore. Proftorirovannaya datolite ore is a crumbly product of grayish color and, according to X-ray phase analysis, consists of a mixture of complex fluoroammonium salts of silicon, boron, iron and CaF_2. However, when ore is fluorinated, there is intense gassing, which is absent when the concentrate is fluoridated, and the product partially overflows the edge of the reaction container,

which is most likely due to the interaction with calcium carbonate NH_4HF_2, which releases CO_2 in addition to ammonia to the gas phase (equation 3). To prevent intense gassing during the fluorination of ore allows the charge to be aged at room temperature until the $CaCO_3$ reflexes disappear on the radiograph. Fluoridation of the charge at 150-160 °C after the disappearance of the reflexes of $CaCO_3$ proceeds calmly, proftorirovannogo product easily poured out of the reaction container.

Fluoroammonium salts of boron, silicon and iron are well soluble in water, therefore at the next stage of processing it is advisable to translate them into solution. The leaching process of the proftorirovannogo product was performed by three-time dissolution in water at Т:Ж = 1:10, followed by separation of the insoluble residue from the solution by filtration. The study showed that the water-insoluble residue amounts to 22.5% of the mass of the initial mineralized product. According to the X-ray phase analysis, it was represented by CaF_2, in which, according to the elemental analysis data, ~ 4-5% of the manganese, magnesium, and aluminum fluoride impurities were present. Thus, the insoluble residue can be used as a high-quality fluorspar concentrate for welding materials.

The filtrate, evaporated to dry salts, was a mixture of soluble fluoroammonium salts of boron, silicon and iron. Fluoroammonium salts of boron, silicon and iron can be separated by sublimation, since the high evaporation temperatures of iron fluorides create conditions for the deep separation of volatile ammonium boron ammonium fluorometalates and silicon and nonvolatile iron fluorides, which form sludge. The study showed that heating the evaporated filtrate to a temperature of 390 °C and keeping it at this temperature for 1 hour allows extracting up to 99.3% of silicon and boron to the gas phase.

After the removal of boron and silicon, sludge remains in which iron is in the form of FeF_3. The restoration of fluoride sludge in an atmosphere of hydrogen, which intensively flows at a temperature of 520-620 °C, results in the production of powdered iron, and its pyrohydrolysis leads to the production of another valuable by-product, the red pigment (ocher) [6].

To separate the mixture of boron and silicon fluoride-ammonium salts, the difference in volatilities of these salts can be used (354 and 319 °C, respectively). On the other hand, the study showed that the possibility of precipitating silicon dioxide with ammonia can be used to separate the water-soluble fluoro-ammonium salts of silicon and boron, since under these conditions boron remains in solution as NH_4BF_4. This will additionally allow to obtain fine silica powders, and ammonium tetrafluoroborate is widely used as catalysts, flux components, as part of flame retardant mixtures, etc.

Thus, the study showed that the opening of datolite ore with ammonium hydrodifluoride allows, bypassing the stage of obtaining the concentrate, to carry out complex processing of this mineral raw materials to produce marketable products.

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从高岭土中获得铝的方法

METHOD FOR PRODUCING ALUMINUM HYDROXIDE FROM KAOLIN

Eranskaya Tatyana Yuryevna
Candidate of Technical Sciences, Senior Researcher,
Institute of Geology and Nature Management of the Far East Branch
of the Russian Academy of Sciences, Blagoveshchensk, Russia

注解。 在空化处理强化过程中煅烧高岭土在硝酸中的分解实验表明，产生的氢氧化铝的量取决于溶液浓度，空化处理时间和初步煅烧温度。 通过在40％酸溶液中60分钟处理在700℃下煅烧的高岭土获得最大结果91.44％。改进这种方法将扩大生产氧化铝和铝的矿物基础。

关键词：超声空化，酸分解，高岭土，偏高岭土，氢氧化铝，焙烧。

Annotation. *The experiment on the decomposition of calcined kaolin concentrate in nitric acid during the intensification of the process by cavitation treatment showed that the amount of aluminum hydroxide produced depends on the solution concentration, the cavitation treatment time and the preliminary calcination temperature. The maximum result, 91.44%, was obtained by treatment in 60 min in a 40% acid solution for kaolin calcined at 700°C. Improving this method will expand the mineral base for the production of alumina and aluminum.*

Keywords: *ultrasonic cavitation, acid decomposition, kaolin, metakaolinite, aluminum hydroxide, roasting.*

Since bauxite reserves are limited, and the economies of different countries require more and more aluminum, it is necessary to develop the production of alumina from other aluminum-containing rocks. Such rocks can be widespread nepheline, gneiss, anorthosite, kaolin, etc. They contain on average from 20 to 60% alumina. Developing a relatively inexpensive technology for isolating aluminum from such rocks is an important task for the near future.

One of the methods that can solve this problem is proposed for consideration in this paper.

The method is based on the damaging effects of cavitation on mineral rocks along cracks, grain boundaries, cleavage edges, and other properties. We were interested in the possibility of cavitation in the intensification of chemical processes.

The intensification of chemical processes under the action of cavitation occurs due to a sharp increase in temperature and pressure in the zone of collapse of cavitation bubbles to a critical value for a given solution. This increases the temperature and pressure in all its volume. In addition, there is a high level of ionization of both the solution and the substance in it. Both that and another promotes increase of degree of interaction of reagents.

For kaolin, which will be discussed in this work, the effect of cavitation on minerals can be interpreted in this way. Kaolin consists of kaolinite, which contains in its structure aluminum, free silica and oxides of some other metals. Kaolinite belongs to the group of clay minerals and has a lamellar structure. Under the action of cavitation, the plates are crushed into small fragments, their destruction to a two-layer minimum size. Thus, the interaction surface increases, unfilled terminal bonds appear, new more favorable combinations of layers appear due to displacements and turns, forming new structures. Under normal conditions, kaolinite has practically no ability for isomorphous substitutions. Therefore, for the interaction of kaolinite with solutions of acids or alkalis, it is necessary to create special conditions - high pressure and temperature simultaneously [1]. During cavitation, the strong hydrogen bond of the O – H type, which prevents the intracrystalline swelling of the lattice and the penetration of the ions and cations of the solution into the interpacket space of the kaolinite, is destroyed. The higher the temperature and pressure, the more intense the exchange of ions and cations between the kaolinite and the solution.

Consider the process of interaction of kaolin with nitric acid. This reaction takes place in normal conditions, and in high-temperature reactors and in cavitation conditions. But not until the end. Only kaolinite interacts with acid. The decomposition of kaolinite in nitric acid occurs in accordance with (1) [2]. Silicon oxide from the composition of kaolin concentrate and resulting from the decomposition of kaolinite and other oxides practically do not participate in the reaction.

$$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O + 6HNO_3 = 2Al(NO_3)_3 + 2SiO_2 + 5H_2O \quad (1)$$

For a more complete decomposition of kaolinite, it is pre-calcined to temperatures of 700-800ºC [1]. When this occurs, the removal of chemically bound water and the destruction of the crystal lattice of kaolinite [3]. The result is an amorphous substance with the structure of metakaolinite (2), which has a relatively high reactivity.

$$2Al_2SiO_2O_5(OH)_4 \rightarrow 2Al_2SiO_2O_7 + 4H_2O \quad (2)$$

Another variation of the metakaolinite formula – $Al_2O_3 \cdot 2SiO_2$.

As a result of interaction with nitric acid, metakaolinite decomposes into aluminate and silicate parts. SiO2 does not react with acid under these conditions. The solution obtained by the reaction consists of aluminum nitrate and unreacted silicon oxide (3).

$$Al_2O_3 \cdot 2SiO_2 + 6HNO_3 = 2Al(NO_3)_3 + 2SiO_2 + 3H_2O \quad (3)$$

Further, the solution filtered and one stripped off to a certain concentration is treated with ammonia water (4)

$$Al(NO_3)_3 + 3NH_3 + 3H_2O \rightarrow Al(OH)_3\downarrow + 3NH_4NO_3. \quad (4)$$

The result is a white gelatinous substance, which, after drying, is an aluminum hydroxide.

According to this principle, aluminum hydroxide is obtained in many well-known acid technologies with calcined kaolin. In autoclave technology, the reaction (3) can last from several hours to two or three days [4]. With a high content of alumina in the rock, the yield of aluminum hydroxide can be up to 98% of stoichiometry.

Based on the reaction (2), (3), (4) and using our own experience with kaolin using alkaline technology [5-9] with cavitation activation of the process, we developed a method for treating kaolin concentrate in a solution of nitric acid under the action of cavitation. Cavitation is a catalyzing factor for reaction (3). Processes (2) and (4) are relatively traditional.

In the experiments, kaolin with the initial content was used: SiO2 - 50.44%, Al2O3 - 32, 83%, intergranular water - 12.42% [5]. The rest is impurity oxides. As a result of roasting, water was removed, and the ratio of all oxides in comparison with the initial one did not change. In tab. Figure 1 shows the oxide composition of kaolin after calcination at 600, 700, 800ºC, in fig. 1 - radiographs of the original and calcined kaolin.

Table 1

Oxide composition of calcined kaolin,%

Oxides		SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	Na_2O	K_2O	P_2O_5	Loi()	Amount
Firing temperature	600° C	56.42	0.46	37.20	1.65	0.01	0.41	0.20	0.18	1.63	0.02	1.60	99.78
	700° C	55.75	0.48	38.46	1.69	0.01	0.42	0.26	0.19	1.66	0.03	0.79	99.74
	800° C	57.15	0.46	37.35	1.66	0.01	0.41	0.20	0.19	1.62	0.02	0.70	99.77

Radiographs 2, 3, 4 have the same appearance. The peaks belong to free SiO2, which does not decompose in this temperature range, and kaolinite has acquired the structure of a metakaolinite.

Cavitational effects on calcined kaolin in a nitric acid solution occurred in a laboratory ultrasound unit (Fig. 2).

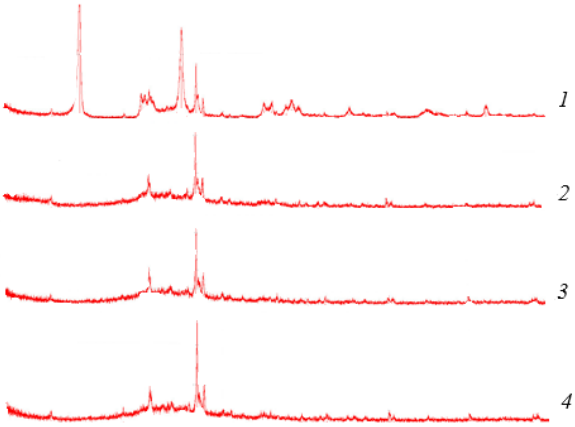

Fig. 1. *Radiographs of samples: 1 - initial kaolin; kaolin after firing: 2 - at 600 °C; 3 - at 700 °C; 4 - at 800 °C*

Fig. 2. *Experimental installation for cavitation processing of mineral raw materials*

The experiment was conducted in solutions of nitric acid with a concentration of 3 - 40%. Part of the metakaolinite, like the silica from the kaolin composition, does not react with the acid. This is seen when comparing curve 1 in fig. 3 and curves 2, 3, 4 in fig. 1. The reacted metakaolinite with an excess of acid is a yellow or dark yellow solution. The solution, one stripped off together with the wash water, is further subjected to the next stage of the experiment - treatment with ammonia water according to (4), drying and grinding the precipitate. This stage is traditional. The dried powder has either an amorphous form or a crystalline x-ray amorphous structure.

Radiograph 2 (Fig. 3) corresponds to AlOOH, radiograph 3 corresponds to a mixture of Al (OH) 3 and AlOOH.

The yield of the finished product, and in our experiments this product is aluminum hydroxide, depends on many factors. The graph (Fig. 4) shows the dependence of the yield of aluminum hydroxide on the calcination temperature (as a percentage of the aluminum content in the initial sample), on the graph (Fig. 5) - on the cavitation treatment time, on the graph (Fig. 6) - on the solution concentration .

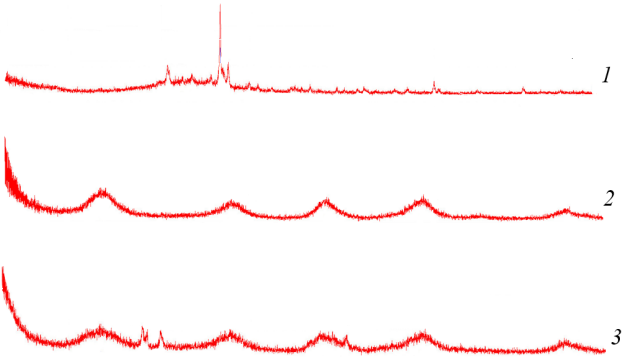

Fig. 3. *Radiographs: 1 - unreacted sediment; dried gel: 2 - 27% acid solution; 3-5% solution of acid*

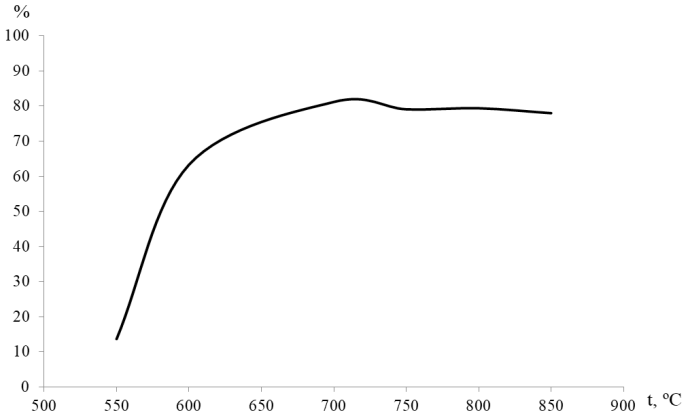

Fig. 4. *The output of aluminum hydroxide from the firing temperature*

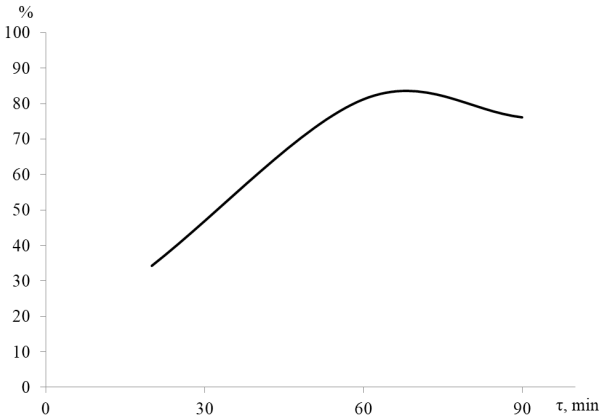

Fig. 5. *The output of aluminum hydroxide from the time of cavitation*

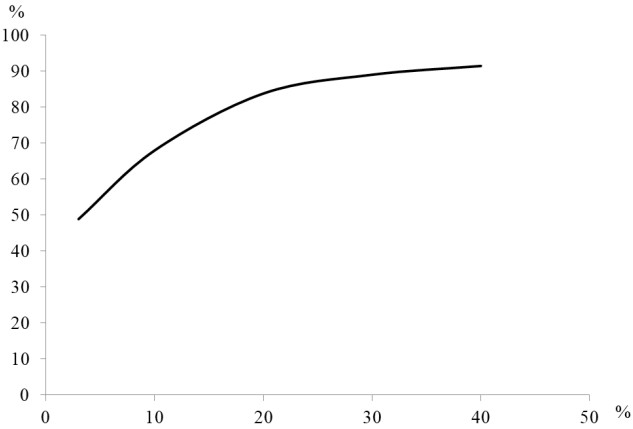

Fig. 6. *The output of aluminum hydroxide from the acidity of the solution*

As a result of experiments, the maximum yield of the finished product was 91, 44% of the stoichiometric rate and was obtained by cavitation treatment for one hour in a 40% solution of nitric acid for kaolin, calcined at 700ºC. This result is at the level of the results obtained in reactor technologies.

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高速冲击粉碎机 – 活化剂技术的可能性，用于解决生物技术领域的紧迫问题
POSSIBILITIES OF HIGH-SPEED SHOCK DISINTEGRATOR-ACTIVATOR TECHNOLOGY FOR SOLVING URGENT PROBLEMS IN THE FIELD OF BIOTECHNOLOGY

Farmakovsky Boris Vladimirovich
Candidate of Technical Sciences, Scientific Secretary
Vasiliev Aleksey Filippovich
Candidate of Technical Sciences, Head of Laboratory
Samodelkin Evgeny Aleksandrovich
Lead Engineer
Central Research Institute of Structural Materials "Prometey" named after I.V. Gorynin

抽象。 2014年1月，俄罗斯联邦政府主席批准了俄罗斯科技发展的长期预测，直至2030年。

该文件确定了主要目标 – 确定我国科技发展最有希望的领域，确保实现国家的竞争优势。七个优先领域是“生物技术”。在由国立研究大学“高等经济学院”开展的工作[1]中，指出生物技术是最重要和迅速发展的“横向”技术方向之一。由于创新技术的发展，将创造出新的高品质生物材料，其具有改善的复杂性质和均衡的营养素和维生素含量。在这方面，合成生物学，代谢工程和生物工程技术的发展是非常有前途的。国家研究中心“Kurchatov研究所” – CM“Prometey”中央研究所[2]进行的研究表明，使用冲击粉碎机 – 活化剂技术方法非常有希望解决实际问题。生物技术[3]。

关于生物材料的粉碎机活化的研究和使用的第一部作品属于Johannes Hint和他的SKTB“Disintegrator”。在他的领导下，在“粉碎机”中发起了关于在农工业综合体中使用粉碎机 – 活化剂技术的研究。其中包括崩解处理对肥料，各种生物质和植物原料生物活性增加的有效影响[4]。在未来，这些作品的范围得到了显着扩展，并在Gorynin Igor Vasilyevich院士的指导和直接参与下进行。

本文给出了高能崩解剂处理各种生物来源材料的结果。

关键词：高速冲击粉碎机 – 活化剂技术，活化。

Abstract. *In January 2014, the Chairman of the Government of the Russian Federation approved the long-term Forecast of scientific and technological development of Russia for the period until 2030.*

This document sets the main goal - the identification of the most promising

areas for the development of science and technology in our country, ensuring the implementation of the country's competitive advantages. Among the seven priority areas is "Biotechnology". In work [1], carried out by the National Research University "Higher School of Economics", it is pointed out that biotechnology is one of the most significant and rapidly developing "horizontal" technological directions. Thanks to the development of innovative technologies, new high quality biomaterials will be created with an improved complex of properties with a balanced content of nutrients and vitamins. In this regard, the development of synthetic biology, metabolic engineering and bioengineering technologies is very promising. Studies carried out at the National Research Center "Kurchatov Institute" - Central Research Institute of the CM "Prometey" [2] have shown that the use of the shock disintegrator-activator technology method is very promising for solving the actual problems in the field of biotechnology [3].

The first works on the study and use of disintegrator activation of biomaterials belong to Johannes Hint and his SKTB "Disintegrator". Under his leadership, research on the use of disintegrator-activator technology in the agro-industrial complex was launched at the "Disintegrator". Including, the effective influence of disintegration treatment on the increase of biological activity of fertilizers, various biomasses and plant raw materials was shown [4]. In the future, the range of these works was significantly expanded and carried out under the guidance and direct participation of Academician Gorynin Igor Vasilyevich.

The results of high-energy disintegrator treatment of various materials of biological origin are given in the article.

Key words: *high-speed shock disintegrator-activator technology, activation.*

Successful solution of the problems of creating innovative biotechnological active substances necessary for effective use in agriculture, medicine, veterinary medicine, pharmacology, the food industry and the environment is an important governmental task. The solution of these problems includes comprehensive studies on the choice of technology that provides the most complete effect of product activation; experimental determination of processing modes; studying the mechanism of increasing biological activity; solving problems of industrial development of the developed technologies, as well as reducing the cost of the product. The Research and Development Center "Kurchatov Institute" - the CSRI KM "Prometey" has a significant scientific and technological reserve for the use of impact disintegrator-activator technology to solve these problems. The institute has a specialized area, equipped with modern disintegrator, auxiliary and diagnostic equipment. There are also strong creative ties with specialized enterprises, together with which the effectiveness of the processed material is evaluated. Some of these estimates are given in this article.

Experimental Conditions

Impact disintegrator-activator technology is now increasingly used in solving problems in the field of mechanochemical synthesis of various materials of various classes and purposes, as well as the production of nanoscale and nanostructured materials.

The essence of the UDA-method lies in the high-energy activation of the materials being processed due to supersonic processing in disintegrator installations [5] (Figure 1). Disintegrants are modern computerized devices whose work is based on the principle of impact of comminuted particles, which are accelerated to supersonic speeds by rotating rotors towards each other (rotation speed up to 26,000 rpm). Percussion organs - fingers - are installed on each rotor with concentric circles. The rotors fit into each other in such a way that the concentric circles with the fingers of one rotor are placed inside the concentric circles with the fingers of the other rotor. The grinding of the treated particles (including nanoscale particles) and their activation occurs due to their collisions with each other in opposite heterophase flows.

A special feature and decisive advantage of disintegrants is the rapidity of grinding processes, when during the time interval 10–2 s the processed material receives up to 7 high-intensity shocks.

The practice of studying the UDA-processing process [6] shows that effective activation is observed in a wide range of materials, including legumes and grains, medicines, feed additives, kelp, mineral components. We illustrate this with a few examples.

Results and discussion.

The specialists of our institute together with the AOZT Grazhdansky Breeding Plant (Leningrad Region) conducted comprehensive studies to increase the digestibility of processed products at disintegrating plants when feeding young cattle and feeding pigs CJSC PZ Rapti. In the course of the research it was established that when calves were fed with grain milling obtained on a disintegrator with a rotor speed of 120-150 s-1, the average daily group weight gain (459 heads) exceeded the mass of calves that were fed in the traditional way.

It has been found that calves that receive grain grinding more easily tolerate various negative factors in case of illness. At the same time, the disease process is easier and faster, against this background, the immune status of young animals increases and the effectiveness of the applied treatment increases. When vaccinating such calves against infectious rhino-trachyitis, the level of immune bodies is quite high, which indicates a good intensity of immunity and effective body resistance to the action of disease-causing agents. For example, the waste of calves from the group that did not participate in the experiment due to the disease of the digestive and respiratory systems was 3.4 times more than the group that received grain desintegrating grinding.

Experiments on a group of cows (334 heads) in maternity wards showed that

in animals receiving grain grinding, the postpartum period was much easier and faster. The number of diseases like postpartum sticking and complications such as hepatitis after calving decreased by 15–20%.

Similar positive effects were found in piglet experiments. The weight gain of piglets of the Landrace breed at the age of 60-70 days, the feeding of which was carried out by the grain activated on the disintegrator, exceeded 19.5% of the weight of the piglets fed by the standard scheme.

Such results can be directly attributed to a high degree of destruction of grain crops, obtained by their high-energy grinding in disintegrating plants.

