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

Materials of the International Conference

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上合组织国家的科学研究：协同和一体化
国际会议

参与者的英文报告

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

Part 1: Participants’ reports in English

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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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CONTENTS

EARTH SCIENCES

TECHNICAL SCIENCE

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

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，
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可再生能源发展的现状与前景

CURRENT STATE AND PROSPECTS OF RENEWABLE ENERGY SOURCES DEVELOPMENT

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抽象。本文讨论了世界主要国家和俄罗斯可再生能源（RES）的发展状况和发展前景。已经确定，近年来可再生能源经历了快速的增长，一方面与环境问题和传统能源的缺乏有关，另一方面与国家对可再生能源的支持措施有关。在这方面，考虑了中国，美国，德国和其他国家在国家对可再生能源投资方面的支持措施方面的经验。结果表明，由于采取了这些措施，从可再生能源公司获得的电费非常接近传统来源的电价。考虑具有大量非传统能源资源的俄罗斯RES州。同时，与其他发达国家相比，俄罗斯的可再生能源份额仍然很小。然而，在未来，由于俄罗斯政府近年来采取的措施，人们观察到了该能源领域的积极变化。
关键词：可再生能源，状况，前景，太阳能和风能发电，世界，中国，美国，德国，俄罗斯，能源消耗，政府支持，电力生产结构，投资，成本，价格。

Abstract. *The article discusses the state and prospects for the development of renewable energy sources (RES) in the leading countries of the world and in Russia. It has been established that in recent years renewable energy has experienced rapid growth, which on the one hand is associated with environmental problems and the lack of traditional energy sources, and on the other, with measures of state support for RES. In this regard, the experience of China, the USA, Germany and other countries on measures of state support for investment in RES is considered. It is shown that thanks to the measures taken, the cost of electricity received from RES is very close to the price of electricity from traditional sources. The state of RES in Russia, which has enormous resources of non-traditional energy sources, is considered. At the same time, the share of RES in Russia in comparison with other advanced countries still remains small. However, in the future, thanks to measures taken by the Russian government in recent years, a positive shift in this energy sector has been observed.*

Keywords: *renewable energy sources, condition, prospects, solar and wind generation, world, China, USA, Germany, Russia, energy consumption, government support, structure of electricity production, investments, costs, price.*

Worldwide

Despite the fact that industrial production and other areas of social activity are becoming increasingly energy efficient, the growth of the planet's population and the development of the global economy leads to an increase in total energy consumption. So, if in 2015 world energy consumption amounted to 20.76 trillion kWh, then according to the International Energy Agency in 2030 it will amount to 33.4 trillion kWh, and by 2050 it will increase to 41.3 trillion kWh. Oddly enough, the increase in energy consumption is partly due to the transition of developed countries to the "digital economy". For example, if a few years ago cryptocurrency mining was the destiny of a small number of users, today this direction on a global scale consumes more energy than many countries. So, according to DigiEconomist, Bitcoin mining "consumes" 14.6 TWh of electricity per year, and Tajikistan's consumption during this time is only 13 TWh [1]. In this regard, the world needs more energy and at a lower cost, which will require qualitative changes in the structure of energy. The use of renewable energy sources (RES), decentralization of generation and the widespread adoption of smart grids will drastically reduce the cost of electricity.

Worldwide, significant attention has been paid to renewable energy over the past decade. Analysis of EES EAEC statistics showed that in the 90s of the 20th century, the main source of electricity was thermal power plants (TPPs), hydroelectric power plants (HPPs) and nuclear power plants (NPPs), while other sources accounted for less than 1%, then by 2016 the share of renewable energy sources (wind and solar) increased to 5.1%.

If we consider the structure of electricity production from renewable sources, then it can be seen that in 1999 the main generation volume was accounted for by geothermal (86.6%) and wind (10.3%) stations. Solar generation accounted for only 1.9%, while the energy of the tides was even less (1.2%). In 2016, the situation changed dramatically - wind generation accounted for 70.1%, solar - 23.8, geothermal - 6.1%, tidal energy - 0.1%. In the whole world, the increase in electricity due to RES for the period from 1999 to 2016 amounted to 1309.87 billion kWh [2].

Despite the crisis in the global economy, energy saving remains a priority and retains its relevance and propriety.

Energy shortages and limited non-renewable fuel resources indicate the inevitability of a transition to RES. The main factors contributing to the accelerated development of RES in the world are:

- ensuring energy security;
- saving of reserves of own energy resources for future generations;
- the desire to preserve the environment and ensure environmental safety.

In recent years, alternative energy has experienced rapid growth. A huge amount of money poured into the industry. The record growth in RES capacities in the world was recorded in 2017. The total capacity of green power plants increased by almost 9% (by 178 GW) compared with 2016 (data from the international association REN21, specializing in the study of alternative energy). The largest increase was achieved by solar power plants commissioned in 2017 (55%), the capacity of which exceeded new nuclear power facilities, as well as facilities using traditional energy sources, commissioned in the same year.

In the whole world, the capacity of alternative energy by the beginning of 2018 reached 2195 GW (26.5% of world electricity) [3].

66 countries have developed programs and plans for using RES. So, China intends to get 15% of final energy by 2020 due to RES, in the European Community - 20%. Sweden by 2020 plans to completely abandon hydrocarbon fuels. Germany has a leading position in the clean technology sector, focusing on solar energy. According to the Fraunhofer ISE Research Institute (Germany) [4], renewable energy sources in Germany generated 41.5% of electricity in the first half of 2018. On January 1, 2018, RES in Germany generated 95% of the electricity, setting a record. High indicators were achieved due to wind and solar energy, as well as low electricity demand during the holidays [4]. In general, wind and solar energy in Germany currently accounts for 28.4% of the electricity generated, and by 2020 they plan to receive 47% of all electricity from RES.

By 2016, 164 countries adopted a RES development policy, which indicates a further increase in their share in the global energy and electrical balance. The development of RES is facilitated by investments from both venture and traditional investors, counting on participation in this promising market.

The best way to promote renewable energy is to pass a law. Such laws and national programs have been adopted in approximately 70 countries around the world. In many countries, the “Alternative Energy Portfolio Standards” are in force, which require retail electricity providers to use a certain proportion of the electricity received from renewable sources.

Spain was one of the first countries to adopt a national energy plan aimed at creating favorable conditions for creating renewable energy sources and reducing greenhouse gas emissions.

The Japanese government also unveiled a strategy for the development of solar energy technology. Its goal is a tenfold increase in the use of solar energy by 2020. The Japanese have created an indicative “city of the Sun”: three-quarters of the houses in the Pal Town area in Ota are supplied with electricity using photovoltaic systems supplied to residents for free.

Despite the fact that in the past few years the cost of solar and, in particular, wind energy has decreased significantly, its generation can be competitive only on

condition of subsidizing or providing tax benefits. In most cases, the development of RES receives more reliable support in the form of special quotas. An increase in market prices for traditional fuels, equalizing them in value with RES, could also contribute to this development.

Charging for carbon emissions would also play a positive role: the introduction of a tax of $ 10 per ton of carbon dioxide emissions would increase by about 1 cent the cost of 1 kWh of electricity generated by coal-fired power plants. The scale of such transformations is enormous, moreover, the production of electricity by burning coal is approximately 70% higher in energy intensity than the use of wind energy for this purpose. Equally impressive are the indicators for oil and natural gas.