The mechanism of increasing the biological activity of wheat grains during UDA-treatment has been studied [7]. The destruction of cereal cells can be judged by the results of electron microscopy of their particles after grinding. Figures 2 and 3 show photographs of the destruction of a grain of wheat, consisting of three main parts: the embryo, endosperm and shells. Analyzing these figures, there is reason to assert that with the UDA-processing, a significantly deeper destruction of the endosperm of the wheat grain occurs. In Figure 2 (a) and (b) (flour) it can be seen that particles of irregular shape, filled with starch and proteins, predominate. Proteins form a continuous matrix in which starch particles of various fractional compositions are embedded. The number of individual starch particles outside the matrix is very small. After grinding on a high-speed disintegrator (Figure 3 a, b), starchy grains of 25 to 40 microns in size are oval-shaped. At the same time, the protein matrix has a more developed surface. Obviously, during the UDA-treatment, the intermediate protein is separated, releasing the starch granules. Moreover, the intermediate protein of the vitreous endosperm is destroyed by disintegrating grinding together with tightly linked starch grains.

The degree of destruction for accessibility to organic substances (in particular, to carbohydrates) was assessed by analyzing the chemical composition obtained using a chromatograph. It was found that with different processing modes on disintegrators in the studied samples, the glucose content is within 1.45 - 1.48%, and maltose from 2.0 to 2.05%. These indicators significantly exceed those that have samples obtained by traditional technology (rotary grinding): the glucose content does not exceed 1.21% and there is a complete absence of maltose. And this suggests that as a result of the UDA-processing of wheat grains, enzyme-free destruction of starch occurs and deep destruction of the wheat weevil is provided for better assimilation by the body of a wide range of nutrients. At the same time, these results make activated forage in the field of horse breeding, pig breeding, animal breeding, poultry farming and fisheries in demand.

The mechanism of activation during high-speed UDA-processing is also observed for a number of other substances. For example, the activated egg shell powder obtained by intensive processing in the disintegrator of shell waste of

the Primorye poultry farm (Leningrad Region), according to experts, has a significantly higher content of activated mineral components. This makes promising the use of activated egg-shell powder very promising as a dietary supplement for baby and dietary food in order to prevent rickets and osteoporosis, in the perfume industry to create toothpastes for the prevention of periodontal disease, and also as a feed additive in grain grinding, the benefits of which stated above.

A similar effect of activation during disintegrating treatment is established for the UDA-treatment of algae (kelp). Specialists of JSC "KGB-M" (Murmansk) found that after high-speed grinding to a fraction of less than 100 microns, the biological activity of algae (a valuable dietary supplement with a high content of iodine, vitamins and mineral components) increases significantly and, when consumed, all nutrients are digested human body almost completely.

It should also be noted that studies conducted in conjunction with the GNU TATNIISH (Tatarstan) showed that the complex introduction of biologically active feed additives (BAFA) prepared from leguminous crops, salt, chalk into the diet of cattle, pigs, poultry and fish and other mineral components. With simultaneous processing of several raw materials, regardless of their quantitative ratio, differences in specific gravity and humidity during high-speed processing in the disintegrator (at speeds of more than 12,000 rpm), a homogeneous mixture is formed, which significantly increases the digestibility of the product.

Finally, it should be particularly noted that the use of complex BAFAs in rations in the amount of 15-30% will lead to a significant reduction in the cost of feed while increasing (on average 2.6 times) their nutritional value, as well as increasing the natural resistance of the organism of animals.

The results of experimental studies show the effectiveness of using high-energy universal disintegrator-activator technology to solve actual problems in the field of agricultural sciences. The spectrum of real use of the UDA-technology can be significantly expanded by studying the possibility of activating mineral components for children's, dietary and sports nutrition, increasing the biological activity of algae with a high iodine content, increasing the effectiveness of radiopaque and other medical preparations; activation of water and other liquids by high-energy exposure.

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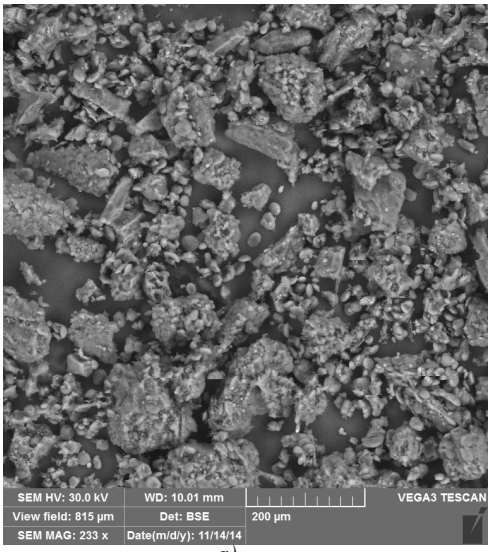
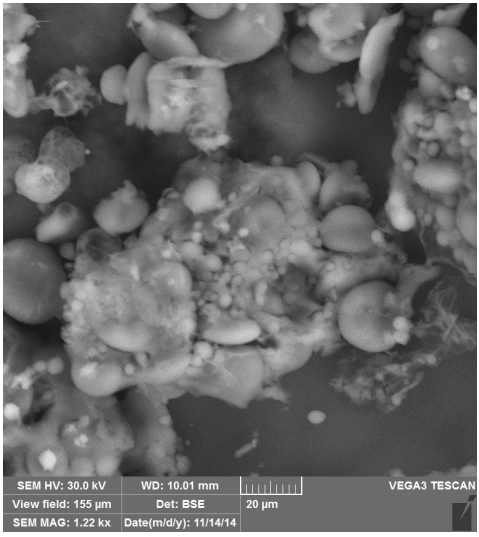
Figure 1 *The appearance of the disintegrator and a diagram illustrating the principle of its operation.*

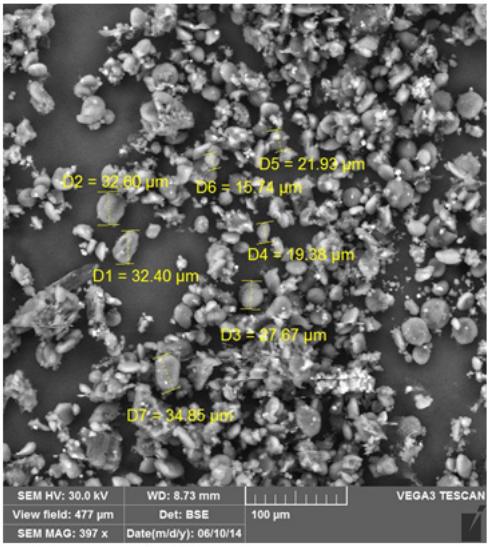


a)

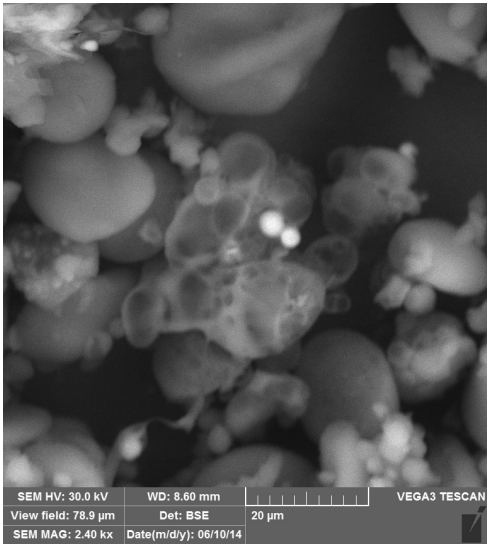


b)

Figure 2 *The appearance of wheat flour (a) and starch grains with protein matrix (b) after grinding at a milling plant.*



a)



b)

Figure 3 *The appearance of the constituent parts of the grains of wheat (a) and starch grains (b) after the UDA-processing on the disintegrator.*

UDC 635.24

耶路撒冷朝鲜蓟的烹饪质量
CULINARY QUALITY OF JERUSALEM ARTICHOKE

Manokhina Alexandra Anatolievna
Doctor of Agricultural Sciences
Associate Professor of the chair of agricultural machinery
Russian State Agrarian University -
Moscow Agricultural Academy named after K.A. Timiryazev
Starovoitova Oksana Anatolievna
Candidate of Agricultural Sciences
Leading Researcher of the Department
of technology and innovative projects
Starovoitov Viktor Ivanovich
Doctor of Technical Sciences, Professor
Deputy Director,
Head of technology and innovation projects Department
Lorch Potato Research Institute

注解。 文章介绍了评估菊芋块茎烹饪质量的结果。 尽管菊芋长期生长，但毫无疑问它仍然是一种新的生产文化。 菊芋块茎可以新鲜和煮沸。

在沙质壤土栽培条件下，EB Korenevo在菊芋块茎中的干物质含量为21.4~26.4%，菊粉含量为11.6%~18.7%。 在比较菊芋块茎的生肉和煮熟的肉的味道时，发现Dieticheskij和Nahodka品种在生和熟的形式中是最美味的。 根据Nahodkd，Dieticheskij，Korenevskij（杂交），Nadezhda，Podmoskovnyj的这种品种，根据消费新鲜块茎和用于烹饪目的的要求，被证明是最可接受的品种。

关键词：菊芋，品种，块茎质量，烹饪质量。

Annotation. *The article presents the results of assessing the culinary qualities of Jerusalem artichoke tubers. Despite Jerusalem artichoke having been growing for long time, there is no doubt that it is still a new culture for production. Jerusalem artichoke tubers can be used fresh and boiled.*

Under the conditions of cultivation on sandy loam soil of EB Korenevo dry matter content in tubers of Jerusalem artichoke was 21.4...26,4%, the content of

inulin was 11.6...by 18.7%. In comparing the taste of raw and boiled flesh of Jerusalem artichoke tubers, it was found that the varieties Dieticheskij and Nahodka were the most delicious in both raw and cooked form. Such cultivars of Jerusalem artichoke as Nahodkd, Dieticheskij, Korenevskij (hybrid), Nadezhda, Podmoskovnyj turned out to be the most acceptable according to requirements for both consuming fresh tubers and using them on culinary purposes.

***Keywords**: Jerusalem artichoke, cultivar, tuber quality, cooking quality.*

INTRODUCTION

Jerusalem artichoke is one of the most highly yielding and unpretentious cultures of the world [1, 2]. The results of deep processing of Jerusalem artichoke are alcohol, biofuel, fructose sugar, medicines based on inulin, food, pectin, acetone, butanol, products for perfumery, glycerin, animal feed and poultry, much more. This production includes energy, feed, food and pharmaceutical directions [3, 4].

Due to the significant scientific and technical achievements of mankind in the twentieth century, the variety of both direct use of plants for food and processing them into food, medicine, alternative energy sources has significantly expanded [3, 5]. On a variety of using Jerusalem artichoke is one of the most promising universal cultures. Today, the genetic variety of Jerusalem artichoke cultivars, both in the world and in our country, allows us to find a balanced approach to the selection of varieties or targeted selection of new varieties, depending on the purpose of their use. Therefore, list of requirements should be assigned with each variety of Jerusalem artichoke, depending on its use [6, 7].

Despite Jerusalem artichoke having been growing for long time, there is no doubt that it is still a new culture for production [8, 9]. Jerusalem artichoke tubers can be used fresh, boiled or canned [10, 11]. Jerusalem artichoke is a promising raw material for the creation of food, especially for children and diet. Tubers are used for food and medicinal purposes[12, 13].

Purpose: assess the culinary quality of Jerusalem artichoke varieties, taking into account the needs of the market and traditional preferences of the population.

Research materials and methods

Experiments on growing varieties of Jerusalem artichoke were carried out in 2014-2016 in the field of EB Korenevo, Moscow region, Russian Federation. The soil of the experimental area was sod weakly podzolic sandy loam with high exchangeable and hydrolytic acidity (pH_{KCl} = 4,4-4,9; Ng = 3,3-4,8 mg-eq./100 g of soil); low amount of absorbed bases and their degree of saturation (S = 1.5-3.9 mg-eq./100 g of soil; V =31,0-46,8 %); high content of mobile phosphorus (267-354 mg/kg of soil) and content of exchangeable potassium below the average (95-136 mg/kg of soil); low humus content (1,6-1,9% of humus).

In this paper we continue studies of 16 varieties of Jerusalem artichoke:

Vyl'gortskij (Russian Federation), Dieticheskij (Russian Federation), Interes (Russian Federation), Interes 21 (Russia), Kaluzhskij (Russian Federation), Korenevskij (hybrid) (Russian Federation), Nadezhda (Russian Federation), Nahodka (Russian Federation), Novost' VIRa (Russian Federation), Podmoskovnyj (Russian Federation), Sireniki (Republic of Belarus), Skorospelka (Russian Federation), Tadzhikskij (USSR), Blank Brekos (France), Violet de Rense (France), Shpindel' (Germany).

Following things were carried out in August for growing the collection: double disking of green manure crops (vika+oats); fall tillage to a depth of 18-20 cm (the first ten-day period of October); spring continuous cultivation with harrowing (the second and the third ten-day period of April); cutting ridges; seed preparation (calibration and selection of healthy tubers).

Planting on the test area was carried out in late April - early may with seed tubers of 25-40 mm in size along the transverse diameter of a clone planter SN-4B-K to a depth of 8-10 cm.

Such fertilizers as azophoska (NPK 60:60:60) were locally used in two rows by cultivator KRN-4,2 during caring for plants in May. Caring for plants: two inter-row processing with hilling were carried out in May and June by KRN-4,2 , the first was pre-emergence and the second was post-emergence.

A test dig for researching samples was performed in early September. In the test dig the following quality parameters of tubers were determined: marketability of crops; dry matter content (by thermostatic-weight method); nitrate content (iodometrically by nitrate tester); the definition of the table qualities of the tubers.

Planting, accounting and observation were carried out according to the requirements of field experience methods [14] and methods of researching of Jerusalem artichoke [15, 16, 17, 18].

Technological requirements for Jerusalem artichoke varieties for consumption of fresh tubers and using on culinary purposes:

- the degree of sweetness: high, medium;
- juiciness of pulp: high;
- taste of the pulp: high (1 – bad (unpleasant, bitter); 3 – insipid; 5 – satisfactory (including sweet); 7 – good; 9 – excellent);
- density of pulp (1 – fibrous; 2 – dense; 3 – moderately dense; 4 – soft (tender));
- smell (1 – not peculiar to the Jerusalem artichoke with a foreign odor; 3 – not peculiar to the Jerusalem artichoke; 5 – mild, satisfactory (with minor presence of foreign odor); 7 – mild, good, odor-free; 9 – pleasant, peculiar to the Jerusalem artichoke, without foreign odors);
- darkening of the pulp (1 – darkens very much; 3 – greatly darkens over the entire surface; 5 – darkens moderately; 7 – darkens weak; 9 – does not darken);

- Biochemical quality of tubers: dry matter content is not less than 25%; inulin content is not less than 14%.

Research results and discussion

The maximum permissible concentration of nitrates for potato tubers is 250 mg/kg, for sugar beet roots it is 1400 mg/kg [19, 20]. Analyzing the obtained data of tubers evaluation of Jerusalem artichoke, dug out in early September, it was found that the nitrate content below 250 mg/kg was in the tubers of varieties: Vyl'gortskij (158), Dieticheskij (230), Interes (200), Interes 21 (121), Kaluzhskij (208), Nahodka (208), Sireniki (238), SHpindel' (244). More than 300 mg / kg appeared in tubers of sorts: Korenevskij (308), Skorospelka (303), Podmoskovnyj (302) and Nadezhda (300). At the same time, it was noted that a much lower content of nitrates accumulated in the part of the tuber closest to the base (stolon).

Samples of following varieties corresponded to the requirements for content of dry matter for early harvesting (figure 1): Korenevskij (25,4%), Novost' VIRa (26,4%), Blank Brekos (25,0%). And tubers of following varieties contained less dry matter: Dieticheskij (24,0%), Interes (24,5%), Interes 21 (24,7%), Kaluzhskij (24,7%), Nadezhda (24.3%), Podmoskovnyj (24,5%), Sireniki (24.8%).

Samples of following varieties corresponded to the requirements for content of inulin in early harvesting: Dieticheskij (14,7%), Kaluzhskij (18,7%), Korenevskij (15,0%), Nahodka (14,1%), Novost' VIRa (15,8%), Blank Brekos (16.7%).

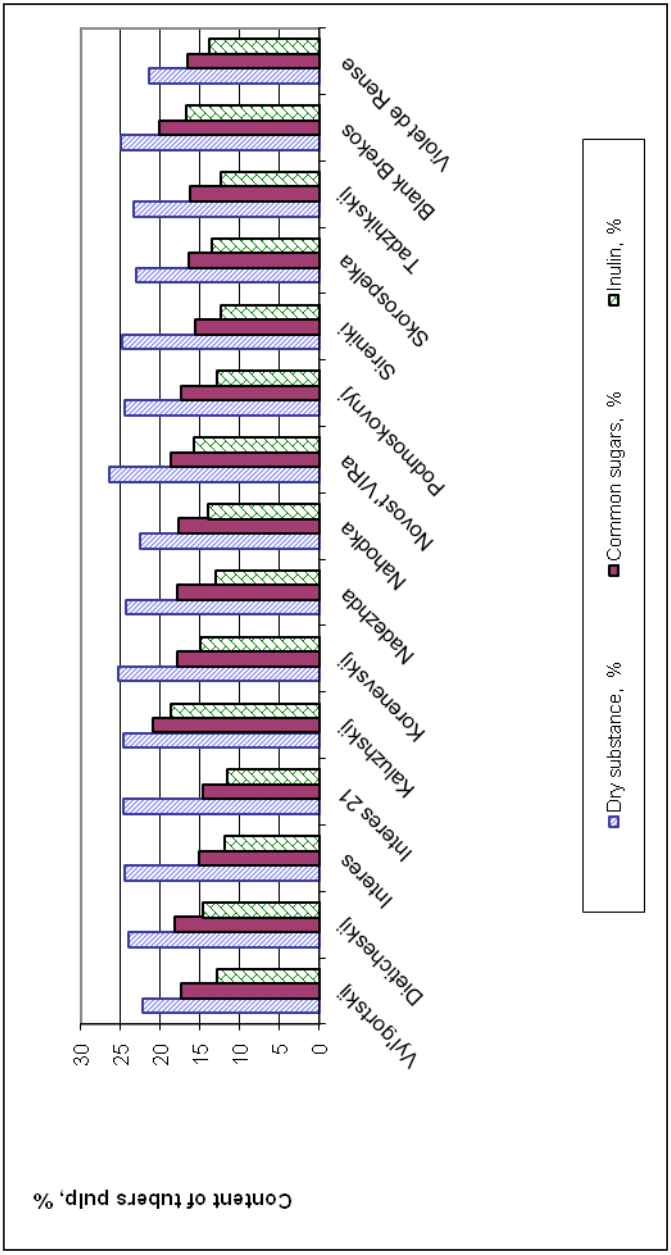


***Figure 1** – dry matter, total sugars and inulin Content in tubers*

Analyzing the quality data of raw Jerusalem artichoke tubers pulp (table 1), it is noted that all varieties corresponded the requirements of the density and darkening of the pulp for consumption of tubers in raw form and for culinary purposes. Darkening of the pulp (after 3 and 24 hours) was not observed in any variety.

Table 1 – *Technological properties of the pulp of raw tubers of Jerusalem artichoke*

№	Variety sample	Sweetness *	Juiciness *	The density of the pulp		Smell	Darkening of the flesh	Taste
				at the base	central part			
1	Vyl'gortskij	B	B	1	4	7	9	7
2	Dieticheskij	B	B	1	4	5	9	9
3	Interes	C	C	1	3	7	9	7
4	Interes 21	C	C	1	3	9	9	7
5	Kaluzhskij	H	C	1	3	5	9	5
6	Korenevskij	C	B	1	3	9	9	7
7	Nadezhda	B	B	1	4	7	9	9
8	Nahodka	B	B	1	4	9	9	9
9	Novost' VIRa	H	H	1	3	7	9	5
10	Podmoskovnyj	H	B	1	4	7	9	7
11	Sireniki	C	C	1	3	7	9	7
12	Skorospelka	C	C	1	3	5	9	5
13	Tadzhikskij	C	B	4	4	7	9	5
14	Blank Brekos	B	B	1	4	1	9	7
15	Violet de Rense	H	B	1	4	9	9	7
16	SHpindel'	H	B	1	3	7	9	5

* - B – high, C – average, D - low

Such varieties as Vyl'gortskij, Dieticheskij, Nadezhda, Nahodka, Blank Brekos were the sweetest. Tubers of following varieties were the juiciest: Vyl'gortskij, Dieticheskij, Korenevskij, Nadezhda, Nahodka, Podmoskovnyj, Tadzhikskij, Blank Brekos, Violet de Rense, SHpindel'. Interes 21, Korenevskij, Violet de Rense had the most pleasant smell, peculiar to fresh tubers of the Jerusalem artichoke. Such varieties as Dieticheskij, Nadezhda, Nahodka had the high taste qualities of raw pulp. Good taste marked in varieties: Vyl'gortskij, Interes, Interes 21, Korenevskij, Podmoskovnyj, Sireniki, Blank Brekos, Violet de Rense.

Density of pulp of all varieties except Violet de Rense and Shpindel' met the requirements for consumption of tubers for culinary purposes, the density of the Violet de Rense and Shpindel' pulp was slightly higher than required. Darken-

ing of the pulp (after 20 minutes, 3 hours and 24 hours) was not observed in any variety. Interes 21, Nahodka, Podmoskovnyj, Blank Brekos had the most pleasant smell, peculiar to cooked tubers of the Jerusalem artichoke. Tubers of Vyl'gortskij, Dieticheskij, Nahodka, SHpindel' had high taste cooked pulp. Interes 21, Nadezhda, Podmoskovnyj, Blank Brekos were a little less tasty.

When comparing the taste of raw and boiled flesh of Jerusalem artichoke tubers (figure 2), it was found out that the varieties Dieticheskij and Nahodka were the most delicious both in raw and cooked form. Sort Nadezhda got the highest score of taste raw and good score cooked. Sort Vyl'gortskij received the highest score of taste boiled and good score raw. Varieties of Interes, Interes 21, Korenevskij, Podmoskovnyj, Sireniki, Blank Brekos and Violet de Rense received good scores of taste both raw and boiled. Sort SHpindel' received the highest score of taste boiled and satisfactory raw. Sort Kaluzhskij, Novost' VIRa, Skorospelka and Tadzhikskij received good taste score boiled and satisfactory raw.

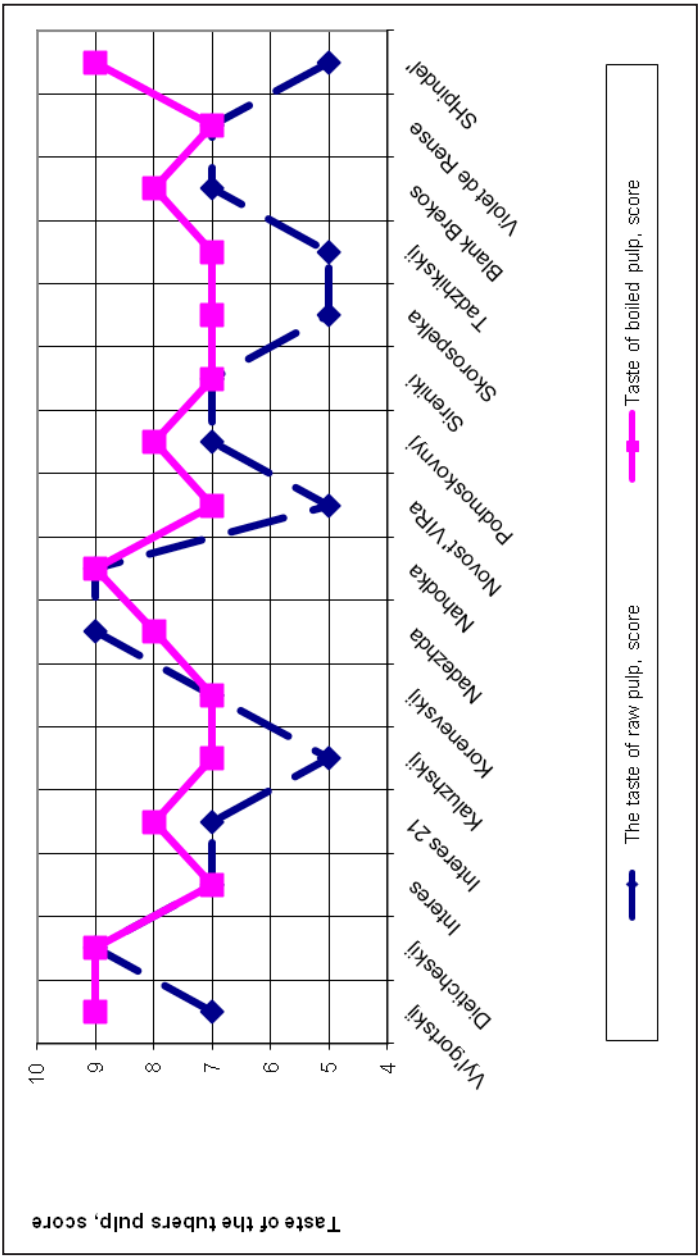


***Figure 2** – Taste of raw and boiled flesh of Jerusalem artichoke tubers*

SUMMARY

1. For early harvesting (in early September) of Jerusalem artichoke tubers, the following varieties most fully met the requirements of morphological characteristics of Jerusalem artichoke for consumption of fresh tubers, for culinary purposes and for processing: Korenevskij (hybrid), Nahodka, Blank Brekos. Such varieties as Skorospelka, Podmoskovnyj, Tadzhikskij, Nadezhda, Dieticheskij almost fully met the requirements.

2. For consumption of the tubers in its raw form, following varieties were the most responding all the requirements: Dieticheskij, Nadezhda, Nahodka, Blank Brekos. Such varieties as Vyl'gortskij, Interes, Interes 21, Korenevskij, Podmoskovnyj took the second place.

3. For consumption of tubers for culinary purposes Nahodka, Vyl'gortskij, Dieticheskij, Interes 21, Podmoskovnyj, Blank Brekos varieties can be recommended as meeting all requirements.

4. The tubers of varieties Dieticheskij and Nahodka were the most delicious both raw and boiled.

5. Under the conditions of cultivation on sandy loam soil EB Korenevo according to all indicators the following varieties were most demanded for the consumption of tubers in fresh form and for culinary purposes: Nahodka, Dieticheskij, Korenevskij, Nadezhda, Podmoskovnyj.

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全球气候变化背景下咸海流域河流径流的变化
THE VARIABILITY OF THE WATER RUNOFF OF THE RIVERS OF THE ARAL SEA BASIN IN THE CONTEXT OF GLOBAL CLIMATE CHANGE

Petrov Georgy Nikolaevich,
Doctor of Technical Sciences, Professor
Akhmedov Hakim Munavvarovich,
Doctor of Chemical Sciences, academician
Center for Innovative Development
of Science and New Technologies of
the Academy of Sciences of the Republic of Tajikistan

抽象。　本文分析了咸海流域河流径流的一般变化，并提出了一种可靠的全球气候变化对水资源影响评估方法。
关键词：循环变异性；水径流预测；线性趋势；水盆；水径流
Abstract. *The article analyzes the general variability of water runoff in the rivers of the Aral Sea basin and suggests a method for its reliable assessment in terms of the impact on water resources of global climate change.*
Keywords*: Cyclic Variability; Forecast of Water runoff; Linear Trend; Water Basin; Water Runoff*

The Aral Sea basin in Central Asia includes two main river basins — the Amudarya and the Syrdarya, located on the territory of five states — Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Both rivers, the Amudarya and the Syrdarya, are formed in the mountainous regions of Kyrgyzstan and Tajikistan, then flow through the arid territories of the lower countries and flow into the Aral Sea.

Since ancient times, the water resources of all the rivers of the Aral Sea basin have been actively used for irrigated agriculture, especially intensively in the second half of the last century. As a result, a sharp shortage of water appeared in the region, which led to the death of the Aral Sea, the consequences of which are still being felt. Under these conditions, the issue of a reliable forecast of water flow becomes extremely important, especially in the context of global warming [1]. The water resources of rivers, for all their merits, are very variable in time.

For example, for Vakhsh and Naryn, the largest rivers forming the Syrdarya and Amudarya basins and intensively used for energy and for irrigation, the annual flow for the entire observation period changed, respectively, 1.9-3.8 times, the average monthly water flow in the river - 15 20 times, and flood flow, compared with the minimum flow - 50 or more times [2].

This variability over more than 300 years of intensive use of water resources in world practice has been well studied and effective methods for calculating, building and operating river hydraulic structures, including unique in scale, ensuring their reliability and safety, have been developed. But at the same time, all these calculations are based on constant (changing only due to new observations and increasing the length of the time series), time-independent statistical parameters. This method of calculation was developed in the first half of the 20th century on the basis of measurements of the runoff of the late 19th and early 20th centuries.

Therefore, the current calculation methods do not take into account the global climate change processes that have begun after this, although many experts predict that these changes can be very significant. In order to confirm or refute this, a special analysis is needed not only of the general parameters of statistical variability, but of variability over time. Taking into account that all changes in other already measured climate change parameters (temperature, CO_2 content, etc.) occur very slowly, for a water runoff the linear trend would be most suitable for this purpose.

Unfortunately, the mechanical use of linear correlation for these methods leads to insufficiently adequate results. For example, the standard linear trends of the water runoff of the Vakhsh and Naryn rivers differ sharply from each other, both in trend and magnitude (Figure 1). This is impossible to find any logical explanation, since they are formed in almost the same climatic and geological conditions. It is also impossible to explain the fact that the water flow r. Naryn according to Figure 1 increases with an intensity of 2.4% over 10 years, but at the same time there is neither a noticeable increase in electricity generation at the cascade of the Naryn Hydroelectric Power Stations, nor a water flow increase in the Syrdarya river basin, into which the Naryn river flows.

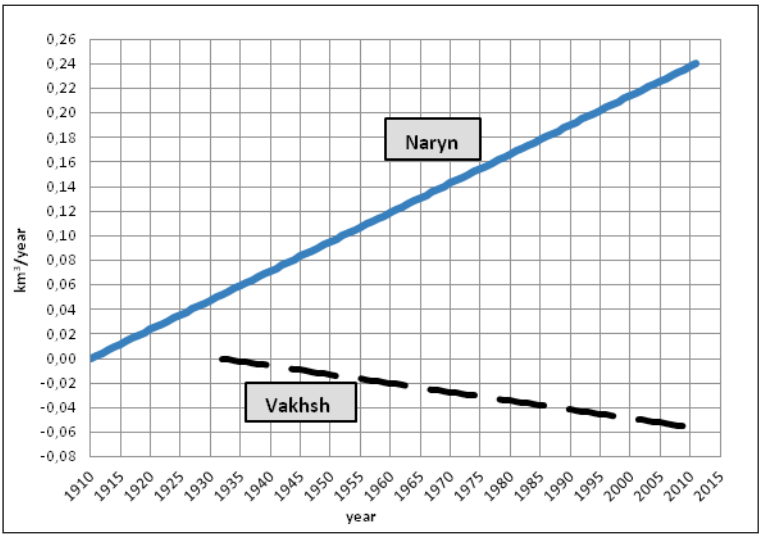

Figure 1. *Normalized linear trends annual flow of the Vakhsh and Naryn rivers*

It is also difficult to find an explanation for the seemingly constant decrease in the water content of the r. Vakhsh, especially against the background of general trends of global climate change. All this shows the need for more detailed analysis.

In Figure 2 and 3 show the results of calculations of the linear trends of the Vakhsh and Naryn rivers for individual periods. It can be seen that in this case the linear trend is not sustainable and reliable. For different periods, it varies in a very wide range, not only in absolute value, but even in sign. Therefore, using the general trend of long-term changes in water runoff to assess the impact of global climate change on it, as is often done, can be misleading.

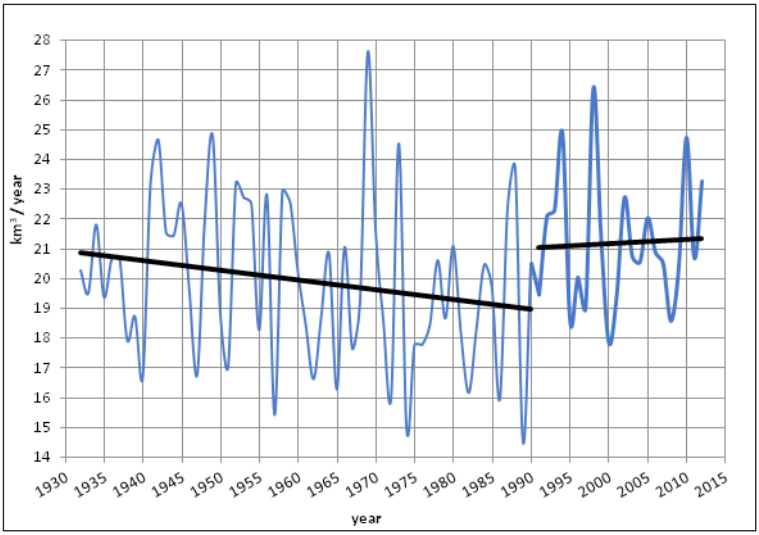

Figure 2. *Linear trend of annual runoff r. Vakhsh*

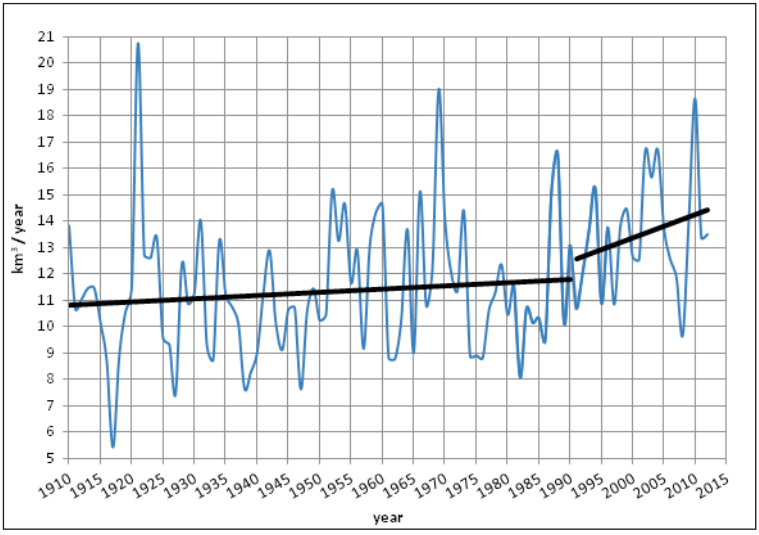

Figure 3. *Linear trend of annual runoff r. Naryn*

This suggests that some cyclical factors seem to influence the linear trend. In the present study, the GFFT, Mathcad [3] algorithm was used to identify the cyclic variability of the annual flow, which decomposes the actual data series into a Fourier series, that is, the sum of harmonics, each of which is a periodic oscillation with amplitude A_k and initial phase φ_k:

$$y(t) = \sum_{k=0}^{n-1} A_k \cos\left(2\pi k \frac{t}{T} - \varphi_k\right), \quad (1)$$

where:

- **T** is the total length of the studied series of observations in years, the coefficients $\mathbf{A_k}$ are the amplitudes of the kth harmonic, and $\boldsymbol{\varphi_k}$ is its phase. The frequencies of all harmonics of the periodic function y (t) are multiples of the fundamental frequency F = 1 / T. Oscillation with a frequency F is called the first harmonic (k = 1), with a frequency 2F — the second harmonic (k = 2), etc.

- **t** is the current time.

The results of studies of cyclical fluctuations of the annual runoff of the Vakhsh and Naryn rivers are shown in Figure 4. It is possible to note their certain synchronism, which, apparently, indicates that the same natural and climatic factors are the cause of cyclical fluctuations in the water content of these rivers.

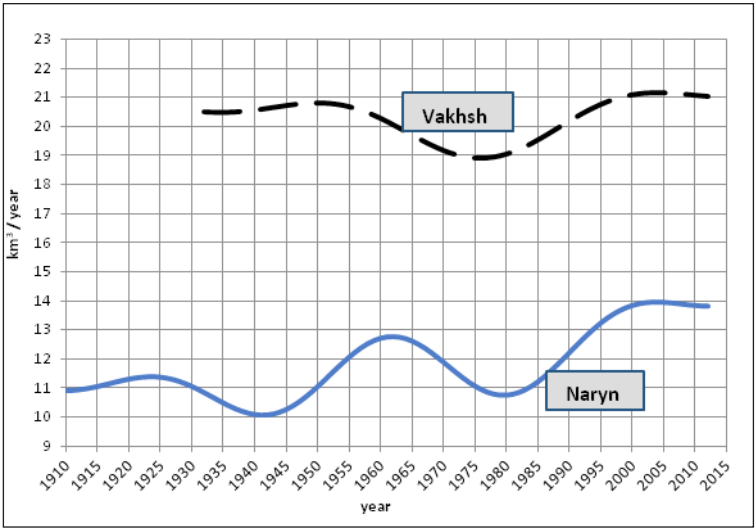

Figure 4. *Cyclic fluctuations of the annual runoff of the Vakhsh and Naryn rivers*

Comparing Figure 4 with Figure 2 and 3, it can be seen that the linear trend of the annual flow of the Vakhsh and Naryn rivers is not constant in different periods because it actually describes different parts of cyclical variability. This is especially

clearly seen in Figure 5, where they are shown together. Therefore, a linear trend can be used to assess the general trend of changes in the water content of the studied rivers, only if the observations cover a sufficiently large number of cyclic variability periods, which is currently impossible, since the period of one cycle is about 40 ÷ 50 or if it is calculated on the plots, the beginning and end of which coincide in phase.

Thus, in the presence of cyclical variability, linear trends are unrepresentative characteristics of time series and can lead to erroneous conclusions. This shows well the simplest example of a sine wave. On short segments - from π / 2 to 3π / 2, the linear trend will be sharply negative, on the segment 3π / 2 to 5π / 2 - sharply positive despite the fact that in reality the sinusoid should have a zero trend. On longer segments of the x-axis, if the phases of their beginning and end differ, the linear trend will also have a trend, only a weaker one. The above analysis of the time series of annual flows of the Vakhsh and Naryn rivers shows this picture (Figure 5).

Representative linear trends of the Vakhsh and Naryn rivers, defined at time intervals, the beginning and end of which coincide in the phase of cyclic oscillations, are shown in Figure 6. In this case, unlike Figure 1 The linear trends of these two rivers are very close to each other and correlate well with the general trends of global climate change at the regional level. Thus, studies of cyclical fluctuations of water runoff are not only interesting in their own right, but also important for a representative assessment of linear trends and, consequently, a more reliable assessment of the impact of climate change on the region's water resources.

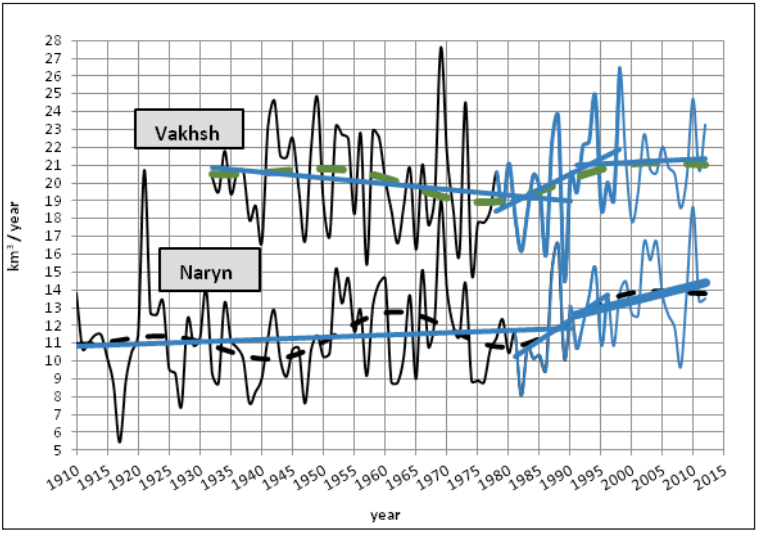

Figure 5. *Trends and cyclical fluctuations of water content Naryn and Vakhsh rivers*

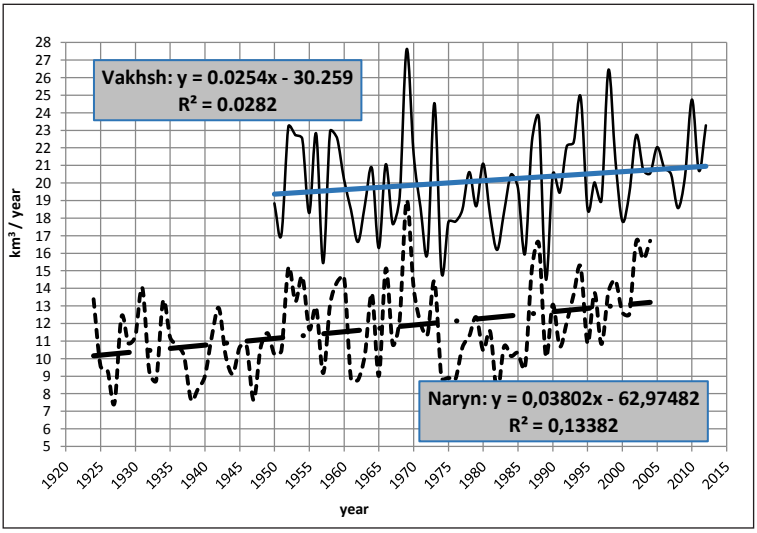

Figure 6. *Linear trends of the annual flow of the Vakhsh and Naryn rivers (periods of observation with equal phases of beginning and end)*

The performed studies indicate a rather high reliability of cyclic fluctuations of the water runoff of the Vakhsh and Naryn rivers, identified using the GFFT algorithm. But, unfortunately, this method cannot be used to predict cyclic variability, since when extending the considered period of time, the GFFT simply repeats the actually obtained calculation cycle.

This drawback can be overcome only in the method of direct expansion in a Fourier series, which is a multiple regression [4, 5]:

$$W_t = a_0 + \sum_{n=1}^{n}(a_n \cos n\pi T_{norm}) + \sum_{n=1}^{n}(b_n \sin n\pi T_{norm}) \quad (2)$$

where:

- $\mathbf{T_{norm}}$ - normalized year, calculated by the dependencies: $T_{norm} = (t_i - t_0)/T_{cycl}$
- $\mathbf{t_0}$ - the initial year of the cycle
- $\mathbf{T_{cycl}}$ - cycle period (the number of years of observations)
- $\boldsymbol{a_0}$, $\boldsymbol{a_n}$, $\boldsymbol{b_n}$ - empirical expansion coefficients.

As experience has shown, to obtain stable results in formula (2), it is sufficient to take into account the first 4-5 members of the series (harmonics).

For the forecast, it is necessary to extend T_{cycl} for the forecast period, T_{norm}, with a corresponding change in the normalized year, T_{norm}:

$$T_{cycl} = T_{fact} + T_{forecast}$$

$$T_{norm} = (t_i - t_0)/T_{cycl} = (t_i - t_0)/(T_{fact}+T_{forecast})$$

Using the proposed approach in Figure 7 shows the forecast of the water runoff of the Vakhsh and Naryn rivers until 2050.

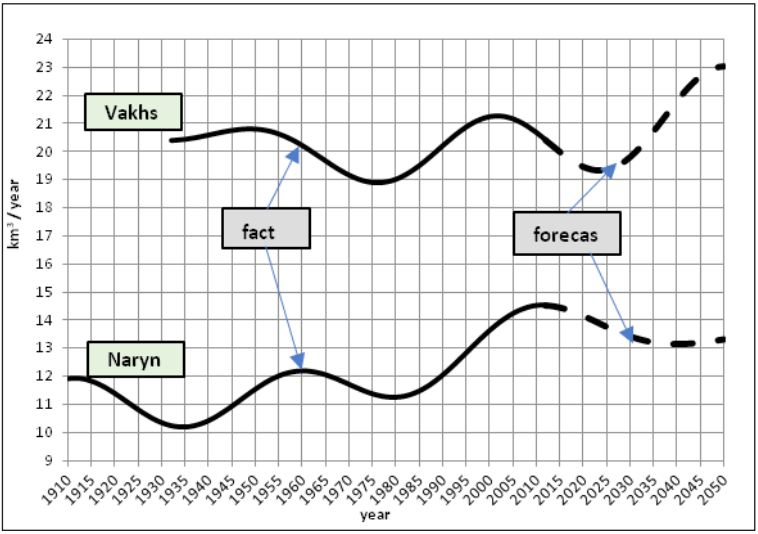

Figure 7. *Forecast of water runoff of the Vakhsh and Naryn rivers*

For comparative analysis, Table 1 shows the general parameters of the variability of the water flow of the Vakhsh river.

Table 1: *Parameters of variability of the water runoff of the Vakhsh river*

Type of variation	Parameters	1932-2012	1932-1990	1991-2012
Average annual runoff	km³/year	**20.276**	**19.930**	**21.206**
Random variations in runoff	Standard deviation, km³/year	**2.350**	**2.385**	**2.298**
Linear trend	Linear trend gradient, km³/year	**+0.00641**	**-0.03261**	**+0.01548**
Cyclic oscillations	Amplitude, km³/year	**2.97 (14.63%** from the average long-term runoff**)**		

The presence of many years of cyclicality and random fluctuations of water runoff shows that the efficient use of water resources of rivers is possible only with the presence of reservoirs. An estimate of their total volume can be made on the

basis of a general analysis of time series of water content. For this it is convenient to present the time series as a function:

$$\Sigma\left(Q_i - \overline{Q}_{average}\right) = f(t_i) \quad (3)$$

where:

Q_i - the annual runoff for year i,

$\overline{Q}_{average}$ - the average annual runoff for the entire observation period,

t_i - time in years.