Although the share of RES in world energy production currently amounts to about 26.5% of global energy consumption, investments in it occupy about 30-40% of all investments in power generation. Thus, the total amount of state investments in alternative energy amounted to about $ 200 billion, of which $ 140 billion fell on the United States and China.

Alternative energy technologies have become significantly cheaper, becoming more competitive. The financial resources that the governments of various countries have allocated to the industry will be spent much more efficiently than was done a year ago.

By its price indicators, alternative energy has come close to the cost of electricity from traditional sources. So, the world average price per kW of electricity generated at a coal-fired power plant is $ 60-80. The same costs a kilowatt of the cheapest geothermal energy, as well as the energy generated by the burning of garbage and landfill gas. In fact, they can already directly compete with traditional energy, but the limited number of places where these projects can be implemented serves as a limiting factor for that.

Russia

Russia has the largest potential for energy in the world, the fourth potential in the world for hydropower, a huge amount of biomass reserves, geothermal sources, etc., which are renewable and could make up a large share in the country's energy balance in the future..

In Russia, RES are represented mainly by solar and wind power plants. Their total capacity in 2017 was about 560 MW (0.2% of all capacities), including the capacity of solar power plants of about 460 MW, and wind power of about 100 MW. The total installed capacity of generating plants and power plants using RES (including hydro plants with a capacity of less than 25 MW) does not exceed 2200 MW. These stations annually produce no more than 8.5 billion kWh of electricity, which is less than 1% of the total electricity production in the Russian Federation [5].

Among the promising technological areas that can change the future face of the Russian fuel and energy complex are hydrogen energy, small distributed generation using renewable energy sources, photoelectric converters, network drives.

The amendments to Federal Law № 35-FL "On Electricity", adopted in November 2007, for the first time laid the foundations of a state system for supporting energy development based on RES in Russia. In order to implement a long-term policy aimed at the development of renewable energy sources, reduce the risks of making investment decisions on projects for the construction of RES facilities, stimulate the use of RES in the wholesale and retail electricity markets, as well as address environmental and social problems, the Government of the Russian Federation approved in 2009 " The main directions of state policy in the field of improving the energy efficiency of the electricity industry through the use of RES until 2020 "(as a result of the Decree of the Government of the Russian Federation dated May 5, 2016, amendments were made to it, and it was extended until 2024). According to this program, by 2024 it is planned to increase the production of electric energy by RES generating facilities up to 2.5 percent. Such an indicator is planned to be achieved by introducing the installed capacity of generating facilities that operate on the basis of the use of solar energy, wind energy and water energy (excluding hydroelectric power plants with an installed capacity of over 25 MW). Under the current program, the main share in the renewable generation segment will be occupied by wind energy - its volume will amount to 7000 MV, which will require significant investments from the private sector and generating companies. To this end, Decree of the Government of the Russian Federation dated 04.10.2012 № 1839-r approved a set of measures to stimulate the production of electric energy by RES generating facilities in the retail markets of electric energy and capacity, in accordance with which the Ministry of Energy of Russia developed a set of regulatory legal acts. They are aimed at simplifying the qualification procedure for generating facilities operating on the basis of RES and certification of the volumes of electric energy produced at qualified generating facilities operating on the basis of RES.

In order to normatively regulate the mechanism for supporting the use of RES in retail markets, a procedure for long-term tariff regulation and price limit parameters for generating facilities operating on the basis of RES in retail markets, which provide support for generating facilities operating on the basis of wind, solar, water, biomass and biogas, as well as targets for the localization of equipment in the Russian Federation used in the construction of such generating facilities projects is determined.

In the wholesale and retail markets of electric energy and capacity, a mechanism is provided for cost compensation from the federal budget for the technological connection of RES generating facilities belonging to electric power industry

entities. Since 2013, the state began to develop this segment through the mechanism of capacity supply agreements (CSA), which was designed to create conditions for financing investments in the construction of new generating capacities. The essence of this program is that the investor agrees to put into operation RES objects with a certain amount of generation within the specified time. In return, he receives a guarantee of return on invested funds through the increased cost of the sold capacity for 10 years.

To support RES generating facilities in the energy markets, tasks have been set that are conditionally divided into federal and regional, differing mainly in support mechanisms.

At the federal level, a mechanism for selling the capacity of RES generating facilities under supply contracts to the wholesale market at a price and in the manner determined by the Government of the Russian Federation is provided as a support measure. The main goal of the support measure is to create economic incentives for the development in the country of production of the main and auxiliary generating equipment used in the production of electric energy using RES.

To implement the mechanism for selling the capacity of generating facilities based on RES to the wholesale market, the Government of the Russian Federation has set targets for the competitive selection of investment projects for the construction of generating facilities for the period up to 2024. These indicators apply to the volume of installed capacity commissioned for RES-based generating facilities, the localization of the production of primary and auxiliary generating equipment in the Russian Federation, the capex for capital construction costs of 1 kW of installed capacity for generating facilities. Based on these indicators, "ATS" OJSC, in accordance with the Wholesale Market Rules, as well as the Rules for the selection of investment projects for the construction of generating facilities operating on the basis of the use of RES, conducts annual competitive selection of investment projects for the construction of generating facilities on the basis of RES for years up to 2024.

So, according to the results of competitive selection of RES held in the period 2013-2016, 120 generating facilities of RES were selected with a total installed capacity of 2055.64 MW (1184 MW - by solar power plants, 801 MW - by wind power plants, 70.44 MW - by small hydro power plants) and attracted about 306.5 billion rubles of private investment.

At the regional level, as a measure of support for RES generating facilities, a mechanism for the sale of electric energy to network organizations is provided, which provides for the compensation of electric energy losses.

The regulatory legal acts on the support of RES generating facilities in retail markets allow regional authorities of the constituent entities of the Russian Federation to independently decide on the support of RES generating facilities, taking

into account their economic and environmental feasibility and the adequacy of resources to ensure them in each case, subject to acceptable rates of price growth on electric and thermal energy.

In Russia there are many innovative developments in the field of RES, which will make it possible in the near future to achieve world-class Russian renewable energy.

Calculations based on current Russian data show that for every ruble spent on stimulating the development of renewable energy, the company receives an economically estimated result from 1.45 to 2.12 rubles. (using existing mechanisms for estimating emission reductions based on the Kyoto Protocol, the cost of saved fuel, the amount of severance taxes and additional private investment in generation). In this regard, the development of renewable energy is considered as one of the most important areas of improving energy efficiency and energy security of the country.

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法律领域的未命名合同
UNNAMED CONTRACTS IN THE LEGAL FIELD

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In the modern age of globalization, when almost every day there are new types of relationships between individuals, the number of contracts increases, as well as their complexity. Increasingly, in practice, there are contracts that include signs of several contracts, as well as mixed and unnamed contracts.

The question arises: how do unnamed contracts arise and what contracts are considered unnamed?

According to the laws of countries such as Russia or Uzbekistan, the actions of citizens and legal entities aimed at establishing, changing or terminating civil rights and obligations are recognized as transactions. The agreement of two or more persons on the establishment, amendment or termination of civil rights and obligations is recognized as a contract. Based on the above, the main difference between a transaction and a contract is that a transaction, unlike a contract, can be one-sided.

Contracts can be divided into two types. Those that are already prescribed in the legislation of the country where the transaction is taking place, or whose countries the residents are persons participating in the contract, and those that are not regulated in any way in regulatory legal acts. For example, a contract of sale, lease or leasing can be attributed to the first type. As for the examples for the second type, one should proceed from the fact that the examples that can be used as an unnamed contract are a contract that takes place in life but has not yet been spelled out in legislation. For example, a donor agreement on donating blood to a blood bank. This agreement states that a person voluntarily gives part of his biological body to a blood bank. In countries such as Uzbekistan, where there is no law on transplantation, this type of contract is considered unnamed. Based on the foregoing, it can be concluded that an unnamed contract is a contract that defines the actions of persons in such relations that are not yet specified in the legislation.

For example, the draft law of the Republic of Uzbekistan **On transplantation of organs, tissues and (or) human cells clearly states** that the effect of this Law does not apply to organs, their parts and tissues related to the process of human reproduction, including reproductive tissues for blood and (or) its components and activities associated with their use, which gives reason to include the above type of contract to unnamed contracts.

Unnamed contracts are an important link in the transition of any relationship in the legal field. Based on the fact that only contracts specified in regulatory legal acts are "named", we can safely say that any contract was once in the status of "unnamed", because as we all know, in the beginning some kind of relationship appears in society, for which separate types of contracts.

The search for new contract designs not described in the legislation is associated with a continuous search for parties to agreements on simplified and mutually beneficial contract terms.

Since, the inclusion of various economic methods and conditions in a single contract not only provides certain conveniences, but also leads to lower costs.

The non-namedness of contracts as well as their lack of regulation in the legal sphere leads to the appearance of different court decisions on identical issues.

Due to the fact that there are no rules governing the essence of unnamed contracts, the issue of determining the named and unnamed nature of contracts becomes relevant. Although at the moment, unnamed contracts are an issue that is not very widely studied.

In particular, issues such as the definition of the boundaries of unnamed contracts, the procedure for separation of named and unnamed contracts from each other, are open.

So, according to the legislation of the country, ratified international legal acts have the highest power over domestic regulatory legal acts. Based on this, it turns out that the contracts specified in international legal acts, but not specified in internal documents can be considered unnamed. Of course, the fact that an international treaty has a higher legal force than the laws of the country makes it possible for entities that have entered into such reservations to go to court in case of non-compliance.

We will consider in more detail the issues of contracts in the domestic legislation of Uzbekistan.

So, for example, sometimes in a normative legal act the name of the contract is indicated, but its essence is not indicated

Clause 13, Article №6, of the Law of the Republic of Uzbekistan on "Electronic Digital Signature" states that "Relations between the registration center and legal entities and individuals are on a contractual basis" It is clear that these relations between the center and the customer are in the plane of the service con-

tract , but the question remains of transferring property rights to an electronic digital signature, which in essence is nothing but a set of numbers in electronic format. What agreement can regulate the transfer of a key, a sales contract? Or can it relate electronic digital signature to intellectual property? As can be seen from this example, with a fuzzy formulation by the legislator of the type and terms of the contract in practice, problems with its implementation may arise.

The issue of bitcoin mining is also one of the types of unnamed contracts. The businessman rents a building in which he is going to install computers for mining bitcoin. It is clear that the lease part of this agreement is governed by the lease. Given that mining of bitcoins mainly consists in the consumption of electricity in huge quantities, the lease agreement indicates that in case of failure to pay on time for electricity from the tenant, the lessor has the right to turn off the power supply. It turns out that an individual or legal entity that rents a room for mining becomes an energy sales organization. However, according to article 549 of the Civil Code of the Russian Federation, the parties to the energy supply agreement ***are*** the energy supplying organization and the subscriber (consumer) having energy receiving devices connected to the networks of the energy supplying organization. A landlord cannot be an energy supplying organization for a tenant, since he himself receives electricity as a subscriber to supply the disputed building. The landlord receives electricity in connection with the rental of premises. In this regard, the agreement, called the contract for the supply and consumption of electricity, is not a contract for electricity supply. This agreement establishes the procedure for determining the lessee's energy costs in the premises he rents and is part of the lease. The lessor's right to disconnect electricity for non-payment of rent contradicts the rules of the Civil Code on rent, therefore this contractual condition is invalid. For non-payment of rent more than two times in a row after the payment deadline established by the contract, the lessor, by virtue of Article 619 of the Civil Code, has the right to demand the termination of the lease.

The transition of an unnamed contract to the status of “official” may take several years. Much in this aspect depends on the number of transactions under such unnamed contracts. If there are few such transactions, such as surrogacy agreements (the number of surrogacy agreements in Uzbekistan is no more than a few dozen), then there is no urgent need to transfer this relationship to the status of named agreements. But when the question concerns numerous contracts, the transition of an unnamed contract to the status of a named one is carried out quickly. This is primarily due to the fact that it is easier for the state to monitor “official” agreements and tax even those agreements that are not specified in regulatory legal acts. For example, based on the laws of Uzbekistan, an agreement on transferring a football player from one club to another club is one of the types of unnamed contracts, since this contract is not only about hiring a football player

as an player, but about the fact that a football player is "sold" in one or another club and is obliged to play in the club specified in the transfer contract the number of years. Of course, everything happens with the consent of the footballer, but since the club receives monetary compensation for the footballer, it is difficult to attribute this type of contract to an employment contract. For example, when a manager or engineer leaves one company for another, no one from the first company where the manager or engineer used to work will ever require monetary compensation for such a transfer from the company where they left, which once again proves that the player's transfer contract cannot only be regulated by an employment contract.

Within the framework of the studied practice, it is proposed to adopt a football soccer player transfer agreement, thereby transferring a soccer player transfer agreement from unnamed to "official" status.

In conclusion, it should be noted that with the development of information technologies, the issue of unnamed contracts will only increase its relevance, due to the fact that the legislator for objective reasons is not able to specify all types of contracts in regulatory legal acts. In addition, as mentioned above, the action is first revived and only then passes as a regulator of such relations in the form of an article, norm or an approved model contract into normative legal acts.

Based on this, it is safe to say that studying the issue of correct and legally competently drawn up unnamed contracts is today one of the priority branches of civil law not only in Uzbekistan but throughout the world.

汉提-曼西斯克自治区-乌格拉的教育空间中一位年轻教师的专业培训
PROFESSIONAL FORMATION OF A YOUNG TEACHER IN THE EDUCATIONAL SPACE OF THE KHANTY-MANSIYSK AUTONOMOUS OKRUG - UGRA

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抽象。 本文讨论了成为汉-曼西斯克自治区-乌格拉（Ugra）的教育系统中年轻专家的方式，该过程的方法论支持，以及职业潜力的增长，年轻教师的领导才能。显示了自治Okrug方法论协会对专业能力发展和专业教师成长的可能性。

关键词：年轻专家，方法论支持，专业潜力，领导才能，专业能力。

Abstract. *The article discusses the ways of becoming young specialists in the education system of the Khanty-Mansiysk Autonomous Okrug - Ugra, methodological support of this process, associated with the growth of professional potential, leadership qualities of young teachers. The possibilities of the methodological associations of the Autonomous Okrug for the development of professional competencies and professional teacher growth are shown.*

Keywords: *young specialist, methodological support, professional potential, leadership skills, professional competencies.*

The formation of a teacher – is a rather complicated process both socially and psychologically, and professionally. During this period, the results of the impact on the personality of a whole complex of positive or negative factors, both internal and external, are most clearly reflected.