Calculations show that the optimal total volumes of these reservoirs should be equal to:

- for the Vakhsh River - 32.18 km^3
- for the Naryn River - 32.5 km^3

At the same time, today the total useful volume of reservoirs on the Naryn river is less than 15 km3, and in the Vakhsh river basin, the total useful volume of reservoirs is only 3.5 km^3 and even after commissioning of the Rogun hydropower plant will be only 14 km^3.

Conclusions

In the long run, global warming is the most stable factor in changing the water content of the rivers of the Aral Sea basin. Over the past hundred years, due to the constant melting of glaciers, which are the basis for feeding rivers in the region, their runoff has increased linearly by 0.0254 (Vakhsh river) ÷ 0.0380 (Naryn river) km3 per year. Apparently, such a tendency will continue for some time, after which, with the exhaustion of water supplies in the glaciers, the water content of the rivers in the region will begin to decrease. At the same time, the flow regime of the rivers will change.

In the medium term, cyclical fluctuations with a period of 40–60 years play the largest role in the variability of the rivers of the Aral Sea basin. Their amplitude significantly exceeds the linear trend associated with global warming.

In the short term, the variability of the regional rivers' water content is determined by random fluctuations, the range of which is ten or more times the linear trend. Unfortunately, it is the random fluctuations of the river's water runoff that determine the current economic activity in the region, its current strategies and plans. This can lead to irreparable consequences in the long term.

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任意磁化下具有任意正交截面形状的旋向波导的广义Helmholtz方程
GENERALIZED HELMHOLTZ EQUATIONS OF GYROTROPIC WAVEGUIDES WITH AN ARBITRARY ORTHOGONAL CROSS-SECTION SHAPE UNDER ARBITRARY MAGNETIZATION

Shirapov Dashadondok Shagdarovich
Doctor of Physics and Mathematics, Head of Department
Itigilov Garma Borisovich
Candidate of Technical Sciences, Associate Professor
East Siberian State University of Technology and Management
Ulan-Ude, Russia

注解。 通过求解麦克斯韦微分方程组，得到具有任意磁化的正交曲线横截面形状的旋转波导的混合HE和EH波的广义Helmholtz方程。 在求解麦克斯韦微分方程组时，采用张量演算装置，允许具有任意正交截面曲线轮廓的旋转波导，利用协变微分描述局部基础曲率和铁氧体磁导率的变化。 二阶张量。

关键词：亥姆霍兹方程，张量，铁氧体磁导率，波导，混合波，电磁波，波导截面，麦克斯韦微分方程

Annotation*. Generalized Helmholtz equations of hybrid HE and EH waves are obtained for gyrotropic waveguides with orthogonal-curvilinear cross-sectional shapes with arbitrary magnetization by solving a system of Maxwell differential equations. When solving the system of Maxwell's differential equations, the tensor calculus apparatus was used, which allows gyrotropic waveguides with arbitrary curvilinear contours of orthogonal cross section to describe changes in the curvature of the local basis and the magnetic permeability of the ferrite using covariant differentiation and a second order tensor.*

Keywords*: Helmholtz equation, tensor, ferrite magnetic permeability, waveguide, hybrid wave, electromagnetic wave, waveguide section, Maxwell differential equations*

Generalized Helmholtz equations for gyrotropic waveguides with an arbitrary orthogonal cross-sectional shape with arbitrary magnetization obtained by solving a system of Maxwell's differential equations [1], assuming a stable process without induced currents and charges

$$\begin{cases} rot\overline{H} = j\omega\varepsilon\overline{E}; \\ rot\overline{E} = -j\omega\overline{B}; \\ div\overline{E} = 0; \\ div\overline{B} = 0, \end{cases} \quad (1)$$

where $\overline{H}$ and $\overline{E}$ – magnetic and electric fields, $\overline{B} = \tilde{\mu}\overline{H}$ - magnetic induction, j – imaginary unit; ε – absolute dielectric constant of ferrite, ω – cyclic frequency, $\tilde{\mu} = \begin{bmatrix} \mu_{11} & jk & jl \\ -jk & \mu_{22} & jm \\ -jl & -jm & \mu_{33} \end{bmatrix}$ - ferrite magnetic permeability tensor.

System (1) is solved using tensor calculus, allowing for gyrotropic waveguides with arbitrary curvilinear contours of orthogonal cross section, to describe changes in the curvature of the local basis and the magnetic permeability of ferrite using covariant differentiation and a second-order tensor.

It is assumed that the electromagnetic wave propagates along the longitudinal coordinate that coincides with the Z axis of the Cartesian coordinate system. This circumstance and the fact that the cross-sectional shape has a curvilinear view along both coordinate axes means:

$$h_1 \neq 1; \quad h_2 \neq 1; \quad h_3 = 1,$$

where h_1, h_2 - Lame coefficients of transverse coordinate axes and h_3- longitudinal [2]. Waveguide is a regular area, so the condition $\frac{\partial h_1}{\partial z} = \frac{\partial h_2}{\partial z} = 0$ is satisfied.

For curvilinear orthogonal coordinate systems with a longitudinal-regular axis for a vector $\overline{F}$ with projections (F_1, F_2, F_3) on the coordinate axes (x_1, x_2, x_3), we have: $x_3 = z$ - a longitudinal-regular axis. Than $h_3 = 1, F_3 = F_z = F_\perp e^{-j\gamma z}$ – longitudinal *Z* axis function ($F_\perp$ – has a dependency on x_1, x_2), γ - propagation constant, $F_\perp \neq F_\perp(z)$. According to these remarks, the formula for *rot* obtained for arbitrary orthogonal curvilinear coordinate systems [3] takes the form:

$$rot\bar{F} = \frac{1}{h_2}\left[\frac{\partial F_z}{\partial x_2} - \frac{\partial h_2}{\partial z}F_2 - \frac{\partial F_2}{\partial x_3}h_2\right]\bar{e}_1 - \frac{1}{h_1}\left[\frac{\partial F_z}{\partial x_1} - \frac{\partial h_1}{\partial z}F_1 - \frac{\partial F_1}{\partial z}h_1\right]\bar{e}_2 + \\ + \frac{1}{h_1 h_2}\left[\left(\frac{\partial F_2}{\partial x_1}h_2 + \frac{\partial h_2}{\partial x^1}F_2\right) - \left(\frac{\partial F_1}{\partial x_2}h_1 + \frac{\partial h_1}{\partial x_2}F_1\right)\right]\bar{e}_3. \quad (2)$$

Since the Lame coefficients h_1 and h_2 are not a function of the longitudinal Z coordinate, i.e. $h_1 \neq f(z),\ \ h_2 \neq f(z)$, then expression (2) is simplified:

$$rot\bar{F} = \frac{1}{h_2}\left(\frac{\partial F_z}{\partial x_2} - \frac{\partial F_2}{\partial z}h_2\right)\bar{e}_1 - \frac{1}{h_1}\left(\frac{\partial F_z}{\partial x_1} - \frac{\partial F_1}{\partial z}h_1\right)\bar{e}_2 + \left[\frac{1}{h_1}\left(\frac{\partial}{\partial x_1} + \Gamma_{21}^2\right)F_2 - \frac{1}{h_2}\left(\frac{\partial}{\partial x_2} + \Gamma_{12}^1\right)F_1\right]\bar{e}_3, \quad (3)$$

where $\Gamma_{12}^1 = \frac{1}{h_1}\frac{\partial h_1}{\partial x_2}, \Gamma_{21}^2 = \frac{1}{h_2}\frac{\partial h_2}{\partial x_1}$ - symbols of Christoffel 2nd kind [4].

In (3), the dependence on the longitudinal spatial coordinate Z, i.e. $e^{-j\gamma z}$. Given this dependence, the partial derivatives in (3) will be:

$$\begin{cases} \frac{\partial F_z}{\partial x_2} = \frac{\partial\left(F_z e^{-j\gamma z}\right)}{\partial x_2} = \frac{\partial\left(F_z\right)}{\partial x_2}e^{-j\gamma z} + \frac{\partial\left(e^{-j\gamma z}\right)}{\partial x_2}F_3 = \frac{\partial\left(F_z\right)}{\partial x_2}e^{-j\gamma z}, \\ \frac{\partial F_2}{\partial z} = \frac{\partial\left(F_2 e^{-j\gamma z}\right)}{\partial z} = \frac{\partial\left(F_2\right)}{\partial z}e^{-j\gamma z} + \frac{\partial\left(e^{-j\gamma z}\right)}{\partial z}F_2 = -j\gamma F_2 e^{-j\gamma z}, \\ \frac{\partial F_z}{\partial x_1} = \frac{\partial\left(F_3 e^{-j\gamma z}\right)}{\partial x_1} = \frac{\partial\left(F_z\right)}{\partial x_1}e^{-j\gamma z} + \frac{\partial\left(e^{-j\gamma z}\right)}{\partial x_1}F_3 = \frac{\partial\left(F_z\right)}{\partial x_1}e^{-j\gamma z}, \\ \frac{\partial F_1}{\partial z} = \frac{\partial\left(F_1 e^{-j\gamma z}\right)}{\partial z} = \frac{\partial\left(F_1\right)}{\partial z}e^{-j\gamma z} + \frac{\partial\left(e^{-j\gamma z}\right)}{\partial z}F_1 = -j\gamma F_1 e^{-j\gamma z}. \end{cases} \quad (4)$$

When determining the partial derivatives in (4), it was taken into account that the transverse components of the vector $\bar{F}$ are not functions of Z, and the longitudinal components are a function of Z.

Taking into account (4) and lowering the dependence $e^{-j\gamma z}$, we get:

$$rot\bar{F} = \left(\frac{1}{h_2}\frac{\partial F_z}{\partial x_2} + j\gamma F_2\right)\bar{e}_1 - \left(\frac{1}{h_1}\frac{\partial F_z}{\partial x_1} + j\gamma F_1\right)\bar{e}_2 + \left[\frac{1}{h_1}\left(\frac{\partial}{\partial x_1} + \Gamma_{21}^2\right)F_2 - \frac{1}{h_2}\left(\frac{\partial}{\partial x_2} + \Gamma_{12}^1\right)F_1\right]\bar{e}_3 \quad (5)$$

In arbitrary orthogonal curvilinear coordinates, the formula *div* was obtained in [3].

Turning to the case when $x_3 = z$ $(h_3 = 1)$ and when $h_1 \neq f(z)$, $h_2 \neq f(z)$, we get:

$$div\bar{F} = \frac{1}{h_1}\left(\Gamma_{21}^2 + \frac{\partial}{\partial x_1}\right)F_1 + \frac{1}{h_2}\left(\Gamma_{12}^1 + \frac{\partial}{\partial x_2}\right)F_2 + \frac{\partial F_z}{\partial z}.$$

Given the dependence $e^{-j\gamma z}$ and calculating the partial derivatives, as in the case of the definition of *rot*, we finally get

$$div\bar{F} = \frac{1}{h_1}\left(\frac{\partial}{\partial x_1} + \Gamma_{21}^2\right)F_1 + \frac{1}{h_2}\left(\frac{\partial}{\partial x_2} + \Gamma_{12}^1\right)F_2 - j\gamma F_z. \quad (6)$$

We introduce the notation:

$$\nabla_1 = \frac{1}{h_1}\frac{\partial}{\partial x_1};\ \nabla_2 = \frac{1}{h_2}\frac{\partial}{\partial x_2};\ \delta_1 = \frac{1}{h_1}\left(\frac{\partial}{\partial x_1} + \Gamma_{21}^2\right);\ \delta_2 = \frac{1}{h_2}\left(\frac{\partial}{\partial x_2} + \Gamma_{12}^1\right). \quad (7)$$

Taking into account (7), rewrite expressions (5) and (6) in curvilinear orthogonal coordinate systems with a longitudinally regular axis:

$$rot\bar{F} = \left(\nabla_2 F_z + j\gamma F_2\right)\bar{e}_1 - \left(\nabla_1 F_z + j\gamma F_1\right)\bar{e}_2 + \left[\delta_1 F_2 - \delta_2 F_1\right]\bar{e}_3, \quad (8)$$

$$div\bar{F} = \delta_1 F_1 + \delta_2 F_2 - j\gamma F_z. \quad (9)$$

Expressions for $rot\bar{F}$, $div\bar{F}$ enter into system (1) and describe the characteristics of an electromagnetic wave in any curvilinear orthogonal coordinate system for the case when the longitudinal axis coincides with the Z axis.

Using (8), in the system of equations (1) we carry out expansions along the axes $rot\bar{H}$ и $rot\bar{E}$:

$$\begin{cases} \nabla_2 H_z + j\gamma H_2 = j\omega\varepsilon E_1, \\ -\left(\nabla_1 H_z + j\gamma H_1\right) = j\omega\varepsilon E_2, \\ \delta_1 H_2 - \delta_2 H_1 = j\omega\varepsilon E_z. \end{cases} \quad (10)$$

$$\begin{cases} \nabla_2 E_z + j\gamma E_2 = -j\omega\bar{B}_1 = -j\omega\left(\mu_{11}H_1 + jkH_2 + jlH_z\right), \\ \nabla_1 E_z + j\gamma E_1 = j\omega\bar{B}_2 = j\omega\left(-jkH_1 + \mu_{22}H_2 + jmH_z\right), \\ \delta_1 E_2 - \delta_2 E_1 = -j\omega\bar{B}_z = -j\omega\left(-jlH_1 - jmH_2 + \mu_{33}H_z\right), \end{cases} \quad (11)$$

where $k, l, m, \mu_{11}, \mu_{22}, \mu_{33}$ - components of the magnetic permeability tensor of ferrite with arbitrary magnetization; ω is the cyclic frequency.

From formula (9) for arbitrary magnetization we get

$$div\overline{B} = jk\left(\delta_1 H_2 - \delta_2 H_1\right) + \delta_1\left(\mu_{11} H_1 + jlH_z\right) + \delta_2\left(\mu_{22} H_2 + jmH_z\right) - \\ - j\gamma\left(-jlH_1 - jmH_2 + \mu_{33} H_z\right) = 0. \quad (12)$$

In the first term (12), we substitute the third equation of system (10):

$$k\omega\varepsilon E_z + j\gamma\left(-jlH_1 - jmH_2 + \mu_{33} H_z\right) = \delta_1\left(\mu_{11} H_1 + jlH_z\right) + \delta_2\left(\mu_{22} H_2 + jmH_z\right). \quad (13)$$

First, we obtain the Helmholtz HE-wave equation. For this E_1 and E_2 from (10) we substitute into the first two equations of system (11). Then we get

$$\begin{cases} \nabla_2 E_z - \dfrac{\gamma}{\omega\varepsilon}\nabla_1 H_z - \dfrac{j\gamma^2}{\omega\varepsilon} H_1 = -j\omega\left(\mu_{11} H_1 + jkH_2 + jlH_z\right), \\ \nabla_1 E_z + \dfrac{\gamma}{\omega\varepsilon}\nabla_2 H_z + \dfrac{j\gamma^2}{\omega\varepsilon} H_2 = j\omega\left(-jkH_1 + \mu_{22} H_2 + jmH_z\right). \end{cases} \quad (14)$$

We act on the first equation of system (14) with the operator δ_1, and on the second equation (14) - with the operator δ_2

$$\begin{cases} \delta_1\nabla_2 E_z - \dfrac{\gamma}{\omega\varepsilon}\delta_1\nabla_1 H_z - \dfrac{j\gamma^2}{w\varepsilon}\delta_1 H_1 + j\omega\delta_1\left(\mu_{11} H_1 + jkH_2 + jlH_z\right) = 0, \\ \delta_2\nabla_1 E_z + \dfrac{\gamma}{\omega\varepsilon}\delta_2\nabla_2 H_z + \dfrac{j\gamma^2}{w\varepsilon}\delta_2 H_2 - j\omega\delta_2\left(-jkH_1 + \mu_{22} H_2 + jmH_z\right) = 0. \end{cases} \quad (15)$$

In (15), for convenience, we separately define differential operators of the 2nd order:

$$\delta_1\nabla_1 = \frac{1}{h_1}\left(\frac{\partial}{\partial x_1} + \Gamma_{21}^2\right)\left(\frac{1}{h_1}\frac{\partial}{\partial x_1}\right) = \frac{1}{h_1^2}\left(\frac{\partial}{\partial x_1} + \Gamma_{21}^2 - \Gamma_{11}^1\right)\frac{\partial}{\partial x_1} = \Delta_{11}, \quad (16)$$

$$\delta_2\nabla_2 = \frac{1}{h_2}\left(\frac{\partial}{\partial x_2} + \Gamma_{12}^1\right)\left(\frac{1}{h_2}\frac{\partial}{\partial x_2}\right) = \frac{1}{h_2^2}\left(\frac{\partial}{\partial x_2} + \Gamma_{12}^1 - \Gamma_{22}^2\right)\frac{\partial}{\partial x_2} = \Delta_{22}, \quad (17)$$

$$\delta_1\nabla_2 = \frac{1}{h_1}\left(\frac{\partial}{\partial x_1} + \Gamma_{21}^2\right)\left(\frac{1}{h_2}\frac{\partial}{\partial x_2}\right) = \frac{1}{h_1 h_2}\frac{\partial}{\partial x_1}\frac{\partial}{\partial x_2} = \Delta_{12}, \quad (18)$$

$$\delta_2\nabla_1 = \frac{1}{h_2}\left(\frac{\partial}{\partial x_2} + \Gamma_{12}^1\right)\left(\frac{1}{h_1}\frac{\partial}{\partial x_1}\right) = \frac{1}{h_1 h_2}\frac{\partial}{\partial x_1}\frac{\partial}{\partial x_2} = \Delta_{21}. \quad (19)$$

We get that differential operators $\Delta_{12} = \Delta_{21}$.

Given (16) - (19), we rewrite (15):

$$\begin{cases} \Delta_{12}E_z - \dfrac{\gamma}{\omega\varepsilon}\Delta_{11}H_z - \dfrac{j\gamma^2}{\omega\varepsilon}\delta_1 H_1 + j\omega\delta_1\left(\mu_{11}H_1 + jkH_2 + jlH_z\right) = 0, \\ \Delta_{21}E_z + \dfrac{\gamma}{\omega\varepsilon}\Delta_{22}H_z + \dfrac{j\gamma^2}{\omega\varepsilon}\delta_2 H_2 - j\omega\delta_2\left(-jkH_1 + \mu_{22}H_2 + jmH_z\right) = 0. \end{cases}$$

(20)

From the second equation (20) we subtract the first:

$$\frac{\gamma}{\omega\varepsilon}\left(\Delta_{11}H_z + \Delta_{22}H_z\right) + \frac{j\gamma^2}{\omega\varepsilon}\left(\delta_1 H_1 + \delta_2 H_2\right) + \omega k\left(\delta_1 H_2 - \delta_2 H_1\right) - \\ - j\omega\left[\delta_1\left(\mu_{11}H_1 + jlH_z\right) + \delta_2\left(\mu_{22}H_2 + jmH_z\right)\right] = 0.$$

(21)

Instead of the third term (21), we substitute the third equation (10), and instead of the fourth term (21) we substitute (13):

$$\frac{\gamma}{\omega\varepsilon}\left(\Delta_{11}H_z + \Delta_{22}H_z\right) + \frac{j\gamma^2}{\omega\varepsilon}\left(\delta_1 H_1 + \delta_2 H_2\right) + \omega k\left(jw\varepsilon E_z\right) - \\ - j\omega\left[k\omega\varepsilon E_z + j\gamma\left(-jlH_1 - jmH_2 + \mu_{33}H_z\right)\right] = 0.$$

(22)

Multiplying expression (22) by $\dfrac{\omega\varepsilon}{\gamma}$, we get:

$$\Delta_{11}H_z + \Delta_{22}H_z + j\gamma\left(\delta_1 H_1 + \delta_2 H_2\right) - j\omega^2\varepsilon\left(lH_1 + mH_2\right) + \omega^2\varepsilon\mu_{33}H_z = 0.$$

(23)

Expression (23) is the generalized Helmholtz equation of the HE-wave for a gyrotropic waveguide with an orthogonal-curvilinear cross-sectional shape with arbitrary magnetization.

To obtain the generalized Helmholtz EH-wave equation, we express H_2 from the first equation of system (11), and H_1 from the second one:

$$\begin{cases} H_2 = \dfrac{\nabla_2 E_z}{\omega k} + \dfrac{j\gamma}{\omega k}E_2 + \dfrac{j\mu_{11}}{k}H_1 - \dfrac{l}{k}H_z; \\ H_1 = \dfrac{\nabla_1 E_z}{\omega k} + \dfrac{j\gamma}{\omega k}E_1 - \dfrac{j\mu_{22}}{k}H_2 + \dfrac{m}{k}H_z. \end{cases} \quad (24)$$

In the first equation (24) we substitute the second and after transformations we get:

$$H_2 = \frac{k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\nabla_2 E_z + \frac{j\gamma k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}E_2 + \frac{j\mu_{11}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\nabla_1 E_z -$$

$$- \frac{\gamma\mu_{11}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}E_1 + \frac{j\mu_{11}m}{k^2 - \mu_{11}\mu_{22}}H_z - \frac{lk}{k^2 - \mu_{11}\mu_{22}}H_z.$$

(25)

In the second equation (24) we substitute the first and after the transformations we get:

$$H_1 = \frac{k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\nabla_1 E_z + \frac{j\gamma k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}E_1 - \frac{j\mu_{22}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\nabla_2 E_z -$$

$$- \frac{\gamma\mu_{22}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}E_2 + \frac{j\mu_{22}l}{k^2 - \mu_{11}\mu_{22}}H_z + \frac{mk}{k^2 - \mu_{11}\mu_{22}}H_z.$$

(26)

The expression (25) is acted upon by the operator δ_1, and on (26) - δ_2. In this case, in the resulting expressions we use (18) and (19):

$$\delta_1 H_2 = \frac{k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\Delta_{12} E_z + \frac{j\gamma k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\delta_1 E_2 + \frac{j\mu_{11}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\Delta_{11} E_z -$$

$$- \frac{\gamma\mu_{11}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\delta_1 E_1 + \frac{j\mu_{11}m}{k^2 - \mu_{11}\mu_{22}}\delta_1 H_z - \frac{lk}{k^2 - \mu_{11}\mu_{22}}\delta_1 H_z.$$

(27)

$$\delta_2 H_1 = \frac{k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\Delta_{12} E_z + \frac{j\gamma k}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\delta_2 E_1 - \frac{j\mu_{22}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\Delta_{22} E_z -$$

$$- \frac{\gamma\mu_{22}}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)}\delta_2 E_2 + \frac{j\mu_{22}l}{k^2 - \mu_{11}\mu_{22}}\delta_2 H_z + \frac{mk}{k^2 - \mu_{11}\mu_{22}}\delta_2 H_z.$$

(28)

From (27) subtract (28):

$$\delta_1 H_2 - \delta_2 H_1 = \frac{j\gamma k\left(\delta_1 E_2 - \delta_2 E_1\right)}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)} + \frac{j\left(\mu_{11}\Delta_{11}E_z + \mu_{22}\Delta_{22}E_z\right)}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)} -$$

$$- \frac{\gamma\left(\mu_{11}\delta_1 E_1 + \mu_{22}\delta_2 E_2\right)}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)} + \frac{j\left(\mu_{11}m\delta_1 - \mu_{22}l\delta_2\right)}{k^2 - \mu_{11}\mu_{22}}H_z - \frac{lk\delta_1 + mk\delta_2}{k^2 - \mu_{11}\mu_{22}}H_z.$$

(29)

In the left-hand side of (29), we substitute the third equation of system (10), and the third equation of system (11) into the first term (29):

$$j\omega\varepsilon E_z = \frac{j\gamma k\left(-wlH_1 - wmH_2 - jw\mu_{33}H_z\right)}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)} + \frac{j\left(\mu_{11}\Delta_{11}E_z + \mu_{22}\Delta_{22}E_z\right)}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)} -$$
$$- \frac{\gamma\left(\mu_{11}\delta_1 E_1 + \mu_{22}\delta_2 E_2\right)}{\omega\left(k^2 - \mu_{11}\mu_{22}\right)} + \frac{j\left(\mu_{11}m\delta_1 - \mu_{22}l\delta_2\right)}{k^2 - \mu_{11}\mu_{22}}H_z - \frac{lk\delta_1 + mk\delta_2}{k^2 - \mu_{11}\mu_{22}}H_z.$$

(30)

Multiplying the expression (30) by the imaginary unit *j*, after the transformation we get:

$$\mu_{11}\Delta_{11}E_z + \mu_{22}\Delta_{22}E_z + j\gamma\left(\mu_{11}\delta_1 E_1 + \mu_{22}\delta_2 E_2\right) + \omega\left(\mu_{11}m\delta_1 - \mu_{22}l\delta_2\right)H_z +$$
$$+ \gamma k\omega\left(-lH_1 - mH_2 - j\mu_{33}H_z\right) - \omega^2\varepsilon\left(k^2 - \mu_{11}\mu_{22}\right)E_z + j\omega\left(lk\delta_1 + mk\delta_2\right).H_z = 0.$$

(31)

Expression (31) is a generalized Helmholtz EH-wave equation for a gyrotropic waveguide with an orthogonal-curvilinear cross-sectional shape with arbitrary magnetization.

In conclusion, we note:

1. The generalized Helmholtz hybrid HE-wave (23) equation is obtained for gyrotropic waveguides with orthogonal-curvilinear cross-sectional shapes with arbitrary magnetization.

2. The generalized Helmholtz equation for the hybrid EH-wave (31) for gyrotropic waveguides with orthogonal-curvilinear cross-sectional shapes with arbitrary magnetization is obtained.

3. Equations (23) and (31) will make it possible to obtain the corresponding partial Helmholtz equations for gyrotropic waveguides with different cross-sectional shapes for different magnetizations (longitudinal, normal, transverse).

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从冶金废料中接收二次金属
RECEIPT OF SECONDARY METALS FROM METALLURGY WASTES

Tokach Yulia Egorovna
Candidate of Technical Sciences, Associate Professor
Doroganova Olga Vladimirovna
graduate student
Udovenko Nikolay Aleksandrovich
graduate student
Belgorod State Technological University named after V.G. Shukhov

注解。 已经通过还原材料对氧化铁的热还原进行了研究。 碳质组分和铝用作还原剂。 恢复条件已定义。

关键词：材料还原剂，铝热，机械活化，氧化铁。

Annotation*. Studies have been carried out on the thermal reduction of iron oxides by reducing materials. Carbonaceous components and aluminum were used as reducing agents. The recovery conditions are defined.*

Keywords*: materials reducing agents, alumothermy, mechanical activation, iron oxide.*

The production of ferrous and non-ferrous metals is accompanied by the formation of a large amount of waste, much of which is not used and stored in dumps and storages. Such wastes include metallurgical slags, gas cleaning products, sewage sludge. Extraction of metals from slags and dusts is an important part of resource saving in metallurgical production, which allows returning the extracted metal to the metallurgical cycle, obtaining high quality slag products, and solving environmental problems of environmental pollution by dusting metallurgical production waste.

In addition, the depletion of raw materials, including non-ferrous metallurgy, can be prevented by developing new technological processes and equipment for the processing of mineral resources and, most importantly, by transferring industrial production to the so-called “closed”, “bottomless” technological schemes [13].

One of the areas of industrial waste processing with the aim of obtaining high-quality metal products is the creation of a technology for the production of pure original mixture - direct reduced iron. For the implementation of the recovery process it is necessary to destroy intramolecular bonds. Quantitatively, such relationships are well studied and are reference values for some elements [4].

Depending on the type of reducing agent used, there are three main methods: restoration, silicothermic and aluminothermic. In practice, the most common reduction technology is carbon, when the energy released during the oxidation of carbon (395 kJ/mol) destroys intramolecular bonds in molecular particles that are in the "burning" zone of carbon.

In scientific and technical literature, the reduction of oxides by carbon is called direct reduction, and the reduction by carbon monoxide is called indirect or non-direct reduction.

Due to the imperfect contact between bulk materials, the possibility of direct interaction between carbon and solid oxides is limited. Therefore, direct reduction reactions proceed mainly with the participation of the gas phase and are the result of the successive indirect reduction reactions.

$$MeO+CO=Me+CO_2 \quad (1)$$

and the interaction of carbon dioxide with carbon

$$CO_2+C=2CO \quad // \quad (2)$$

The result of the successive reactions (1) and (2) can be described by the equation

$$MeO+C=Me+CO \quad (3)$$

According to the law of Hess

$$2MeO+C=2Me+CO_2 \quad (4)$$

Aluminum thermal processes using aluminum powder are associated primarily with the production of such pure metals as chromium, manganese, vanadium, zirconium, niobium, boron, and also ferroalloys. Under production conditions, it is important that aluminothermic reduction, which spontaneously extends to the entire charge consisting of a mixture of powders of aluminum and metal oxide, gives enough heat to melt the reaction products, as well as to separate the metal and slag. Pop-up slag protects the metal from interaction with the atmosphere.

The success of the aluminothermic reaction depends on the particle size of the metal oxide and aluminum, as well as on the composition of the mixture: the thinner the powder, the more intense the reactions.

$$3MeO+2Al=Al_2O_3+3Me \quad (5)$$

The authors conducted studies on the carbon and aluminothermic reduction of metal oxides from dusts and sludge from waste waters of metallurgical production.

The objects of research were selected: gas-cleaning dust of electric arc steel-smelting furnaces, mill-scale of the rolling processing shop and water purification

sludge of «Oskolsky Electric Metallurgical Combine» OJSC. The following materials were used as a reducing agent: aluminum powder - GOST 5494-95 “Aluminum powder. Technical conditions "; charcoal; Coke of «Gubakhinsky Coke» OJSC, (Gubakha, Perm Territory).

Characteristics of the objects of research are presented in Table 1-4.

Table 1. *The chemical composition of gas cleaning dust of electric arc steel-smelting furnaces (mass fraction, %)*

CaO	**Fe_2O_3**	**SiO_2**	**Na_2O**	**MgO**	**ZnO**	**Al_2O_3**	**K_2O**	**MnO**	**SO_3**	**Cl**	**PbO**	**Cr_2O_3**	**CuO**	**P_2O_5**	**TiO_2**	**NiO**	**V_2O_5**
6,06	56,42	5,48	13,45	6,58	3,75	0,44	2,89	1,88	1,24	0,53	0,25	0,25	0,14	0.14	0,02	0,02	0,01

Table 2. *The chemical composition of sludge water treatment (mass fraction, %)*

CaO	**Fe_2O_3**	**SiO_2**	**Cr_2O_3**	**SrO**	**ZnO**	**Al_2O_3**	**K_2O**	**MnO**	**$S_{сульф}$**	**CuO**	**NiO**	**P_2O_5**	**TiO_2**	**Organic**	**H_2O**
4,26	53,09	1,61	0,38	0,03	0.07	1,74	0.11	0,99	0.36	0.26	0.04	0.27	0,04	13,35	23,40

Table 3. *The chemical composition of the scale (oily) rolling mill (mass fraction, %)*

Fe_2O_3	**SiO_2**	**Al_2O_3**	**CaO**	**$S_{сульф}$**	**$P_{общ.}$**	**Cr_2O_3**	**CuO**	**NiO**	**MnO**	**Масло**	**Organic**
79,78	1,53	2,03	0,56	0,11	0,14	0,97	0,36	0,14	0,78	1,30	12,30

Table 4. The chemical composition of coke (mass fraction, %)

C	H	**N**	**O**	**S**
96,60	0,45	0,67	0,30	1,98

The reduction of metal oxides from iron-containing wastes by aluminoemia was carried out on batches of 50 g each.

To this end, in accordance with the reduction reaction (5), the stoichiometric amount of aluminum powder was determined. The waste and the reducing agent were thoroughly mixed and the resulting mixture was heated in a muffle furnace at atmospheric pressure to determine the temperature at which the exothermic reduction reaction began.

As a result of the reaction, intense oxidation of aluminum occurs due to oxygen contained in iron oxides and other metals. The process is accompanied by the release of large amounts of heat, for example, during the reduction of iron, 3560 kJ / kg is released, which provides rapid heating of the mixture to the melting point of metals and the formation of ingots.

The change in the residual content of metal oxides in a mixture of aluminum and dust EDSP (dust) depending on the temperature of preheating in a muffle furnace is presented in table. five.

Table 5. *Changes in the content of metal oxides from the heating temperature*

Heating temperature, °C	Metal oxide content									
	Al_2O_3	Fe_3O_4	CaO	SiO_2	ZnO	MgO	MnO	PbO	Cr_2O_3	CuO
500	51.65	23.76	6.80	3.90	2.55	1.57	1.04	0.19	0.25	0.12
550	51.32	23.81	6.51	3.93	2.55	1.55	1.07	0.19	0.20	0.10
570	51.71	4.97	15.77	11.16	0.39	3.79	1.86	0.01	0.14	0.09
590	53.51	2.94	16.25	11.47	0.06	4.25	2.17	0.03	0.14	0.08

From the table it follows that the content of iron oxides decreased by more than 16 times compared with the original. A decrease in the content of heavy metal oxides is also observed. This is due to the reduction of these oxides and the formation of a metal alloy. The increase in the content of aluminum oxides in the residual slag is associated with the recovery process, and the increase in oxides of silicon, calcium and magnesium can be explained by their transition from the crucible material. Figure 1 shows the metal ingots obtained by aluminothermy.

Fig. 1. *Metal ingots produced by aluminothermy from electric arc steel-smelting dust a) at the bottom of the crucible; b) after grinding*

To study the recovery of metal oxides from the sludge of radial clarifiers and descaling of the rolling shop using carbon, the samples were prepared as follows. Crushed coke or charcoal was placed at the bottom of a corundum crucible and covered with a layer of scale or dried sludge on top. The crucible was closed with a lid and placed in a muffle furnace. The results of studies at a temperature of 1350 °C and a holding time at a maximum temperature of 90 minutes are shown in Figures 2-4.

Fig. 2. *Recycled metal from sludge from radial sumps using charcoal*

Fig. 3. *A metal ingot obtained by heating a scale with coke*

Fig. 4. *A metal ingot obtained by heating a scale with charcoal.*

The results of the experiments showed that the process of aluminothermic reduction of metal oxides begins when the waste mixture with aluminum is heated to 570-590 °C in accordance with the chemical reaction

$$Fe_2O_3+2Al=2Fe+Al_2O_3$$

with the release of heat and heating the material to the melting point of metals. As a result, metal ingots are formed, which are easily separated from the non-metallic part.

The recovery efficiency depends on the quality of mixing the mixture. Oxidation reduction processes after preliminary mechanical activation proceed more intensively.

In carbon reduction, the greatest effect is achieved at a temperature not lower than 1350 ° C. When layered heat treatment is the separation of metal ingots and spent carbon material. Secondary oxidation of the reduced metal is eliminated due to an additional layer of carbon reducing agent located above the layer of the material being processed. [five].

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使用植物吸附剂去除水体表面的漏油

THE USE OF VEGETABLE ADSORBENT TO REMOVE OIL SPILLS FROM THE SURFACE OF WATER BODIES

Rubanov Yury Konstantinovich
Candidate of Technical Sciences, Associate Professor
Palenova Maria Vitalevna
graduate student
Rozin Ivan Mikhailovich
graduate student
Belgorod State Technological University named after V.G. Shukhov

注解。 据专家估计，由于油轮，输油管道，近海区石油生产等事故造成的每年约有1000万吨石油进入水中。用于吸收石油和 石油产品涉及各种各样的植物和天然原料：荞麦壳和向日葵壳，燕麦和稻壳，玉米芯（废物），草加工废物，稻草，甘蔗花序等[1- 2]。

关键词：吸附，吸油，吸水，油容，疏水性，吸附剂，淡水，海水。

Annotation. *According to expert estimates, about 10 million tons of oil annually gets into the water as a result of accidents of tankers, oil pipelines, during oil production in offshore zones, etc. The materials used in the production of sorbents for the absorption of oil and oil products involve a significant variety of plant and natural raw materials: husks of buckwheat and sunflower, oat and rice husks, corn cobs (wastes), grass processing wastes, straw, cane inflorescences, etc. [1- 2].*

Keywords*: adsorption, oil absorption, water absorption, oil capacity, hydrophobicity, sorbent, fresh water, sea water.*

In this paper, the process of sorption collection of oil and oil products during the emergency oil spill response with a vegetable adsorbent has been investigated. For research used oil Alekseevskogo field, Samara region, which belongs to the class of sulfur, high resin and relatively heavy. The density of oil is from 0.896 to 0.908, the viscosity at 20 °C is 64 mm^2/s, the sulfur content is 3.68%, asphaltenes - 8.9%, tar - 19.26%, paraffins - 5.59%.

Oil spill sorbent was developed on the basis of the fruit of the tree STAGHORN SUMAC (vinegar tree), previously widely used in industry, as having coloring and tanning properties.

The STAGHORN SUMAC tree, like most trees throughout Russia, bears fruit only once a year. During the flowering period, the plant is covered with fluffy white pyramids consisting of hundreds of inflorescences. When the sumac blossoms, in their place are tied with long, pointed red-bright paintbrushes, (Fig. 1). Brushes consist of a set of processes covered with a shaggy seed. Organic acids (tartaric, malic, citric), essential oil, ascorbic acid, tannins and antraglycosides are present in the hands. As a sorbent, fruit seeds with a fleecy sheath, which is covered with an oil film containing fatty acids, were used (Fig. 2).

Fig.1. *Fruits of the tree STAGHORN SUMAC*

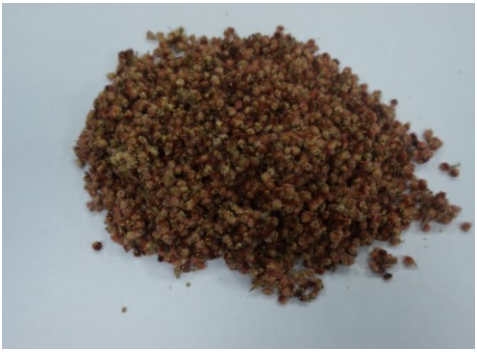

Fig. 2. *Seeds of fruit STAGHORN SUMAC*

The absorption of spilled oil by mats models was investigated in an open container made of plastic. A nylon mesh was used as oil permeable mats and booms (Fig. 3).

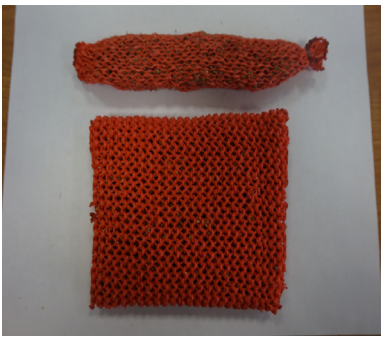

Fig. 3. *Models of mats and booms filled with Sumach seeds*

The hydrophobicity of the sorbent was investigated by holding the sorbent sample in fresh and salt (sea) water. For the preparation of sea water used sea salt STO 484068846, produced by URALMEDPROM PTK with a concentration of 35 g/l.

The results of the experiment are presented in Table 1.

Table 1

The study of the water-absorbing properties of the sorbent

The contact time of the sorbent with water, hours	**The average value of water absorption, g/g sorbent**	
	Fresh water	**Salt water**
0,5	0,10	0,13
1,0	0,11	0,13
2,0	0,13	0,15
3,0	0,15	0,18
24,0	0,42	0,48

Analysis of the results shows that the sorbent is a hydrophobic substance; after applying the sorbent to the water surface during the first 0.5 hour of contact of the sorbent with water, the water absorption value is 0.10-0.13 g / g, which is 9-11.5%. As the contact time increases, the absorption value increases. But this fact does not affect the sorbent oil capacity, since the adsorption of oil occurs within not more than 1 minute, and thus the adsorbent is hydrophobized. A day later, the value of water absorption was 0.42-0.48 g/g (30-33%).

The water absorption values of salt water are higher in the weight dimension due to the increase in its density.

The sorbent's hydrophobicity is ensured by the fact that the seeds of the fruit

are covered with a fleecy coat that has a fatty film (like goose down) because in natural conditions are intended to be preserved in winter after the period of ripening.

The sorbent oil film contains fatty acids, which mainly include palmitic, linoleic, and oleic acid, which characterizes it as close to the chemical composition of cottonseed oil.

It should be noted that the absorption of oil by a sorbent is a complex physicochemical process and includes such phenomena as self-adsorption, adhesion, capillary phenomena, and also purely physical processes of sorbent deposition in the oil product and filling of the free absorber with oil product can be observed [3].

The determination of the oil capacity of the sorbent for oil was determined by adding the sorbent to the surface of the oil in a wide vessel (D = 9 cm) at room temperature and at a temperature of +40 °C in order to simulate various climatic conditions. At the same time, the amount of sorbent was changed in such a way that it was enough to distribute 1, 2, 3 and 4 layers over the surface of the oil mirror. Spin sorbent carried out manually.

The results of the experiments are presented in Table 2, 3

Table 2

Absorbing capacity of the sorbent at t = 20 °C

The number of layers of sorbent	Weight, g	Amount of absorbed oil, g	The height of the layer of absorbed oil, mm	Oil capacity, g/g	The degree of extraction of oil,%
1	4,2	12,1	2,1	2,8	48
2	8,4	23,4	4,0	2,8	45
3	12,6	32,2	5,6	2,5	42
4	16,6	36,3	6,4	2,1	39

To determine the absorbing capacity of the sorbent at a low temperature, the oil was pre-cooled to + 40 °C.

Table 3

Absorbing capacity of the sorbent at t = 40 °C

The number of layers of sorbent	Weight, g	Amount of absorbed oil, g	The height of the layer of absorbed oil, mm	Oil capacity, g/g	The degree of extraction of oil,%
1	4,2	12,6	2,2	3,0	46
2	8,4	25,2	4,4	3,0	42
3	12,6	35,3	6,2	2,8	39
4	16,6	39,8	6,9	2,4	39

The decrease in absorption capacity with an increase in the number of layers of the adsorbent can be explained by the lack of mixing. At rest, the oil rises due to capillary forces to a height equal to three layers of the adsorbent. With a particle diameter of the adsorbent of 3 mm, this height will be 9 mm. In real conditions, with a sufficiently large layer of spilled oil products, a decrease in oil intensity will not occur due to the mixing of the layers of the adsorbent due to the action of waves.

The increase in oil capacity during adsorption under conditions of low temperature is caused by an increase in the holding capacity on the lint of the adsorbent when it is removed after saturation due to an increase in the viscosity of the oil.

The amount of oil pressed manually is less than 50%. Mechanical squeezing will lead to the destruction of the particles of the adsorbent, which eliminates its reuse after regeneration.

Thus, the spent adsorbent can be used in the production of fuel briquettes. The kinetics of oil absorption depending on temperature conditions is shown in Fig. four.

Studies on the removal of spilled oil from the surface of the water were carried out under the conditions of a spill in fresh and salt (sea) water.

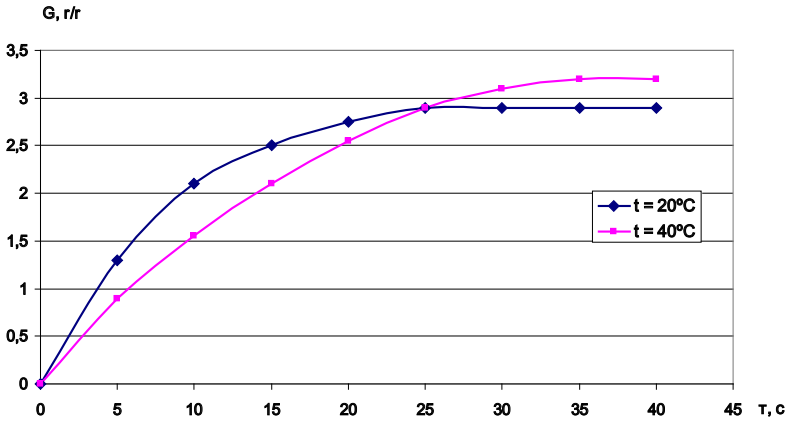

Fig. 4. *Dependence of oil absorption at various temperatures*

To determine the intensity of oil absorption, the process was carried out at different heights of the oil layer on the water surface, cm: 0.21, 0.40, 0.56, 0.64, which corresponded to the value of oil absorption of the 1st, 2nd, 3rd and 4 layers of adsorbent (Fig. 5).

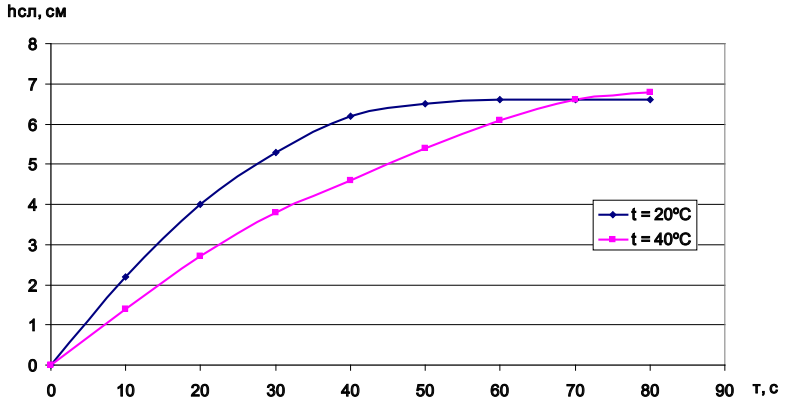

Fig. 5. *The dependence of oil absorption on the height of the oil layer on the surface of the water*

After adding the adsorbent to the film of spilled oil in the first 10-20s, its intensive absorption takes place. Full saturation is provided through 60-80s. The saturation process is slightly faster at room temperature, compared with adsorption at 40 °C.

In the study of the process of removing spilled oil from the surface of salt (sea water), the amount of absorbed oil does not differ, as compared with the removal of fresh water from the surface.

Conclusions.

The possibility of using vegetable sorbent on the basis of the seeds of the fruit of the tree SUMAH in the process of collecting emergency oil spills from the surface of fresh and sea water is shown.

It is proved that the sorbent oil capacity when oil is removed from the surface of water at a low temperature (40 °C) is higher by 6-8% due to an increase in the holding capacity on the lint of the adsorbent more viscous oil.