Proper management of the process of professional adaptation and professional development helps not only the professional growth of young professionals, but also contributes to the development of an educational organization. Properly constructed work with a young specialist from the first day of his stay in an educational organization is one of the factors for successful entry into a professional environment.

Currently, the "Ugra Pedagogue" project is being implemented in the Khanty-Mansiysk Autonomous Okrug - Ugra, within the framework of which a set of measures is being developed and is being implemented to organize and establish a multi-level system of methodological support and development of professional competence of teachers and heads of educational organizations. An important direction of the project is to support creative initiative and develop the professional potential of young teachers of Ugra. In the educational organizations of the Autonomous Okrug today there are more than 300 young teachers, whose work experience does not exceed five years.

In order to implement a systematic approach in working with young specialists in the educational space of the district, active work is being carried out related to the creation of conditions:

- for scientific, theoretical, psychological, pedagogical, methodological training of a young specialist and to foster a culture of choosing one's own pedagogical position;
- for studying and introducing into the practice of teaching advanced pedagogical experience and the main achievements of pedagogical science;
- for the creative work of a young specialist.

The goal of working with young professionals is to make them successful, to create a space for self-realization. Mastering a specialty in practice is a rather lengthy process, involving the development of the basic functional duties of a teacher and class teacher, familiarity with the regulatory framework of educational activities, the formation of professional competencies and the formation of professionally significant qualities.

At the same time, novice teachers are able to bring new perspectives on teaching, upbringing, development of students, initiate, develop and introduce innovations in teaching practice.

The main form of work with young teachers in Ugra is their active inclusion in various activities based on the use of active creative potential and the desire to show the qualities and abilities of the young leader.

Of great interest is the experience of working with young teachers in the framework of methodological associations of young teachers. The work of the methodological association is ongoing and is aimed at increasing the competence and professional skills of each young teacher, as well as developing creative potential, improving the quality of educational activities in preschool educational organizations.

Meetings of methodological associations are held on issues relevant to the development of professional competence of a young specialist. In this case, various formats are used with a predominance of active forms of inclusion of young teachers in professional discussions and processes related to the solution of professional pedagogical problems.

Here are some examples:

- workshops "How to ensure a system-activity approach in educational activities";
- master classes "Organization of active classes with parents" Family traditions ";
- workshop "Designing a lesson with the inclusion of group work of students";
- festival of pedagogical finds and innovative projects.

The work experience of the youth public association of pedagogical workers of educational organizations “Pedagog-NV” in the city of Nizhnevartovsk is interesting. The youth association was created more than ten years ago at the initiative of young specialists with the aim of developing spiritual and civic values of young teachers of the municipal educational organizations of the city of Nizhnevartovsk, ensuring their personal development, professional growth, social, creative and business activity. The highest collegial governing body of the association is the general meeting. The highest permanent governing body is the Association Council, which includes 14 young teachers. In 2018, more than 170 teachers from among young specialists of preschool educational organizations, general educational organizations, and supplementary education organizations of the city of Nizhnevartovsk under the age of 30 became participants in the youth public association.

The “Pedagog-NV” youth public association organizes its activities by sectors, each of which solves certain tasks:

- the socio-legal sector organizes work to increase the legal literacy of young teachers, to promote their social and professional adaptation;
- the organizational and methodological sector helps to increase the professional skill of young teachers through the organization and conduct of scientific and practical conferences, seminars, and professional skill competitions;
- the sports sector holds sporting events for young teachers and members of their families, as well as organizes their participation in urban sports events;
- the cultural and leisure sector carries out activities to establish and develop friendly relations both within the association and with the surrounding society, organizes and conducts cultural and entertainment events.

In 2018, within the framework of the youth association, 16 events were held, in which more than 70 young teachers took part. The youth association is actively searching for innovative forms of work, one of which is the project “Rally for Young Educators “PRO - School”. Within the framework of the Meeting, six key events are planned: a meeting with representatives of the government “without a tie”, computer diagnostics of the professional competencies of young teachers, a round table with representatives of the trade union organization of teachers, presentation of projects in the form of a heap furnace, open lessons, and educational events. The website of the youth association, the city educational portal, instant messengers, social networks, media, etc. are used as information tools.

The results of the project will be: identification of the main professional difficulties of young teachers, the consolidation of new ideas of young teachers, the search for young education leaders, the formation of a pool of mentors.

Thus, the experience of the educational system of the Khanty-Mansiysk Autonomous Okrug - Ugra shows that the active involvement of young teachers in various types of professional and creative activities is an effective incentive for professional pedagogical creativity, contributes to the creation of conditions for professional teacher growth, self-improvement and self-realization of young talented personnel.

成人和初学者的钢琴培训
PIANO TRAINING FOR ADULTS AND BEGINNERS

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抽象。 为成年初学者学习弹奏钢琴有助于培养他们的艺术品味和实现他们的创造潜力。 由于最短的时间以及运动技能的形成，对这类学生的训练非常困难。 为了吸引学生，老师必须具有艺术能力。 形成了个人的艺术品味，因此他们的训练与孩子不同。 选择曲目和相当定期的家庭作业非常重要。

关键字。成人初学者，班级，钢琴，动机，艺术品味，时限，教师艺术性，曲目，教学方法，能力发展。

Abstract. Learning to play the piano for adult beginners helps to develop their artistic taste and realize their creative potential. The training of such students is quite difficult, due to the minimum amount of time, as well as the formation of motor skills. In order to captivate students, the teacher must have artistic capability. An individual artistic taste is formed, so their training takes place differently than in children. The selection of a repertoire and fairly regular homework are very important.

Keywords. Adult beginner, classes, piano, motivation, artistic taste, time limit, teacher artistry, repertoire, teaching methods, development of abilities.

"Modern pedagogical science is called upon to organize a full-fledged system of musical education for adults, since their education performs no less important cultural and spiritual functions than the education of children. However, there is a contradiction between the need for such education and the insufficient methodological and organizational support for this area of musical pedagogy..." [3, p. 97].

Graduates of higher musical and musical-pedagogical educational institutions receive sufficient education to work not only with children and adolescents, but also with adults, including students of teacher training colleges, among which there are many who begin to learn music from scratch.

It must be said that the training of such students is very difficult, which is associated with the minimum amount of time devoted to mastering the instrument, as well as difficulties in the formation of motor skills. However, this is offset by a more conscious attitude to learning, an understanding of the vital need to master the tool for further work.

Joseph Hoffmann in the book “The Piano Game”. Answers to questions about the piano playing, "answering the question at what age should one start to study music, says that" the usual age to start playing music is between six and seven years, "but" if you have the abilities, quick wit, desire and ability to study, age should not be an obstacle ... It is not too late to start at twenty-five years, "despite certain difficulties caused by the late onset. [2, p.190-191]

In order to captivate both young and adults in learning to play the piano, as well as on any other musical instruments, the teacher must create an atmosphere of creativity in his lessons, so *artistry* is a critical component of his professionalism. The teacher-classic of music education in Russia, D. B. Kabalevsky, emphasized that the most important part of the methodology of teaching musical disciplines is the ability to arouse students' interest in the subject of study and to form their artistic taste. In our opinion, it is more difficult to form it in an adult because to some extent, their artistic predilections are already framed and the teacher needs to be very convincing in order to try to change the prevailing stereotypes.