It is advisable to use the developed sorbent once. The spent sorbent after the release of oil can be used in the production of fuel briquettes.

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为各种功能用途的多组分多层涂料创造新设备 为各种功能用途的多组分多层涂料创造新设备
CREATION OF NEW EQUIPMENT FOR MULTI-COMPONENT MULTI-LAYER COATINGS OF VARIOUS FUNCTIONAL PURPOSES

Kolesnik Valery Vladimirovich
Candidate of Technical Sciences, Associate Professor
Rubanov Yury Konstantinovich
Candidate of Technical Sciences, Associate Professor
Tokach Yulia Egorovna
Candidate of Technical Sciences, Associate Professor
Belgorod State Technological University named after V.G. Shukhov

注解。提出了与单组分涂料相比具有更广泛性能的多组分涂料的制备实验结果。基于多组分Co合金（18 ... 20%） - Cr（5 ... 7%） - Al（0.3 ... 0.4%） - Y（0.2 ... 0.5）的涂层形成过程正在研究中。研究了涂层的化学组成，其厚度和过渡区的状态。给出了所得涂层的X射线荧光和X射线微区分析结果。结果表明，表面微细凹凸的性质取决于涂层的形成条件，每个样品上涂层中的化学元素组是相似的，它们的浓度取决于沉积过程的条件，分布样品厚度上的化学元素是恒定的，涂层材料和基材的扩散区几乎不存在。揭示了在形成的涂层中存在不显着百分比的基底材料。随着涂层厚度的增加，基底材料的百分比急剧下降。

关键词：多组分涂层，磁控管系统，过渡层，基板，靶阴极。

Annotation. *The results of experiments on the preparation of multicomponent coatings with a wider range of properties compared to single-component ones are presented. The processes of coating formation on the basis of a multicomponent Co alloy (18 ... 20%) - Cr (5 ... 7%) - Al (0.3 ... 0.4%) - Y (0.2 ... 0.5) are studied. The chemical composition of the coating, its thickness, and the state of the transition zone were investigated. The results of X-ray fluorescence and X-ray microanalysis of the obtained coatings are presented. It is shown that the nature of the surface microrelief is determined by the conditions of the formation of coatings, the set of chemical elements in the coating on each of the samples is similar, their concentration depends on the conditions of the deposition process, the distribution of chemical elements in thickness on the samples is constant, the diffusion zone of the coating materials and the substrate is almost absent. The presence in the*

formed coating of an insignificant percentage of the substrate material is revealed. As the coating thickness increases, the percentage of substrate material decreases sharply.

***Keywords**: multicomponent coatings, magnetron systems, transition layer, substrate, target cathode.*

Introduction. The formation of multicomponent coatings with specified characteristics and adjustable component composition in the scientific and technical literature are reflected quite widely [1-9]. To obtain high-quality precision coatings using vacuum methods of spraying materials. [12-14]. As a coating material, an alloy of the type MeCrAlY is widely used, where cobalt, cobalt + nickel, cobalt + chromium, etc. are used as the main component (Me).

Methodology. To study the controlled processes of the formation of coatings based on multicomponent alloys, a series of experiments on the sputtering of the Co alloy (18 ... 20%) - Cr (5 ... 7%) - Al (0.3 ... 0.4%) - Y () laboratory installation, the scheme of which is shown in Fig. 1 [15].

The plasma generator included twelve cathodes-targets made of a sputtered alloy and located coaxially relative to the anodes. All target cathodes were connected to one or several power sources (the cathode connection scheme allowed introducing additional power sources to one or several targets).

The formation of the coating was carried out on polished substrates made of copper. The substrate material is chosen different from the components that make up the alloy, to facilitate the X-ray fluorescence and X-ray microanalysis of the resulting coatings.

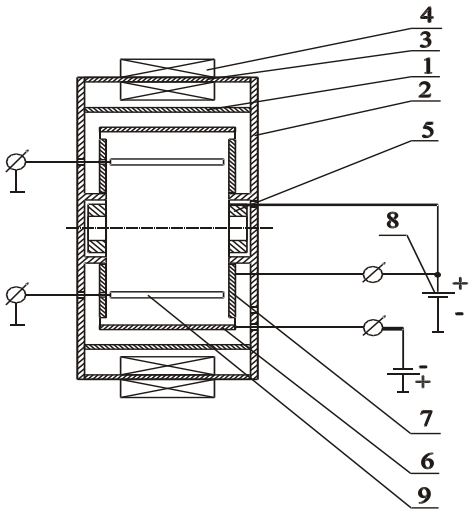


Fig.1. *The design of the plasma generator*
1- chamber, 2- flanges, 3- magnetic cores, 4 - solenoids, 5- anode,
6- substrate holder, 7 - cathode disks, 8 - power supply,
9 - sputtered target cathodes

To test the possibility of controlling the elemental composition of the formed coating in the deposition process, several series of experiments were conducted:

Series 1. Formation of the coating of the main alloy Co-Cr-Al-Y. (sample 1). For this purpose, 10 target cathodes were made from the main alloy.

Series 2. Aluminum was added to the main Co-Cr-Al-Y alloy. For this, two target cathodes made of aluminum were additionally installed in a vacuum chamber (sample 2).

Series 3. Aluminum and nickel were additionally added to the basic Co-Cr-Al-Y alloy. For this purpose, 10 target cathodes of Co-Cr-Al-Y alloy, one target cathode made of aluminum, and the second target cathode of nickel were installed (sample 3).

Series 4. Aluminum, nickel and chromium were added to the main Co-Cr-Al-Y alloy. For this purpose, 9 target cathodes made of Co-Cr-Al-Y alloy, one aluminum target cathode, one nickel and one chromium target cathode were installed (sample 4).

Main part. The formation of coatings was carried out at a working gas pressure of ~ 0.7 Pa and a 2.2 kW electric power supplied to the discharge, while a constant positive potential was applied to the substrate holder. The potential was chosen experimentally from the condition of ensuring the maximum deposition

rate [15]. Before deposition of the coating, the substrates were subjected to ion cleaning.

The coatings were studied on a JSMT-300 electron scanning microscope with the Phoenix X-ray Microanalysis Attachment (PCMA) from EDAX, USA. The chemical composition of the coating surface was determined by the X-ray fluorescence method on an EX – 6500 instrument from BAIR, USA.

As a result, the chemical composition of the coating, its thickness, the state of the transition zone, the surface relief, and the presence of a droplet phase were investigated. The study of the microstructure was complicated by the fact that a soft material — copper — was used as the substrate. In the manufacture of microsections, the removal of copper was more intense than the coating, and a ledge was formed on the border with the coating, which gave some distortion when micrographs were taken.

From the results of X-ray fluorescence analysis (Table 1) it follows that the set of chemical elements in the coating on each of the samples is similar, and their concentration depends on the conditions of the deposition process and can be set in a wide range;

Table 1

Chemical composition

Sample number	Coating thickness, micron	Al	Cr	Fe	Co	Ni	Ti	Y	Zr	Cu (substrate)
1	16	6,0	19,0	8,1	50,0	1,7	10,5	0,45	1,40	2,30
2	20,4	36,5	13,6	5,0	33.0	0,55	6,2	0,27	0,60	3,20
3	27,3	21,5	8,9	2,2	25,4	36,4	3,0	0,40	0,09	0,67
4	33,3	22,0	16,0	2,4	14,6	40,3	3,6	0,30	0,09	0,20

The presence in the formed coating of an insignificant percentage of the substrate material is revealed. As the coating thickness increases, the percentage of substrate material decreases sharply.

In the composition of the coatings of samples 1, 2, 3, 4, impurities were detected in the amount, mass%: 0.55; 1.08; 1.44; 0, 51, respectively. The presence of impurities in the coating caused by the design features of the vacuum compartment. For example, the poles of the magnetic system are made of magnetic conductive steel, and the screens covering the insulators are made of titanium, which were subjected to slight spraying.

Since the purpose of the research was to determine the possibility of obtaining multicomponent coatings with a specified percentage ratio of components, the presence of impurities in the coating, in this case, can be neglected. However, to obtain multi-component coatings without impurities, it is necessary to screen the

structural elements of the vacuum compartment from the materials that make up the coating.

In the experiments of series 1, the deposition rate of the base coating (CoCrAlY alloy) was 0.8 μm / h. Since aluminum, nickel and chromium were added in the remaining series of experiments, the thickness of the formed coatings is greater than the thickness of the base coating. The relatively low deposition rate of additional components is due to the small area of target cathodes made from added materials relative to the area of target cathodes made from base alloy.

Analysis of the obtained results of X-ray microanalysis (PCMA) in the point-by-point linear scanning mode of the coating (Fig. 2) on samples 1–4 allows us to conclude that a transition layer is formed between the substrate and the coating.

According to the results of X-ray microanalysis in the point-to-point linear scanning mode, it was shown that the chemical composition of the coatings is constant, the diffusion zone is practically absent, due to the rather low ion energy of the material deposited on the substrate (Fig. 3 - 6). It is known that the width of the diffusion zone is directly proportional to the temperature of the substrate, which depends on the ion energy of the deposited material and the plasma-forming gas. To increase the diffusion zone, it is recommended to carry out diffusion annealing or to conduct the formation of a layer on the heated substrate.

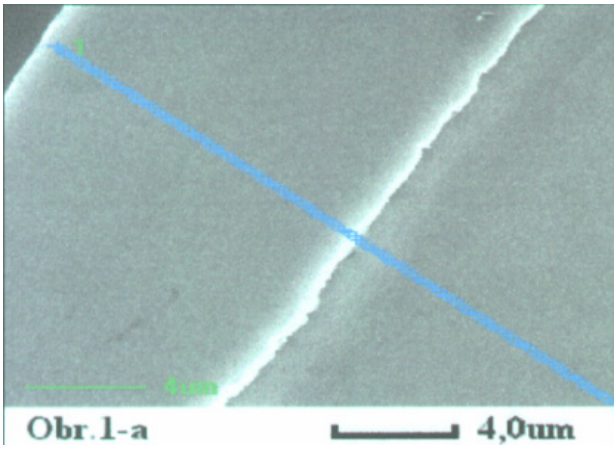
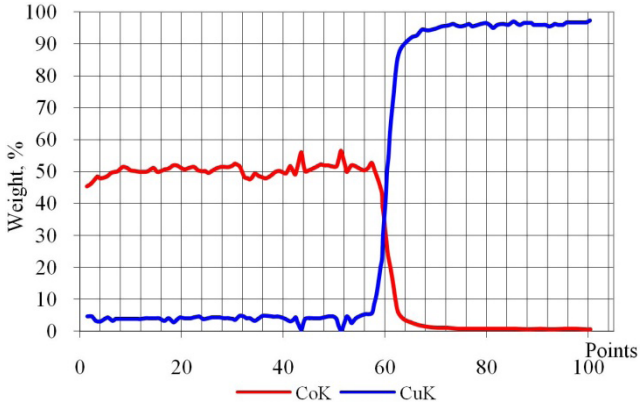


Fig. 2. *Scanning line of electronic probe*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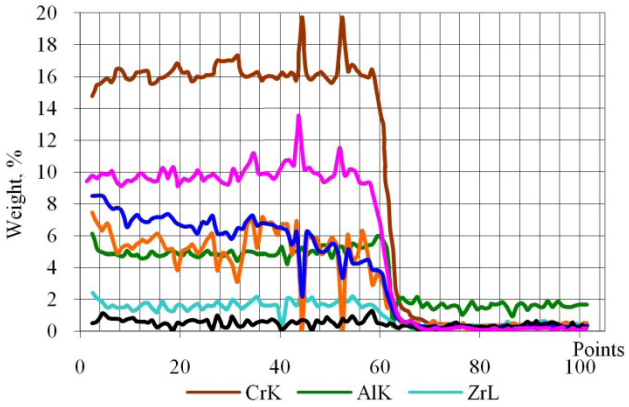
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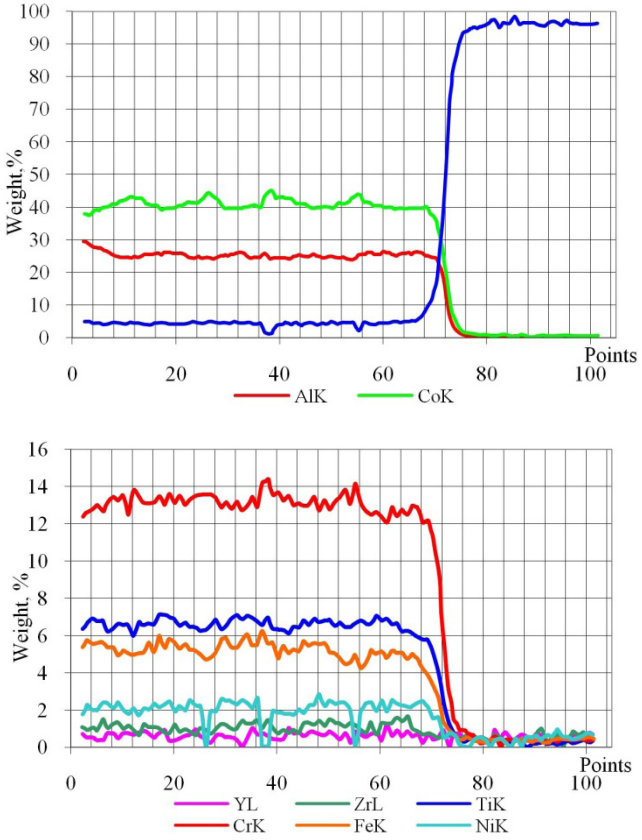
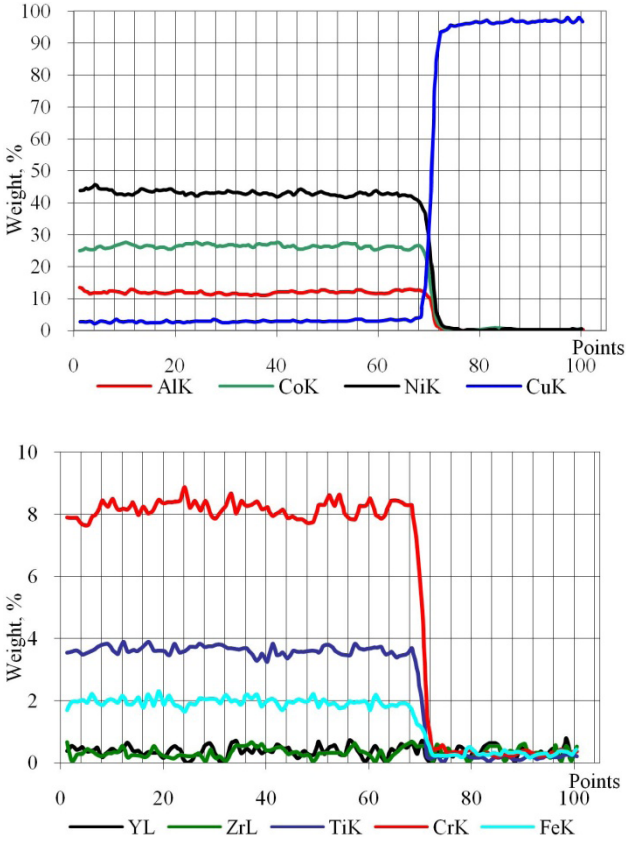
sample 1



sample 2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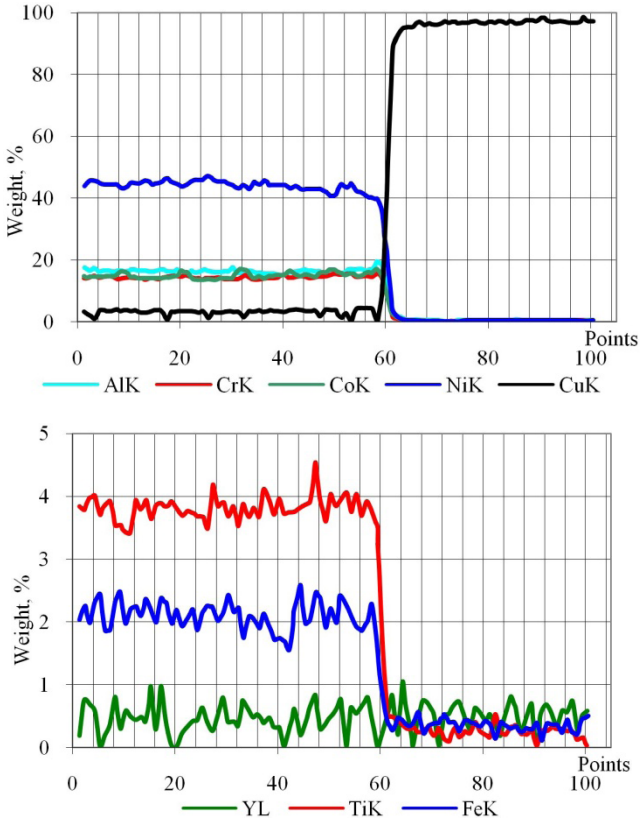
sample 3



sample 4

Fig. 3. *Distribution of chemical elements over the thickness of sample coatings*

Conclusions. Studies of the formed multi-component coatings allowed to establish that: the set of chemical elements in the coating on each of the samples is similar; mass concentration of elements depends on the conditions of the deposition process and can be set in a wide range; the distribution of chemical elements in thickness on samples is constant, the border with the substrate is distinct, the zone of diffusion adhesion is practically absent; the coating is dense, without shells; the nature of the surface microrelief is determined by the conditions of the formation of coatings.

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确定与建筑改造相关的能效因素 – 科学出版物概述
IDENTIFYING ENERGY EFFICIENCY FACTORS RELEVANT FOR BUILDING RECONSTRUCTION– OVERVIEW OF SCIENTIFIC PUBLICATIONS

Abramyan Susanna Grantovna
PhD in Engineering Sciences, Associate Professor
Oganesyan Oganes Valeryevich
Postgraduate
Rasstrygin Andrey Gennadyevich
Postgraduate
Volgograd State Technical University, Russian Federation

抽象。本文旨在确定通过重建确保建筑物和设施能效的现代方法和方法。对俄罗斯和外国作者的科学出版物和专利检索的概述和分析表明，由于其多标准性质，特别是在不受约束或约束条件下的重建，需要对每个建筑物进行定制。还发现，在目前的重建发展阶段，通过垂直延伸调整空间规划，轻金属和轻薄壁钢结构元素的使用越来越受欢迎，最大程度上有助于避免加固下面的结构元素和加强土壤基础，并降低运输成本。一般来说，有各种能效提升器：使用新的绝缘材料和复合材料来消除建筑外壳的热量损失;为外涂层创造新的外立面外壳和外墙拱壳。工作方法应以技术为导向，以及环境友好。

关键词：热损失，重建，垂直延伸，低材料强度，可施工性，轻金属结构，复合材料。

Abstract. *The paper aims to identify the modern approaches and ways of ensuring energy efficiency of buildings and facilities through reconstruction. The overview and analysis of scientific publications and patent search of Russian and foreign authors shows that reconstruction,due to its multi-criteria nature, especially underconstrained or constraining conditions, requires custom approach to every building. It isalso found thatat the current stage of reconstruction development, with spatial planning adjusted by vertical extension, the use of light metal and light thin-wall steelstructural elements is gaining popularity, asitmostly helps avoid reinforcing underlying structural elements and strengthening soil basements, and reducetransportation costs. In general, there is a variety of energy efficiency boosters: use of new insulants and composite materials to eliminate heat loss through building envelope; creating new façade shells andthin-wall arch shells for outer coatings. Work methods are to be technology-oriented, as well as environment friendly.*

Keywords: *heat loss, reconstruction, vertical extension, low material intensity, constructability, light metal structures, composite materials.*

The current building energy efficiency factors include the methods that help eliminateheat losses and work techniques that employ minimum material, energy and human resources. The choice of construction or repair and construction methods and ways and related materials depends on the characteristics of a structural part of the building tobe reconstructed, including its wear, tear and obsolescence, and the goals and tasks to be accomplishedby thereconstruction of a structural system.

Typically designed buildingscannot however be approached with typical organizational and technological solutions for reconstruction and require custom approach. This is due to the multicriteriality of reconstruction: working underconstrained and constraining conditions,which requires integrated innovative solutions covering both the choice of materials, the technology and organization of works, and the design patternsemployedfor the existing building.

In practice, about 40 % of thermal energy during wintertime is actually used to heat the outside air. Out of this amount, approximately 40 % of heat losses come from walls, 20 % – from windows and doors, 20 % – from top, 20 % – from cellar and ventilation system [1].

Another research[2] exploring the topic of interest provides differing data (Fig.1), which still identify the key factors of heat lossas enclosingstructures.

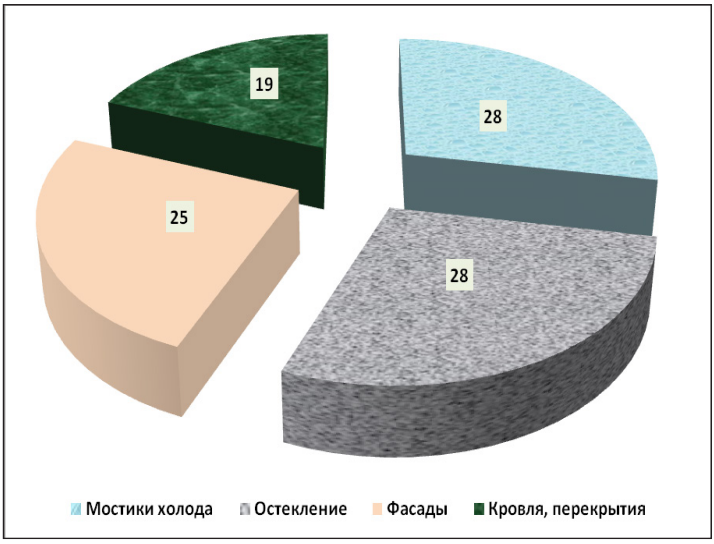


Fig. 1. *Heat loss through enclosingstructures: glazing – 28%; thermal bridges – 28%; façades – 25%; tops – 19%*

However, according to the historical data, major heat losses come from the building envelope. There is a fairly broad range pf modern solutions ensuring energy efficiency offaçadesystems. This includes the use of energy saving windows, efficient insulants, other materials and products, creating additionalfaçade shells etc.

For example, a number of scientific publications[3–13] state that the energy efficiency issue in the existingbuildings and facilities can be resolved with a variety of methods, such as: polyvalent walls [3, 4], additional heat insulating façadeshells [5–7], including shells with composite materials [8], modified space planning[9, 10], new utility networks [11–13] etc.

It is also worth noting that some scientists consider mezzanine structures as a means not only to adjust the performance characteristics of buildings and facilities through reconstruction, but also toensuretheir energy efficiency[9, 10, 14–17].

From the organizational perspective, of special interest are vertical extensionmethods as described in[18], because, firstly, they allow workingin space-limited environments, and secondly, they make construction and installation works more technology-oriented.

Foreign scientific publications[19–23] pay special attention to the possibility and relevance of light thin-wall steelstructures(LSTS) andlight metal structures(LMS) for vertical extensionofbuildings and facilities. The above papers mention that the useof LSTSandLMSfor vertical extension ofbuildings also conforms to the sustainable urban development requirements. The use of said structuresreduces adverse impact on the environment, because the transportation of these structuresdoes not require large-size heavy-duty trucks, and their installation does not require cranes with a great lifting capacity. Besides, vertical extensionworks can be performed both under constrained or constraining conditions.

The scientific paper[24], apart from the above-mentioned benefits of using LSTSand LMSfor vertical building extension, notes that in selecting materials of construction care should be taken to avoid increasing static and dynamic loads on the existing foundations and basements. To this end, it is recommended that translucent façadeenvelopes should be made with the use of energy efficient translucent materials and ETFE 40 (ethylene tetrafluoroethylene) film.

The analysis of other scientific publications[25, 26] shows that the use of ETFE instead of architectural glass is not only helpful in reducing the weight of a building, but also half as expensive. ETFE film is elastic, resistant to significant temperature variations, and has excellent thermal insulation properties. SinceETFE film is a self-cleaning material, its use for vertical extensionand building transparent roofs and atriums is very convenient and energy efficient. Although the service life of this material is 25 years, this does not exclude recycling, for instance, for use in dormer windows, as an opticallytransparent and elastic material. This is especially relevant because there are known technologies of making window sashes using not only alu-

minum framing, but also other light-weight metal materials. Among other benefitsof thismaterial are non-flammability, low wettability, friction, adhesion, elasticity, thermal stability etc. For the moment, the main drawback of this material is a danger of it being damaged by sharp objects, which is why the surfaces made of this material normally consist of two or three layers with air space in between, while damaged surfaces can easily be replaced. The material is also chemically inert.

Modernreconstruction and upgrading are almost always cheaper than new construction, especially including demolition [27]. Since anenergy efficient way of building reconstruction is directly related to the solution of social and economic problems (including housing problems),many countries of the world (in particular, the USA, Great Britain, Germany, France, Singapore, Japan etc.) use derelict fabrics and plants for reconstruction as residential buildings [28, 29].

The issue of providing housing for refugees from various countries aiming for the EU are burning, especially in the light of the recent war events in Syria etc. According to the UN data, by mid-2018 there were about 68.8 million migrants, displaced persons and asylum seekers. This figure is 300 thousand greater than that reported for the end of December 2017.

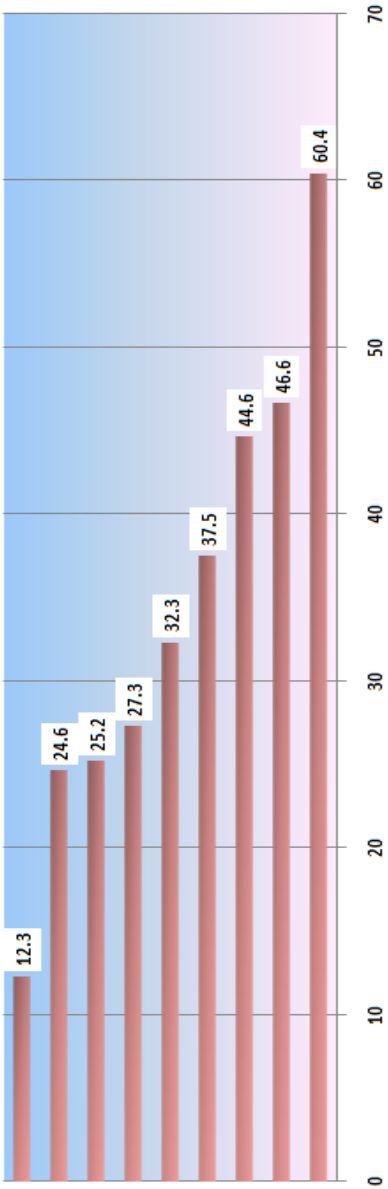
The analysis of a number offoreign scientific papers shows a variety of approaches for making energy efficient buildings, in particular, through reconstruction. Adjustment of the space planning solutions as part of reconstruction also contributes to improved energy efficiency. It is assumed that northern areas mostly feature buildings with curvilineal upper enclosingstructures or dome-shaped buildings. Archthin-wallshells are also suitable for employing the principle of combined load-bearing enclosures. With their enhanced constructability andlow metal-intensity, thin-wallcurvilineal enclosuresare a mechanism of active surface ensuring the energy efficiency of superstructures for building reconstruction.

Finding an optimal ratio of the footprint and volume of a building envelope is one of the waysof reducing heat losses. According to the computations of an American architect Ralf Nolse, the lower this ratio, the less a building will be exposed to climatic effects [30].

On the other hand, floors are normally added inbuildings located in the central districts or closer to downtown, where the housing cost per square meter is the highest. The cost of making new floors is less than the cost of a whole new building with a similar footprint area as it does not include costs involved in land allotment, underground construction and installation of utility systems.

The vertical extension experienceas part of building reconstruction can be of interest to municipal administrations,investors, owners of buildings or facilities to be reconstructed and future tenants.

Specific preferences were ranked after interviewing tenants of buildings subject to reconstruction by way of vertical extension (Fig. 2).



	Improvement of building operational characteristics	Improvement of building architectural appearance	Increase of the cost of apartments	Insurance of construction risks	Purchase of additional housing on addedfloors	Heat insulation of enclosing structures	Upgrading of attic	Purchase of housing in central districts	Vertical extension with heatproof light metal structures
1	60.4	46.6	44.6	37.5	32.3	27.3	25.2	24.6	12.3

Fig. 2. *Ranking of interests and specific preferences of tenants of buildings subject to reconstruction by way of vertical extension [31]*

It also should be noted that the making of additional vertical levels in a reconstructed building is required to focus on three tasks: choice of the structural layout of the added part of the building; ultimate reduction of the dead weight of the superstructure; reinforcement (where necessary) of load-bearing structures of the existing building.And whatever the goalsof parties concerned, the synergy of reconstructionbuilds upon cost effectiveness, energy efficiency, and environmental safety.

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放射物理学和无线电定位中的分形，纹理和分数算子（40年基础研究）
FRACTALS, TEXTURES AND FRACTIONAL OPERATORS IN RADIOPHYSICS AND RADIOLOCATION (40 YEARS OF FUNDAMENTAL RESEARCHES)

Potapov Alexander Alekseevich
Doctor of Physics and Mathematics, Chief Researcher, Professor,
Institute of Radio Engineering and Electronics
named after V. A. Kotelnikov,
Russian Academy of Sciences, Moscow, Russia;
President of the JNU-IREE Joint Laboratory
of Fractal Method & Signal Processing,
Department of Electronic Engineering, College of Information Science
and Technology, JiNan University, Guangzhou, China

注解。 本文介绍了作者（40多年来）在俄罗斯和世界上首次创建基于纹理，分形，分数算子，缩放效应和动态混沌的新信息技术所获得的主要基本结果。

关键词：放射物理学，无线电定位，非线性动力学，纹理，分形，缩放

Annotation. *The paper presents the main fundamental results obtained by the author (over 40 years) in creating for the first time in Russia and the world new information technologies based on textures, fractals, fractional operators, scaling effects and dynamic chaos.*

Keywords: *Radiophysics, radiolocation, nonlinear dynamics, texture, fractal, scaling*

Introduction The article discusses the main directions for the introduction of textures, fractals, fractional operators, dynamic chaos and nonlinear dynamics methods into the fundamental tasks of science and technology for creating new information technologies. The study is conducted in the framework of the fundamental scientific direction "Fractal Radiophysics and Fractal Radioelectronics: Designing Fractal Radio Systems", initiated and developed by the author for the first time in Russia and in the world at the IRE them. V. A. Kotelnikov of the Russian Academy of Sciences from 1979 to the present - fig. 1.

The results of scientific activity of Professor A.A. Potapov in IRE named after V. A. Kotelnikov of the Russian Academy of Sciences on fractal-scaling and textural processing of information in intensive interference, as well as on fractal radio systems and radio elements [1-12] published in four reporting reports of the Presidium of the Russian Academy of Sciences (2008, 2010, 2012, 2013) and in the Report to the Government of the Russian Federation. On the results of the implementation in 2011 of the Basic Scientific Research Program of the State Academies of Sciences for 2008–2012. - Moscow: Science, 2012.

Main fundamental results. As a result of joint long-term field experiments with leading industrial research institutes and design offices of the USSR and Russia, a statistical analysis of large amounts of new data on the spatial and temporal characteristics of earth cover dispersion in the ranges of millimeter waves and microwave was carried out, taking into account their seasonal and angular variations in a variety of meteorological conditions in order to assess the boundaries of radar contrasts, the laws of the distribution of specific radar cross-section (SRCS), the width of the spectrum, the time and the interval of correlation of intensity fluctuations coherence of space-time radio channels with variable parameters for optimal selection of the width of the probe signal spectrum, frequency separation in multi-frequency systems and the size of the base of complex probing signals, characteristics of reflected signals, generalized uncertainty functions, potential accuracy size irregularities. Theoretical and experimental results were used to create reference digital radar maps of the terrain.

For the first time, a new class of informative features has been proposed, based on the fine structure of reflected radar signals of the millimeter range of radio waves, and allowing to improve the identification of land covers.

For the first time, complete ensembles of textural and spatial correlation-spectral features of optical and radar images of real earth covers were studied, followed by the allocation of clusters and the determination of the most informative features for certain classes of textures. It is proved that the region of existence of the textural signs of radio-location images in the millimeter waves range is completely determined by the corresponding areas of the optical image features. The experiments carried out demonstrated the effectiveness and generality of the proposed approach in the problems of the classification of earth covers when integrating images on optical and millimeter waves. The integration of images increases the efficiency of detection, recognition and classification based on an extended vector of informative and stable features. The result of image processing are detailed digital radar location maps. Such maps allow us to provide radar information in a form convenient for further use in aircraft radio navigation and recognition of various types of ground objects. Note that these studies had no analogues, both in the USSR and in Russia, and have not lost their relevance at the present time.

For the first time, a number of texture methods were developed for detecting various objects and their contours on real optical and radar images of the earth's surface for small signal-to-background ratios. The relationship between the size of the object and the analyzed fragment of optical and radar images of a wide class of

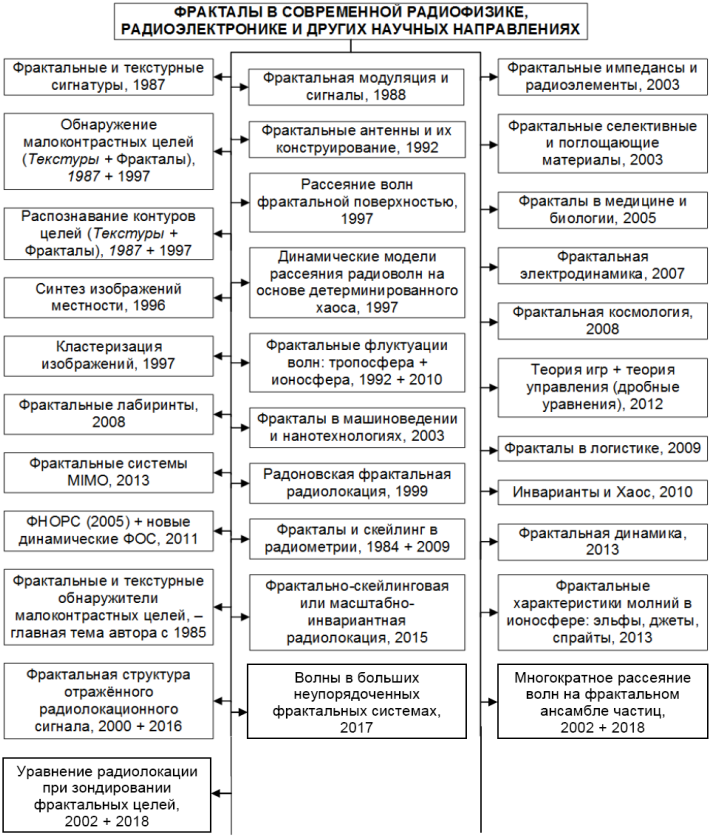

Fig. 1. *Sketch of development by the author of breakthrough technologies based on fractals, fractional operators and scaling effects for nonlinear physics and radio-electronics.*

earth covers in the case of optimal detection has been established.

The possibility of stochastic autoregressive synthesis of optical and radar images of earth covers with the operation of converting brightness histograms is theoretically substantiated and experimentally confirmed. The optimal dimensions of the luminance space and the order of the autoregressive series involved in the

prediction for adequate image synthesis have been determined. With an increase in the order of correlation, the domain for determining the textural characteristics of the synthesized images is narrowed. When comparing areas of the original optical or radar image with a synthesized standard, it is shown that the resulting two-dimensional binary field of cross-correlation coefficients directly fixes the object's location in the original image. This allows you to create a map of the movement and dynamics of the detected object. It was established using various combination algorithms (classical correlation, the method of pair functions, the method of absolute difference), that the physical accuracy of stochastic autoregressive synthesis reaches 90%.

A systemic approach to the formation of the information-axiomatic model of radar maps of heterogeneous terrain was developed and implemented on the basis of the above radiophysical studies. A generalized radiophysical model for the formation of radar maps of heterogeneous terrain was created, which included both the methods of stochastic autoregression image synthesis and information about the field of specific SRCS of the earth covers. The characteristic number of gradations of the specific SRCS of the earth's surface was established. Based on the analysis of the architecture of the standard receiving system, an algorithm for synthesizing contour and halftone radar maps of heterogeneous terrain is implemented in the radio range. It is shown that the destruction of the correlation maximum occurs for a contour radar map of the terrain at a wavelength of 8.6 mm at an angle of mutual rotation of 50 ... 70, and for a halftone radio-location map - at an angle of 140 ... 170. Then, in a generalized radiophysical model of radar formation Fractal parameters were introduced for the first time in maps of heterogeneous terrain, which increased the information content of the synthesis.

The presence of a strange attractor that controls radar scattering from vegetation covers is predicted. Subsequently, the effect was detected experimentally at a wavelength of 2.2 mm (2002). The obtained results confirmed the theoretical ideas about the existence of chaos in a dynamic system that describes the nature of the scattering of electromagnetic waves by plant covers. The reconstruction of the attractor made it possible to determine its fractal dimension D, the maximum Lyapunov exponent, the dimension of the investment, the interval (time) of prediction. Experimental characteristics of a strange attractor formed the basis of a fundamentally new non-Gaussian model of radar scattering of millimeter waves by vegetation based on the theory of dynamic systems and stable distributions. It is shown that the interval (time) of predicting the intensity of the reflected radar signal is approximately an order of magnitude longer than the classical correlation time. This made it possible to introduce into the theory of radar a new essential characteristic, namely, the interval (time) of prediction, which extends the methods and circuitry of radar.

A reliable physical substantiation of the practical application of fractal methods in modern areas of radio physics, radio electronics, and information control systems is given.

In the mid 80s. XX century. A working model of a coherent compact digital solid-state radar (DSSR) on parametrons with a probing wavelength of 8.6 mm with a complex base signal > 106 and processing the input podshumovy signal at the carrier frequency was created together with Almaz Central Design Bureau. With optimal processing, the energy potential of the DSSR increased by 50 dB. Then, a DSSR was created on two probing frequencies in the millimeter waves and microwave ranges with a fractal slot antenna (the first in the USSR); For the synthesis of images, the Radon Transformation was used. In 1997, the methods of fractal modulation and fractal signals were developed for the first time, including the signals H, first introduced by the author.

For the first time, the efficiency and prospects of applying the theory of fractional measure and scaling ratios (for textures and fractals) in the case of detection and recognition (generalized filtering) of one-dimensional and multidimensional radar signals from low-contrast targets against intensive non-Gaussian interference of various kinds were discovered and proved. Thus, this is a *fundamentally new* radio engineering.

It is proved that when collecting, converting and storing information in modern complex monitoring systems of remote and mobile objects under conditions of intense interference, the latest methods for processing information flows and multidimensional signals proposed by the author are of great importance. Typically, the features of such complex systems appear on different spatial - temporal scales. The most adequate estimates of the state of the system under study and the dynamics of changes in the state of its subsystems are realized using the theory of fractals and processing multidimensional signals in fractional space with the necessary consideration of scaling effects, which was first proposed and developed by the author in IRE V. A. Kotelnikova RAS.

A new method, named by the authors as “locally dispersive”, was proposed and substantiated for measuring the fractal dimension and the corresponding fractal signatures of signals, images, and wave fields. This method, as well as its effectiveness, has been confirmed in practice by numerous examples of appropriate digital processing of optical and radar images of natural and synthesized images, including those with low-contrast objects. Textural and fractal digital methods make it possible to partially overcome a priori uncertainty in radar tasks using *the geometry or topology of the sample* — one-dimensional or multidimensional. At the same time, topological features of the sample become important, rather than averaged implementations, which are often of a different nature.

For the first time, methods of fractal classification, clustering and recognition

of many types of natural and artificial objects were studied on large arrays of experimental data in the form of optical and radar images of real earth covers with surface and subsurface objects. The number of areas around which fractal dimension values are grouped depends on the parameters of the algorithm and the measurement method. For example, when the measurement window is small, we have a large number of groups; increasing the size, we obtain a fixed number of groups or clusters; and, finally, with a very large window size, 2 - 3 groups remain (fractal objects - non-fractal objects - objects of elimination).

Studying the type or topology of a sample of a one-dimensional (multidimensional) signal for tasks, such as artificial intelligence, for the first time made it possible to create dictionaries of fractal attributes based on fractal primitives that are elements of a fractal language with fractal grammar. The obtained data were incorporated into the synthesis of reference and current radar maps of heterogeneous terrain, as well as into non-energy radar detectors.

The results (UAVs - unmanned aerial vehicles, SAR - synthetic-aperture radar , medicine, etc.) show that fractal processing methods increase the quality and detail of objects and targets in a passive and active mode in about time. These methods can be successfully applied to information processing from space, aviation complexes, low-profile high-altitude pseudosatellites (HAPS) or detection of HAPS clusters and UAVs, synthesized clusters of space antennas and space debris.

The fractal characteristics of elves, jets and sprites, the most interesting types of recently discovered high-altitude discharges in the ionosphere, are investigated.

The algorithms for isolating a moving distant object of an unknown form (fractal or non-fractal) in a low-contrast image formed in optical-electronic systems have been synthesized with co-authors. Experimental results on images obtained in natural conditions, confirm the effectiveness of the proposed processing methods.

The possibility of synthesizing new fractal functions and fractal functionals based on the theory of fuzzy sets is shown for the first time. The construction of new classes of fractal and multifractal subsets on fuzzy sets has been formalized. You can use any classical non-differentiable functions as test functions.

It was shown for the first time that the physical content of the theory of diffraction containing multi-scale surfaces becomes more precise with the fractal approach and the allocation of the fractal dimension D or the fractal signature as a parameter. Accounting for fractality significantly brings together the theoretical and experimental characteristics of the indicatrices for the scattering of earthly beds, which is important for radar and remote sensing tasks.

For the first time in the world, an extensive catalog of characteristic types of more than 70 fractal surfaces based on Weierstrass functions, as well as more than 70 three-dimensional indica-tris scattering and their cross sections calculated for

wavelengths of mm, mm and cm for different values of the fractal dimension D and changing geometry was investigated and scattering.

Analogs of Maxwell's equations with fractional Caputo derivatives are obtained. Calibration invariance is considered and the diffusion-wave equation for scalar and vector potentials is derived. The particular solution of the diffusion-wave equation is found and analyzed.

A rigorous electrodynamic calculation of numerous types of fractal antennas, the design principles of which underlie the fractal frequency-selective surfaces and volumes (fractal sandwiches), has been carried out. A family of broadband miniature fractal antennas was synthesized on the basis of the topology of fractal labyrinths. The author proposed to synthesize large stochastic robust antenna arrays using the properties of fractal labyrinths. Combining several fractal labyrinth clusters with different fractal dimensions allows you to create adaptive broadband fractal antennas. For the first time, a model of a "fractal" capacitor as a fractal impedance was proposed and implemented.

Fractal-scaling methods were created, substantiated and applied for the tasks of radiolocation and the formation of the fundamentals of the fractal element base, fractal sensors and fractal radio systems. A physical approach to modeling fractal impedances has been developed. The perspective elements of fractal radio electronics are functional elements, the fractal impedances of which are realized on the basis of the fractal geometry of conductors on the surface (fractal nanostructures) and in space (fractal antennas), the fractal geometry of the surface microrelief of materials.

A new type and a new method of modern radar has been discovered, proposed and substantiated, namely, *fractal-scaling or scale-invariant radar*. The efficiency of functionals, which is determined by the topology, fractional dimension and texture of the received multidimensional signal, is proved for the synthesis of fundamentally new non-energy detectors of low contrast objects against the background of noise. An increase in the sensitivity of the radio system (which is equivalent to an increase in the range of action) when using fractal and texture features in topological detectors was confirmed. This entails fundamental changes in the very structure of theoretical radar, as well as in its mathematical apparatus. Fractal radar can adequately describe and explain a much wider class of radar phenomena. The basis of the scientific direction created for the first time in Russia and in the world is the concept of fractal radio systems and fractal radio elements, the topology of the sample and the global fractal-scaling method proposed and created by the author in the IRE V. A. Kotelnikova RAS. Conducted research in the field of theoretical radar allows you to effectively solve the problem of detecting signals in conditions of intense interference and create new fractal multi-frequency MIMO systems.

The postulates of fractal radar have been developed: **1** - intelligent signal / image processing based on the fractional measure theory and scaling effects for calculating the field of fractal dimensions; **2** - the sample of the received signal in noise belongs to the class of stable non-Gaussian probability distributions of the D signal; **3** - the topology maximum with the minimum energy of the input random signal (ie, the maximum “escape” from the energy of the received signal). These postulates open up new possibilities for ensuring stable operation with a small signal / (noise + interference) relationship or an increase in the radar range.

The results of experimental and theoretical studies obtained by the author were introduced by leading industrial research institutes and design offices of the USSR and Russia and were used in designing radio systems for various purposes, in interpreting data from remote radiophysical studies of the environment and in other applied tasks in which optical and radar information materials serve images of the earth's surface. Based on many years of research, new theoretical directions were formulated and developed in the theory of statistical solutions, statistical radio engineering and statistical radiophysics, for example, Statistical Theory of Fractal Radar, Statistical Fractal Radio Technology, Theoretical Foundations of Fractal Radar etc. The listed results formed the basis of the fractal paradigm and ideas of fractal natural science. In the direction of "Fractal Cosmology": On the basis of the Schrödinger equation with the fractional calculus operator with respect to spatial coordinates, the Feynman integral over trajectories was calculated.

Conclusion. The studies performed are priority in the world and serve as a basis for the further development and substantiation of the practical application of fractal-scaling and textural methods in modern radiophysics, radiolocation and nanotechnology, as well as in improving fundamentally new and more accurate fractal-textural (topological) mecha - methods for detecting and measuring parameters of signals in a space-time radar channel of wave propagation with scattering. Thus, this is *a fundamentally new* radio technology.