It should be noted that most of the children who come on their own, or who are brought by their parents to the piano class, as a rule do not have any specific goals, they just want to "learn how to play," and one of the main tasks of the teacher is to interest the child with music in more depth. With adults, things are often the other way around, they are full of desire to learn, but many of them come to study with specific tasks: to learn how to play a specific work (especially often the “Moonlight” Sonata or “To Elise” by Beethoven) or pick up by ear Songs and accompaniment to it, etc. An individual approach to the student is always needed, but in the case of adult education, special attention should be paid to this.

A.N. Chertovskoy in his article "Innovative approaches to the method of teaching piano to adult beginners" divides the process of teaching such students into four stages.

The author advises at stage I "...the study of musical notation on a two-line musical instrument, familiarization with the fret features of music, registers..., the development of specially selected, minimal in complexity / adapted / popular melodies, at the same time - the simplest accompaniment, ensemble game with a teacher... In educational work, it is advisable to use intonations concentrated in song, folk music genres..." [4, p. 86].

At the II stage, other tasks are already being solved, the main of which is "comprehension of elementary ... means of musical and performing expression.

Of great importance is the selection of a repertoire, the components of which should be brightly-shaped light plays of various genres, song melodies with elementary accompaniment, ensemble music playing with a teacher of diverse works..." [4, p. 86-87].

At the III stage of study, "etudes, popular classical, pop, jazz miniatures with simple accompaniment, the most famous excerpts from popular operas and symphonies arranged for piano" are studied [4, p. 87].

Stage IV sums up the previous three stages and "is characterized by the achievement of a certain level of student readiness for various types of musical and instrumental activities", that is, "...to tune and sing a choir, perform solo works, accompany the choir, instrumental soloists ..., pick out popular tunes with a variety of accompaniment..." [4, p. 87-88].

There are a number of author's methods for teaching piano. One of these authors is L.G. Archazhnikova. The methodology is based on a number of provisions that can be quite successfully applied in working with adults: "activation of musical-auditory representations; development of the ability to operate with mental-auditory actions; training the skill of mental presentation of musical material in unity with motor representations; activation of auditory attention and self-control "[1, p.4].

It is also appropriate to mention the methodology of A.D. Alekseev, which can also be used at the initial stage of adult musical education. The author considers the most important part of working with the student to be self-control and auditory representations, which must be developed from the very beginning of training. A.D. Alekseev highlights the role of synthesis of auditory, logical and motor memory in learning a work, also mentions visual memory, which to one degree or another is possessed by performers.

I would also like to mention the textbook "Method for the formation of pianistic thinking", the author of which is professor S. S. Karas. The textbook is intended for beginners (children and adults) and is a system for mastering the basic elements of a musical language: rhythm - intonation - polyphony - harmony - musical form. The repertoire offered in this book can be supplemented by musical literature intended for adult beginners, as well as reading material from a sheet, otherwise the textbook can be successfully used by adults, including as a self-instruction manual.

Next, we consider *the characteristic features when teaching adult students.*

The main feature in teaching adult beginners is *work with a repertoire*. At this age, most people come to classes not with the goal of becoming a serious musician, but with the desire to learn how to play "for themselves", and many are not ready, and sometimes just do not want to play special exercises and etudes that could really help develop a particular piano playing technique, because due to the busy schedule of work, the family, the level of occupation is growing, and hence there is very little time left for independent students to study at home. Therefore, in this situation, it is necessary to especially carefully learn from the student his musical preferences, so that the student himself constantly reaches for the instrument, which would greatly encourage him in independent studies.

The second equally important aspect is *communication in the classroom*. A conversation with a student is a very important point, but most adults who come to class after a hard day's work are not ready to seriously immerse themselves in work on a musical play, and in this case the lesson begins to acquire not only an educational, but also a "therapeutic" character. For most students, playing the piano is not only another area for self-development, but also a way of some emotional discharge, which also needs to be considered when conducting the lesson.

It is necessary to take into account the fact that teachers always need to be convincing and explain to their "wards" why in the lessons we will deal with things, that at first glance, seems to be not so important for a student who comes to classes for a specific purpose. Adult students quite often do not want to spend time studying the so-called "additional" material, in their opinion, since the time for training is already limited or they will not need it, so it's very important to explain why exactly specific information or specific exercise is important.

From the foregoing, the following conclusions should be made, which must be taken into account when working with adults:

1. Adults are occupied with professional and domestic problems;

2.They are more demanding on the content of the lesson and presentation of the material;

3. Adult students are more motivated to study.

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英语学术论文的特色
CHARACTERISTIC FEATURES OF ACADEMIC ESSAY IN ENGLISH

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注解。 写作在不同的文化中有不同的组织。 英语学术写作具有其特征，涉及不同的策略（体裁，论文类型，如叙事，描述，定义，分类，例证，比较和对比，因果关系，论证），并具有结构性限制和严格要求。 要遵守的规则。 学术作品的目的基本上是由策略，发展的结构模式和风格所决定的，而语言的风格则取决于为读者选择的语言单位。 因此，学习英语写作意味着遵循特定的发展模式和构图结构。

关键字：学术写作，策略，结构模式，写作目的，段落。

Abstract. *Writing is organized differently in different cultures. Academic writing in English has its characteristic features, involves different strategies (genres, types of essay, such as narration, description, definition, classification, exemplification, comparison and contrast, cause-and-effect, argumentation), and has structural restrictions and strict rules to be followed. The purpose of a piece of academic writing is determined basically by the strategy, structural patterns of development and the style that is conditioned by the linguistic units chosen for it, with the audience in mind. Thus, learning to write in English means following a particular pattern of development and structure of composing.*

Keywords: *academic writing, strategy, structural pattern, purpose of writing, paragraph.*

No wonder, writing is a complex and time-consuming process. And no wonder, the writing process is a combination of creativity and critical thinking; it comprises the necessity and urge to be eloquent and persuasive at the same time. These two skills depend on and enhance each other. We turn to both creativity and critical thinking when writing for different purposes. Whether we produce fiction, non-fiction, expository writing or a business letter, we have to be completely conscious of what we are doing; the point is that we should creatively organize a piece of writing around a well-structured, well-verbalized and well-worked out idea.

There is no need to speak about writing as a means of communication and writing skills as one of the indispensable aspects of language learning. One of the most important skills students take with them into their future lives is the ability to write for any audience and purpose. If the purpose of literary writing is predominantly to entertain, the purpose of scientific texts is, in the main, to inform. The purpose of academic writing besides those two, is principally to explain and convince the audience that one's point of view is correct, or at least worth respecting.