Fractal geometry is a huge and brilliant merit of B. Mandelbrot (1924 - 2010). But its radiophysical / radiotechnical and practical implementation is the merit of the Russian school of fractal methods known in the world under the guidance of Professor A.A. Potapov (*especially after a personal meeting with B. Mandelbrot in the USA in 2005 - Fig. 2).*

Fig. 2. *Meeting with B. Mandelbrot at his home in New York on 16.12.2005*

According to the monographs of Professor A.A. Potapov delivered lecture courses on fractals in radio-physics and radio electronics at various universities in Russia and neighboring countries, as well as in China. At the beginning of 2019, our author's priority in the above-mentioned scientific fields is secured by more than 1,000 scientific works and 37 domestic and foreign monographs and individual chapters in them [12].

The work was partially supported by the project of the International Science and Technology Center No. 0847.2 (2000–2005, USA), the Russian Foundation for Basic Research (projects No. 05-07-90349, 07-07-07005, 07-07-12054, 07-08-00637, 11-07-00203, 18-08-01356-a), as well as the "Leading Talents" project, No. 00201502 (2016–2020) at JiNan University (Guangzhou, China). In China, the author is the President of the international laboratory on fractals.

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SD板弹塑性弯曲的数值模拟

NUMERICAL MODELING OF THE ELASTIC-PLASTIC BENDING OF SD-PLATES

Pavilaynen Galina Voldemarovna
Candidate of Physical and Mathematical Sciences
Associate Professor of the Department of Theoretical and Applied Mechanics
St. Petersburg State University
St. Petersburg, Russia
Kropacheva Nataliya Yuryevna
Candidate of Physical and Mathematical Sciences
Associate Professor at the Department of General Mathematics and Computer Sciences
St. Petersburg State University
St. Petersburg, Russia

抽象。考虑圆形板的弹塑性弯曲。金属合金在拉伸和压缩下具有不同的强度性质。这种材料被称为塑性各向异性或具有SD效应的材料。对其性能的研究是新建筑结构设计和施工中的一项重要任务。我们使用SD材料的特性，经典的Hill塑性理论和各种数学模型，其中我们考虑了横向各向同性参数和塑性各向异性参数（SD参数）。我们提出了应力的渐近公式，我们将其用于数值模拟和圆形SD板弹塑性特性的图形表示。在计算五阶微分方程组后，我们得到了板弯曲的数值解。我们使用Euler差分方法或软件包COMSOL 5.4。我们以图形和图形的形式呈现数值解的结果。

关键词：SD效应;双轴应力状态;屈服准则;板;各向异性;分布式负载;弹塑性弯曲

Abstract. *The elastic-plastic bend of circular plates are considered. The metal alloys have different strength properties under tension and compression. Such materials are called plastically anisotropic or materials with SD-effect. Investigation of their properties is an important task in the design and construction of new building structures. We use the properties of SD-materials, the classical Hill's theory of plasticity and various mathematical models in which the transversal isotropy parameter and the plastic anisotropy parameter (SD-parameter) we take into account. We present asymptotic formulas for stresses that we use for numeri-*

cal modeling and graphical representation of elastoplastic properties of circular SD-plates. We obtain the numerical solution of the plate bend after calculating the system of fifth-order differential equations. We use Euler difference method or software package COMSOL 5.4. The results of the numerical solution we present in the form of figures and graphs.

***Keywords**: SD-effect; state of biaxial stress; yield criterion; plates; anisotropy; distributed load; elastic-plastic bending*

Introduction

The classical theory of elastic and elastoplastic bending was developed in the scientific works of R. von Mises, R. Hill, L. H. Donnell. For thin isotropic plates S.P. Timoshenko was consider elasticity theory. Further development, with allowance for plasticity, belongs to V.V. Sokolovsky [1]. The material of the plate has different strength properties under tension and compression. It is called "plastically anisotropic" [2] or materials with SD-effect. Impact of the SD effect is significant for anisotropic metal alloys [3], modern structural materials and carbon plastics [4] at the biaxial stress state.

Numerous experimental studies [5, 6] show that the difference in yield stress in transversely isotropic materials reaches 40%, and the difference in yield stress in stretching and compression in SD materials reaches 25-30%.

The use of metal alloys with SD-effect in structures such as plates and shells operating under biaxial stress conditions, gives a significant increase in strength and load-bearing capacity [7]. An important problem is the estimation of the stressed state of a circular transversely isotropic plate made of a material with an SD effect [8]. In the present paper, a freely supported plate is investigated under the action of a constant distributed pressure.

To study the elastoplastic bending, various criteria of fluidity were used [9, 10]. They introduced the parameters of transverse isotropy and plastic anisotropy. The influence of these parameters on the development of plastic regions and on deflection was considered in [11].

Mathematical model

Let us consider the problem of elastic-plastic bending of a round freely supported SD-plate possessing the properties of transverse anisotropy and uniformly loaded with pressure p on the upper surface.

Figure 1 shows the central cross section of a curved circular plate and the following notation is introduced: h is the half thickness of the plate, x_1 , x_2 is the radius of the plastic regions from below and from above respectively, a_1 ,a_2 are the

depths of the plastic zones from below and from above, respectively. The plastic regions are shaded. The neutral surface, in the case under consideration, does not coincide with the geometrically average surface. A solid line — the neutral surface, a dashed line — the geometrically the middle surface.

The beginning of the coordinate system is in the center of the plate on the neutral surface (point *O* in Figure 1.). The development of plastic zones is disturbed.

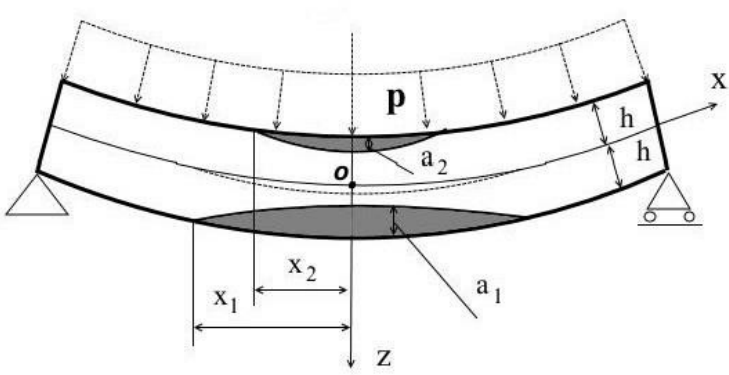

Figure 1. *Elastic-plastic bending of a circular plate from SD material.*

At first, we consider the simple case of elastic-plastic bending of the transversal isotropic plate without SD-effect and the corresponding yield criterion [8]

$$\sigma_p = \sqrt{\sigma_r^2 - A\sigma_r\sigma_\theta + \sigma_\theta^2}. \quad (1)$$

where σ_r, σ_θ are the stresses in the plane of the plate. In this criterion uses the transversal isotropy parameter A, which varies from 1 to 2 and calculates by the formula

$$A = 2 - \frac{\sigma_p^2}{\sigma_{pz}^2} \quad (2)$$

where σ_p is the yield point for uniaxial tension in the plane of the plate and σ_{pz} is the yield point for uniaxial tension in a direction perpendicular to the plane of the plate.

The relationships between the stresses and the curvature parameters for a transversal- isotropic material without an SD effect were obtained in [8].

In the articles [9], [10], the mathematical model for the SD-plate was made more complicated and a new criterion of fluidity was proposed:

$$\bar{k} = \sqrt{\sigma_r^2 - A\sigma_r\sigma_\theta + \sigma_\theta^2} + \sigma\beta \quad (3)$$

in which a parameter β introduces. The β characterizes the plastic anisotropy property (SD effect).

For uniaxial stretching (the formula on the left) and uniaxial compression (the formula on the right), criterion (3) is equal to:

$$\bar{k} = \sigma_p + \frac{1}{3}\sigma_p\beta, \quad \bar{k} = \sigma_c + \frac{1}{3}\sigma_c\beta. \quad (4)$$

Here σ_p is the yield point for uniaxial tension in the plane of the plate and σ_c is the yield point by uniaxial compression in the plane of the plate. Then the relationship between β, σ_p and σ_c is:

$$\frac{\sigma_c}{\sigma_p} = \frac{3+\beta}{3-\beta} \quad (5)$$

We substitute β from (5) into (3). Then:

$$\bar{k} = \frac{2\sigma_p\sigma_c}{\sigma_p+\sigma_c} \quad (6)$$

In the case of a biaxial stress state, the criterions for stretching and compression can be written accordingly:

$$\bar{k} = \sigma_{pz}\sqrt{2-A} + \frac{2}{3}\sigma_{pz}\beta, \quad \bar{k} = \sigma_{cz}\sqrt{2-A} - \frac{2}{3}\sigma_{cz}\beta \quad (7)$$

or

$$\sigma_{pz}\sqrt{2-A} + \frac{2}{3}\sigma_{pz}\beta = \sigma_{cz}\sqrt{2-A} - \frac{2}{3}\sigma_{cz}\beta \quad (8)$$

then

$$\beta = \frac{3\sqrt{2-A}}{2}\frac{(\sigma_{cz}-\sigma_{pz})}{(\sigma_{cz}+\sigma_{pz})}. \quad (9)$$

Substituting the resulting expression for β in (9), we obtain the formula for A:

$$A = 2 - \frac{(\sigma_{pz}+\sigma_{cz})^2}{(\sigma_p+\sigma_c)^2}\frac{\sigma_p^2\sigma_c^2}{\sigma_{pz}^2\sigma_{cz}^2}. \quad (10)$$

The bending of the plate is considered according to the model of a plane stress state. The deformation of the transverse shear is ignored. The stress in the direction perpendicular to the plane of the plate is assumed to be zero, then the average stress is equal to:

$$\sigma = \frac{\sigma_r+\sigma_\theta}{3}. \quad (11)$$

Proceeding from formulas (8), (9) and (10) it is possible to establish a connection between yield strengths

$$\frac{\sigma_c}{2\sigma_{cz}} = \left(\frac{\sigma_c}{\sigma_p} - 1\right)\left(\frac{\sigma_{cz}}{\sigma_{pz}} - 1\right)^{-1}. \quad (12)$$

If the σ_p, σ_c, σ_{pz}, σ_{cz}, are known, then the values of β and A can be calculated. To most metal alloys, $\sigma_p \approx \sigma_c$ [6], therefore it follows from formula (9) that $\beta \approx 0$, from formula (10) $A \approx 2$.

In the article [10] shows a more complex the relationship between the stress and the curvature parameters ξ_r, ξ_θ for a transversely isotropic SD-material:

$$\sigma_r = \frac{\bar{k}}{\sqrt{3(2-A)}}\left(\frac{(2\xi_r + A\xi_\theta)}{sign(z)\xi} - \frac{2\beta}{\sqrt{3}}\right)\left(1 - \frac{\beta(\xi_r+\xi_\theta)(2+A)}{sign(z)\sqrt[3]{3(2-A)}\xi}\right), \quad (13)$$

$$\sigma_\theta = \frac{\bar{k}}{\sqrt{3(2-A)}}\left(\frac{(2\xi_\theta + A\xi_r)}{sign(z)\xi} - \frac{2\beta}{\sqrt{3}}\right)\left(1 - \frac{\beta(\xi_\theta+\xi_r)(2+A)}{sign(z)\sqrt[3]{3(2-A)}\xi}\right), \quad (14)$$

where

$$\xi = \frac{sign(z)\beta(2+A)(\xi_r+\xi_\theta)}{\sqrt[3]{3(2-A)}} + \sqrt{\frac{(2+A)(\xi_r^2 + A\xi_r\xi_\theta + \xi_\theta^2)}{3(2-A)}}, \quad (15)$$

The most critical from the point of view of the evaluation of the stressed state of the plate is its center, therefore we will consider the stresses in the plastic regions near the centers of the upper and lower surfaces of the plate.

Suppose that $\beta \ll 1$ 1. In this case, can propose simplified formulas with an allowable error. In the center of the plate $\xi r = \xi_\theta$, therefore $\sigma_\theta = \sigma_r$ and formulas (13), (14) take the form:

$$\sigma_\theta = \sigma_r = \frac{\bar{k}}{a}\left(\frac{1}{sign(z)F} - \frac{2\beta}{3a}\left(1 + \frac{1}{F^2}\right) + \frac{4\beta^2}{sign(z)9a^2F}\right), \quad (16)$$

where

$$a = \sqrt{2 - A}, \qquad F = 1 - \frac{sign(z)2\beta}{3a}. \quad (17).$$

We introduce the new notations F_- and F_+.

$$F_- = 1 + \frac{2\beta}{3a}, \quad F_+ = 1 - \frac{2\beta}{3a}. \quad (18)$$

Consider first an isotropic material with an SD effect. Then, in formula (17) $A = 1$, $a = 1$, exact formula for the stress at the center of the lower surface of the plate (stretching zone) is

$$\frac{\sigma_+}{\sigma_p} = \frac{3+\beta}{3}\left(1 - \frac{2\beta}{3} - \frac{2\beta}{3}\left(1 - \frac{1}{3+2\beta}\right)^2\right), \quad (19)$$

and for the stress at the center of the upper surface of the plate (compression zone)

$$\frac{\sigma_-}{\sigma_p} = -\frac{3+\beta}{3}\left(1 + \frac{2\beta}{3} - \frac{2\beta}{3}\left(1 - \frac{1}{3+2\beta}\right)^2\right) \quad (20)$$

Expanding (19) and (20) in a Maclaurin series with respect to the small parameter β and neglecting terms of the order of β^3 and above, we write out approximate formulas for the stresses in the stretching and compression zones:

$$\frac{\sigma_+}{\sigma_p} = \frac{3+\beta}{3}\left(1-\frac{2\beta}{3}\right), \quad \frac{\sigma_-}{\sigma_p} = -\frac{3+\beta}{3}\left(1+\frac{2\beta}{3}\right). \tag{21}$$

Numerical modeling

We denote the exact values of the stress ratio σ_+, σ_- to the yield point σ_p as:

$$= \frac{\sigma_+}{\sigma_p} \qquad = \frac{\sigma_-}{\sigma_p} \tag{22}$$

and approximate values as:

$$\approx \frac{\sigma_+}{\sigma_p} \qquad \approx \frac{\sigma_-}{\sigma_p} \tag{23}$$

Table 1. *Comparison of the exact and approximate values* $\frac{\sigma_+}{\sigma_p}, \frac{\sigma_-}{\sigma_p}$.

β	$= \sigma_-/\sigma_p$	$\approx \sigma_-/\sigma_p$	$= \sigma_+/\sigma_p$	$\approx \sigma_+/\sigma_p$
0	1	1	1	1
0.01	1.0096	1.0100	0.9969	0.9966
0.05	1.0506	1.0506	0.9826	0.9828
0.1	1.1025	1.1022	0.9638	0.9644

Comparison of the exact formulas with the approximate ones (Table 1) shows that for the parameter β varying in the range from 0 to 0.1, the allowable error in the stretching zone does not exceed 0.3 percent, and in the compression zone 0.2 percent.

We now turn to an analysis of the mutual influence of the transversal isotropy and the SD effect. In this case, $A > 1$, $\neq 1$ and the calculated formulas take the form:

$$\frac{\sigma_+}{\sigma_p} = \frac{\beta+3}{3\sqrt{(2-A)}}\left(1-\frac{2\beta}{3\sqrt{(2-A)}}\right), \tag{24}$$

$$\frac{\sigma_-}{\sigma_p} = -\frac{\beta+3}{3\sqrt{(2-A)}}\left(1+\frac{2\beta}{3\sqrt{(2-A)}}\right). \tag{25}$$

Thus, it becomes possible to estimate the influence of the parameters A and β on the stresses in the plate, not solving the large problem of elastoplastic equilibrium of the plate [11].

The results of calculations using formulas (24) and (25) are given in Table 2.

Table 2. *Dependence of stresses in the plate on the parameters β and A.*

	$A = 1.1$	$A = 1.1$	$A = 1.2$	$A = 1.2$	$A = 1.3$	$A = 1.3$
β	$\approx \sigma_- / \sigma_p$	$\approx \sigma_+ / \sigma_p$	$\approx \sigma_- / \sigma_p$	$\approx \sigma_+ / \sigma_p$	$\approx \sigma_- / \sigma_p$	$\approx \sigma_+ / \sigma_p$
0	1.054	1.054	1.119	1.119	1.195	1.195
0.01	1.065	1.050	1.131	1.114	1.205	1.185
0.05	1.110	1.033	1.178	1.094	1.245	1.150
0.1	1.165	1.0128	1.242	1.067	1.333	1.136

As the parameter of transversal isotropy increases, the stresses increase. An increase in the parameter A by 10% causes an increase in stresses at $\beta = 0$ by 7%, and at $\beta = 0.1$ by 10%, therefore, the rate of stress growth with increasing β increases. With an increase in β by 5% and a fixed A, the compressive stress increases by 5.5%, and the tensile stress drops by 2.3%. Analysis of the results of numerical simulation shows that for weak plastic anisotropy, the influence of the transversal isotropy parameter is greater than the effect of the SD, but with a strong plastic anisotropy, the effect of the SD increases substantially. This conclusion becomes even more obvious if we plot the stress functions that depend on the parameters A and β.

Graphical representation

Let us turn to a graphic illustration of the calculations performed. The asymptotic formulas (24) and (25) allow one to analyze the influence of the parameters of the transversal isotropy A and the plastic anisotropy β on the stresses in the plate. Formulas (24), (25) do not depend on the level of pressure on the plate, nor on its dimensions. Therefore, they are universal.

The calculations made in the software package “MATHEMATICS 5.0”.

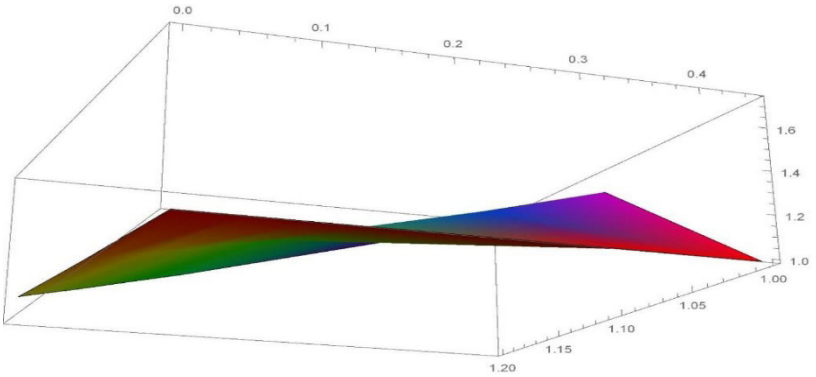

Figure 2. *Graph of the function of compressive stresses in the center of the upper surface of the plate* $\frac{\sigma_-}{\sigma_p}$ *(β, A).*

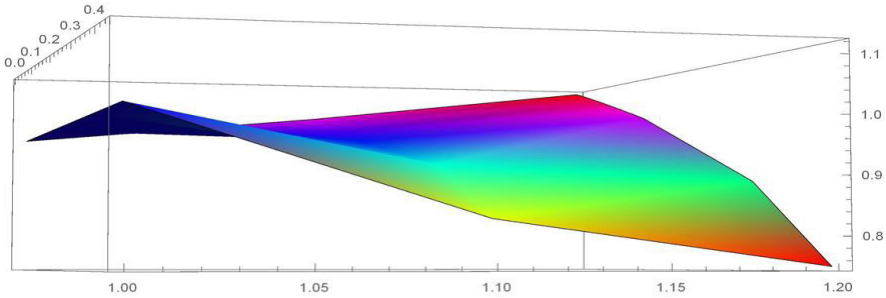

Figure 3. *The graph of the function* $\frac{\sigma_+}{\sigma_p}$ *(β, A) at the center of the lower surface of the plate*

The graphs of the functions $\frac{\sigma_-}{\sigma_p}(\boldsymbol{\beta}, \boldsymbol{A})$ and $\sigma\frac{\sigma_+}{\sigma_p}(\boldsymbol{\beta}, \boldsymbol{A})$ clearly show convex subsets in which we can determine the values of β, A for which the stresses $\frac{\sigma_+}{\sigma_p}$, $\frac{\sigma_-}{\sigma_p}$ — locally are minimal.

As a result of calculations, we know that plasticity area in the compression zone of the plate is substantially smaller than those in the tension zone. We assume that the yield strength during compression is greater than that under tension. To calculate the bending, the COMSOL 5.4 software package is used. Depending on the pressure, we calculate the sizes of plasticity zones. According to the results of the calculation, the magnitude of the plasticity "spot" and the depth of plasticity areas significantly depends on the condition of compression or tension (see fig.4,5).

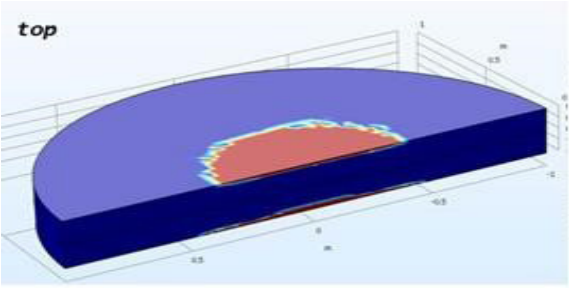

Figure 4. *The plasticity "spot" at the top of the plate*

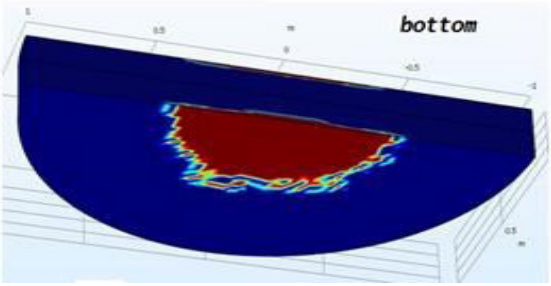

Figure 5. *The plasticity "spot" at the bottom*

Conclusions

Numerical modeling and graphical representation of the elastoplastic properties of circular transversely isotropic and plastic anisotropic plates showed that for surface stress functions a solution to the problem of optimizing the selection of the parameters of transversal isotropy and plastic anisotropy under the condition of minimum stresses is possible.

The application of the yield criterion, taking into account the transversal isotropy and the SD effect for the elastoplastic bending of a circular plate, made it possible to construct asymptotic formulas for their calculation. The formulas obtained are universal and estimate the influence of the parameters of transversal isotropy and SD effect on the stress-strain state of any material satisfying the described conditions. Asymptotic formulas allow us to make a rapid evaluation of the stress state of a plate without cumbersome calculations, which is important in engineering practice. As a result, we can conclude that the capabilities of the COMSOL software package allow us to investigate many problems of nonlinear deformation of SD-materials.

Acknowledgement

This study was supported by the Russian Foundation for Basic Research, grant No. 16-01-00523.

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上合组织国家的科学研究：协同和一体化

国际科学大会的材料

（2019年2月11-12日，中国北京）

编辑A.A.Siliverstova
校正A.I.尼古拉耶夫

2019年2月16日印刷版。格式60×84/ 16。
USL。沸点：98.7。 订单253.流通450份。

在编辑和出版中心印制
无限出版社


中央民族大学