For academic purposes, students are asked to write different kinds of essays. The goal is the information, ideas, attitudes, and feelings they are asked to convey, the effect they want to produce and thus, to persuade the reader of the correctness of what they are writing about. To achieve this or that purpose mentioned above, the writer has to choose a pattern of development (a strategy, a genre, a type of essay). Otherwise stated, students are asked to do various kinds of writing based on a number of patterns: narration, description, exemplification, definition, comparison/contrast, process, causal analysis, argumentation and persuasion. Each strategy has its distinctive formal features and content, and within one essay, several of them can be used: "Although texts vary within the same genre (no two autobiographies, for example, are the same), texts in a genre nonetheless follow a general pattern". [1, 5]

In other words, the strategy determines the type of the essay and the purpose, which is general, on the one hand, and specific, on the other. The general purpose is, to inform, to entertain and to persuade. As for the specific purpose, it should be mentioned that academic writing a priori means writing for specific – in this case – academic purposes. Apart from this, the strategy and the subject matter itself also determine the specificity of the purpose. To do this, very often students are asked to define a particular goal by narrowing down the topic of the essay. For example, the general aim of the topic 'Smoking is hazardous for health' is to inform and persuade the reader that this bad habit is dangerous. The aim is achieved by arguing for and against, i.e. by means of a particular strategy, in this case, by argumentation. Likewise, the writer can inform and persuade the reader not to smoke by telling a story about somebody who died of lung cancer caused by smoking. Besides, some other strategies can be used, such as exemplification to illustrate the arguments, as well as the strategy of cause-and-effect to show the bad effects of smoking on health. While the general purpose is to inform and persuade, a specific aim appears; to narrate, to argue or to prove. In other words, the specific aim is achieved by means of the strategy (genre, type of essay).

Thus, the general and specific purposes overlap. Academic essays are written in order *to inform* about a *particular* situation or aspect of life or activity, *to express* one's own personal thoughts, attitudes and feelings about something *in particular*, *to have an impact* on the readers and *to persuade* them of the correctness of one's thoughts, attitudes and feelings about something *specific*.

The purpose of writing is determined by the audience as well. It means that the academic essay should be written with a particular audience in mind. The audience can be one's classmate and instructor) or a particular group of people (e.g. a group of classmates), or a specialized audience, like a group of economists or medical doctors. In this case, the writer has to establish certain boundaries for the essay and supply it with certain details for one audience and with some other details for another. The audience can also be general or universal – whoever ever reads what has been written, as it may be addressed to nobody in particular or anybody in general, although written within the course of academic writing and for academic purposes first and foremost. It should be mentioned that the idea of general audience may seem and is quite controversial, but its discussion is outside the scope of this article.

The audience, along with the subject matter, determines also the tone and the language of a piece of writing. The tone is formal in academic writing and very often the choice of words, sentence structure, grammatical structures, and the length of the paragraph change depending on a particular audience.

Writing is organized differently in different cultures. Learning to write in English means following a particular pattern of development and structure of composing. Besides a certain pattern of development (strategy, genre, type of essay) mentioned above (narration, description, etc.), there are also structural restrictions or rather strict rules to be followed in academic writing in English.

The basic unit of organization in English academic writing is the paragraph that consists of three parts: a topic sentence, supporting sentences (details) and a concluding (summary) sentence. The paragraph often begins with the topic sentence that states the main idea of the paragraph and it limits the issue to one or two areas (aspects) that can be discussed within the space of a single paragraph. Supporting sentences develop the topic sentence. The concluding sentence summarizes the main idea of the paragraph. An academic essay, being a group of paragraphs on one subject, in many ways is like a paragraph, in extended, fuller form. Just as the paragraph has a topic sentence, body and conclusion, so too the essay has an introduction, body and conclusion.

Thus, on the expression plane, the division into paragraphs and its indispensable parts is mainly conditioned by the restrictions imposed on the writer. On the content plane, the division depends on the idea expressed and developed within the paragraph; the latter is a conceptually conditioned, idea-based structure; we have one idea, one paragraph. Only in this case can we speak about the two other elements of the paragraph: unity and coherence. Unity means that only one idea is discussed in a paragraph, it must stick to its announced subject and must not drift away into another discussion. Coherence means that all the

sentences and ideas in the paragraph flow together to make a clear, logical point about a topic. The paragraph should not be a confusing collection of ideas, set down in random order; each sentence should grow out of, or be related to the preceding sentence. To make the essay or the paragraph cohesive, i.e. logical, focused and unified, it is strongly recommended to use cohesive devices – repetition of key words, using pronouns instead of key nouns, parallel structures, sentence structure repetition and what is more important, transition signals. These are words and expressions (sentence connectors, clause connectors) that point at and contribute to the logical organization. They connect one paragraph, sentence, and clause with another and identify the kind of connection (e.g., transition signals to introduce comparison/contrast, or cause/effect, or result, or conclusion, etc.). [1. pp. 473-480]

The dependence of the language on a specific audience and a specific purpose is an obvious and a well-known fact. However, can we speak in terms of a variety of language (register), a variation of language use (style) in academic writing? This is quite a difficult question to answer and it could make another article, but as far as the language use is concerned, we can speak of a particular vocabulary, linguistic units, and it is chiefly the transition signals (connectives, transitional expressions and words, such as 'however', 'consequently', 'thus', 'on the other hand', etc.) that stand out.

To sum up, academic writing is writing an essay, which is a specific genre and has its characteristic features. The purpose of a piece of academic writing is determined basically by the organizational form, structural patterns of development and the style that is conditioned by the rhetorical form chosen for it, with the audience in mind. The purpose of academic writing is both general and specific. On the one hand, it is meant to inform the audience about something in particular, to convey a message and have an impact on a particular audience. On the other hand, it is meant to tell a story, to describe something, to define a notion, to exemplify, to compare and contrast, to classify, to argue in order to prove the correctness of one's viewpoint on a particular subject. The purpose, the audience and the strategy (the genre, the type of essay) determine the language of academic essay in English (the choice of words, shaping the sentences and developing the paragraphs).

No writer is born knowing how to put words together to its best effect (unless he or she is a Shakespeare!). Writing is a skill that can be learnt through practice. The ability to write on a certain level is not a special gift; it is a technique. Doing it in English means learning not only what and how to do, but also what and how *not* to do. Be aware of the rules and beware of the restrictions! Whatever the purpose.

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这位领导人的西伯利亚流放者以斯大林时代的苏联艺术为主题
THE LEADER'S SIBERIAN EXILE AS A THEME IN THE SOVIET ART OF THE STALIN ERA[1]

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抽象。 在1930–1950年代的苏联文化中，革命前的西伯利亚流亡者是一个非常受欢迎的话题。 它不仅在故事和小说中得到展示，而且在绘画中也得到展示。这篇文章分析了斯大林时代艺术家创作主题绘画时使用的主要肖像画方案，当时作品的英雄是苏联领导人列宁和斯大林。

关键词：西伯利亚，流亡，领导人，列宁，斯大林，绘画，肖像。

Abstract. *In Soviet culture of the 1930-1950s pre-revolutionary exile to Siberia was an extremely popular topic. It was presented not only in tales and novels, but also in paintings. The article analyzes the main iconographic patterns used by the artists of the Stalin era when creating paintings on this topic with the main characters of their works being Soviet leaders - Lenin and Stalin.*

Keywords: *Siberia, exile, leader, Lenin, Stalin, painting, iconography.*

The history of the Siberian exile and the history of its visual representation naturally have different durations. The exile to this distant remote land has been known almost since its accession to Russia. Over the course of the 17th-18th centuries, an extensive structure of state institutions was created in Siberia, which ensured and controlled the constant influx of criminal and political criminals. Talking about the reflection of this phenomenon in the visual arts is possible only from the first half of the XIX century, or rather, from the time when the region for many years became the residence of the Decembrists.

By its nature and functions, the process of creating images by the Decembrists was close to the process of creating diary entries: everything that was seen and experienced was recorded in order to save it for memory, for history. Images focused on the present and did not imply a direct appeal to the past. However,

[1]The reported study was funded by RFBR according to the research project № 18-001-00001.

their temporal parameters were wider because they contained many motives that were far from momentary. At N.A. Bestuzheva, N.P. Repin, A.I. Yakubovich, D.I.Zavalishin and other authors panoramic views of landscapes, slow tempo of collective portraits, the stopped action of interior images appealed to eternity, went beyond the narrow boundaries of the actual present. Slowness, orderliness and emotional restraint are important characteristics of the picture of the world created by Decembrist artists. The authors strove for objectivity and did not contribute to their work an increased tragic glow, images of the horrors of Siberian existence, "crying for a ruined life."

A look at the link and hard labor through the eyes of the exiles and convicts themselves for a long time remained the main one in the formation of the visual image. However, over time, the works written directly in Siberia were supplemented by work performed upon return from exile. Correspondingly, pictorial ones were added to the graphic fixations, from the transfer of a direct impression the artists switched to a thoughtful, conceptual alignment of the composition and the figurative structure of the paintings.

Work from memory resembled not diaries, but memoirs. And this means that the category of time is increasingly actively invading the image of Siberian exile. A look from another time and space predetermined, among other things, the strengthening of the estimated characteristics of artistic images.

An example is the work of the Polish artist A. Sokhachevsky, whose Siberian exile lasted more than twenty years (1864-1884). The Siberian space on them has lost the independence and self-sufficiency of existence, and, therefore, could no longer have objective beauty: it is a place of hardships and deprivations, a scene on which human suffering unfolds (“Farewell to Europe”, “Evening. Shackled in shackles”). In such works, the narrative principle was noticeably enhanced, and with it the pathos of conviction, and the call for sympathy (which was not asked and did not appeal to the Decembrists).

But even these emotionally revealing works created by an eyewitness seem restrained against the background of paintings by Polish artists who have never been to Siberia - Y. Malchevsky (“Death at the Stage”, “Sibiryak” and others), A. Grotter (“Siberia", "The Way to Siberia"). The world, freed from real observations, built according to the laws of myth, carried a concentrated expression of human torment and pain. In it, people eked out a miserable existence, suffered, indulged in despair, died.

The same transformations took place in Russian realistic (for the most part, ascetic) painting of the second half of the century.

The reflection of the growing process of mythologization, the process of consolidating stereotypical public perceptions of Siberian exile was the formation of stable visual formulas. The most common among them in the second

half of the XIX century was the road. It appears again and again on dozens of paintings. Exiles and convicts could go by cart ("On the Great Siberian Way. To exile" by N.E. Sverchkova, "Halt of Prisoners" by V.Ya. Jacobi), but more often made their way through the snow and mud on foot, lining up in long dull columns ("A kopek was spared", "On the way to Katorga" by N.N. Karazin, "Into the Siberian exile" by V. Prushkovsky and others). Snow-covered fields, desertedness and vastness of the surrounding space formed the image of the "outskirts of the world." Artists never depicted the road home - only the road to Siberia. The refusal to convey the hope of deliverance, the desire to focus exclusively on the topic of hopeless and gloomy human existence was one of the evidence that the mythology of the Siberian exile was finally formed, incorporating the most gloomy allusions and meanings.

No less vividly were they reflected in other stable visual motives: parting, endlessly lasting expectation, death.

An important evidence of the completed process of mythological formation is the acquisition of a historical dimension in images of Siberian exile. The visual interpretation of the plot included works of the historical genre (Avvakum's Journey through Siberia by S. D. Miloradovich, Menshikov in Berezov, V. I. Surikov, and others), linking it with the definition "depth of centuries", which is so important for mythological perception.

The historical genre introduced another important aspect - the development of the theme of personality, a vibrant human personality. The focus was not on the suffering of the "little man" (translated into the category of "suffering of the people"), but on the image of the "hero of Russian history", in relation to which the Siberian exile from the fact of personal biography grew to an integral part of the epoch-making events in the life of the country.

Thus, throughout the XIX and early XX centuries, the mythologem of Siberian exile was formed, having acquired stable features. Fine art actively participated and simultaneously fixed this process, reflecting its most important stages. It has gone from images pretending to the objectivity of visual evidence to creating a generalized emotional image of human suffering; from contemplation to narrative; from fixing the present tense to the maximum expansion of the temporal parameters of the image; from individual compositional solutions to the formation of stable visual formulas.

Significant actualization, but at the same time, the transformation of the theme of Siberian exile took place in the painting of the 1930-1950s. During this period, it ceased to be just an object of public attention, turning into an important element of state ideology, into a clear and vivid way of exposing the "bloody tsarist regime". The graphic interpretations of the plot lost the parameters of the present, turning into an exclusively historical narrative (the Soviet link could not

appear in the painting). The theme of popular suffering was not removed from it, but in the visual arts it was seriously supplanted by the theme of “revolutionaries in exile”. The pantheon of the portrayed heroes was extremely rigidly outlined, including the characters of school books: from Radishchev to the Decembrists, further to Chernyshevsky and Narodnaya Volya, and, finally, to the main characters - the Bolsheviks. The undisputed leaders in the number of images were Lenin and Stalin.

As is known, Lenin was in exile once: in the village of Shushenskoye he spent almost three years (from 1897 to 1900). In the life of Stalin there were three Siberian exiles, but the most famous, longest, truly significant was the last - the Turukhansk exile, which lasted from 1913 to 1917. The geographical names of Turukhansk krai, Kureyka in the 1930-1950s were comparable in degree of fame with Shushensky.

The Lenin Museum in Shushensky was opened in 1930, the Stalin Museum in Kureyka - in 1938. The whole country learned about them. Memoirs, non-fiction books, poems were written about these places. They were included in the massive Soviet travel guides. Feature films and documentaries were shot about them. And, of course, they were reflected in works of art.

Quickly enough, a set of iconographic schemes was formed. It included previously unknown motives or motives transformed in accordance with ideological tasks:

- a hero on the road ("IV Stalin on the way to exile in Turukhansky Krai" by K.K. Kerimbekov);
- the hero works (reads or writes) in a hut ("V.I. Lenin in Shushensky" by I. Ilyinsky);
- the hero communicates with local peasants ("V.I. Lenin among the peasants of the village of Shushenskoye" by V.N. Basov);
- hero against the background of the Siberian landscape ("I.V. Stalin in the Siberian exile" by I.V. Titkov);
- a hero in a confrontation with representatives of the authorities ("I.V. Stalin in Turukhanskoy exile in 1916 by P. Sokolova-Skaly).

On the canvases of the Stalin era, the theme of suffering, longing, and despair did not pedal. Her heroic pathos replaced her. Hope, which was absent in the works of artists of the era of critical realism, turned into a solid "confidence in a bright future." However, the Soviet mythologem still did not cross out the meanings that the previous generations filled the Siberian exile. On the contrary, it did not defiantly, but nevertheless exploited it quite clearly: the optimistic pathos of Soviet visual images could not have sounded heroically if he had not stood for a stable, fixed in the historical memory of the people, image of human torment and suffering.

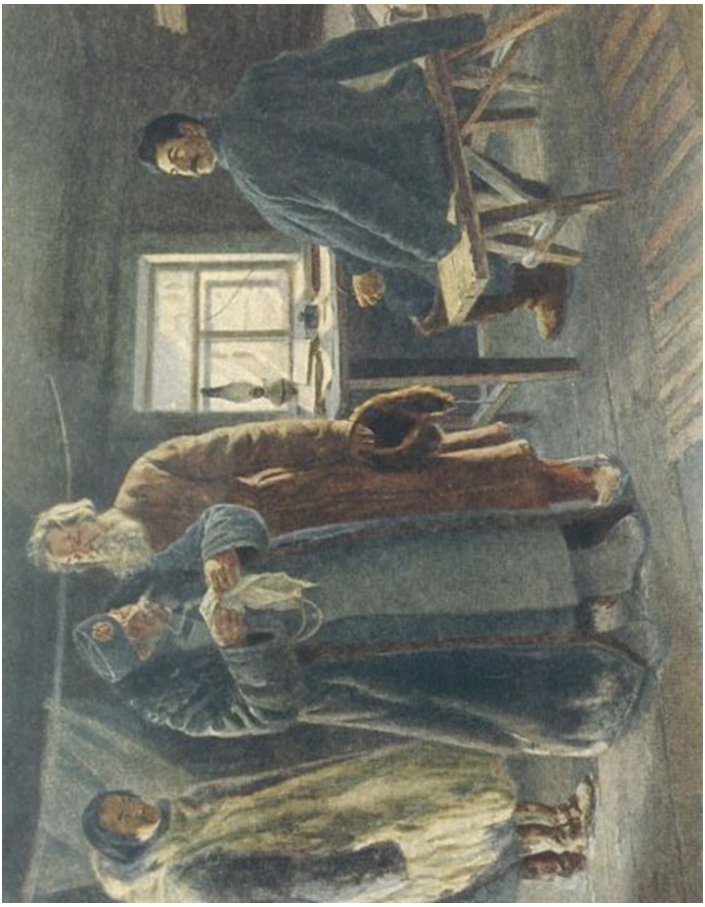

Fig. 1. *P. Sokolov-Skalya "I.V. Stalin in the Turukhansk exile in 1916. " (1949)*

Fig.2. *V.N. Basov "V.I. Lenin among the peasants of the village of Shushenskoye"(1953)*

联觉的本质及其对当代艺术的影响
THE NATURE OF SYNESTHESIA AND ITS IMPACT ON CONTEMPORARY ART

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抽象。这项研究的目的是要描述和解释“合奏体验”，尤其是在艺术语言的背景下。本文的主要内容是分析视觉艺术和音乐产业与联觉现象的联系。本文提供了有关当代和过去几个世纪艺术领域发展趋势的信息。它由两部分组成：第一部分包括有关联觉的关键信息。第二部分侧重于艺术上联觉的创造形式，它们在现代艺术中的发展和影响。目的是分析合成方法作为本领域实验的影响。

关键字和词组：通感；艺术语言；联觉连接；视觉艺术;神经学现象颜色色调文献;联觉联想；科学研究;感官融合；展览;数字技术;音乐产业；感觉系统；灵感;联觉类型。

Abstract. *The objective of this study is to come to describe and explain the “synesthetic experience”, especially in the context of artistic language. The main content of the article is the analysis of visual art and musical industries’ connection with the phenomenon of synesthesia. The article provides information on the base of both contemporary times and past centuries’ tendencies in art sphere. It consists of two parts: the first part includes the key information about synesthesia. The second part focuses on the created forms of synesthesia in art, their development and effect on the modern art. The intention is to analyze the impact of synesthetic approaches as experiments in art.*

Key words and phrases: *synesthesia; artistic language; synesthetic connections; visual arts; neurological phenomenon; color tonality; literature; synesthetic associations; scientific research; fuse of senses; exhibition; digital technology; musical industry; sensory system; inspiration; synesthetic types.*

The experience of color as people usually understand it is mostly a visual one. But for some people, color is a more multi-sensory affair, linked to sound, texture, taste or shapes. Numbers, letters and days of the week have their own shade: for example, the number one is white, the letter L is blue and Monday is red.

This neurological phenomenon is called synesthesia. Synesthesia is a neurological crossing of the senses, in which a stimulus in one sense (say, sight) evokes a sensorial response in another (say, smell), so that the synesthete registers a particular smell as inherently endowed with a particular color (or a number with a sound, or a tactile texture with a smell). People who experience synesthesia are usually born with it or develop it very early in childhood. It's possible for it to develop later. Research indicates that synesthesia can be genetically inherited.

Best described as a union of the senses, synesthesia is when one sensory experience involuntarily, and consistently, prompts another. There are up to 70 different types, such as the ability to see sounds, hear time, and taste shapes; however, the most common involve color.

Some scientists believe that synesthesia results from "crossed-wiring" in the brain. This means that for synesthetes (people who have synesthesia), neurons and synapses that are usually contained within one sensory system cross to another. It is not known exactly why this might happen but some researchers believe that these crossed connections are present in everyone at birth—it's not until later that the connections are refined.

Nowadays synesthesia was admitted as a great impact on contemporary kind of art. In the world of visual art, many artists attempted to understand the connection between sound and color. In the 19th-century, a tradition of musical paintings started to appear and, in return, it influenced symbolist artists. For many artists who were involved into visual art revolution the main tool helping to shape the ground for their experiments, which focused on the unification of the arts, became the book "Concerning the Spiritual in Art", written by Wassily Kandinsky. Kandinsky was also a crucial figure in using the ideas of sound as the basis in the production of many of his abstract paintings. Linking line, shapes and color to various musical instruments, many of his images not only carry musical phrases such as composition as their titles, but are the result of artist experiencing a certain melody, note, or composition in a concert hall. Kandinsky also played the cello – an instrument that, for him, evoked a deep blue, a color he also used heavily. Although not commonly cited as a synesthet, it's interesting to note that Henri Matisse described the same rich, deep blue – famously used in his "Blue Nudes" – as affecting the viewer like "a vigorous stroke of a gong."

Analogies between musical and pictorial order, general tonality, emotionality are inevitable. According to the idea of Soviet artist N. Volkov, there is an analogy between color and line in painting with the sound component of music. Such

components of music as gamma, rhythm, harmony, major and minor, are not only musical concepts. Moreover, such pictorial means as color and line can be close to music. The development of the plot in painting and composition can be associated with a poetic beginning.

N. Volkov, dealing with the problem of color in painting, turns to the concepts of "color range" and "color tonality". In working with color relationships, according to N. Volkov, limiting the color range is most important. The artist deals with the synthesis of a system of relations, the perception of a whole and careful study of color transitions.

Color is one of the important elements of the language of painting, the perception of color in a picture is associated not only with the artist's coloristic choice, but also with the general system of color differences and intervals. When colors form rows and differ from neighboring rows in tone, lightness, saturation, they are perceived as a continuous color transition. A pronounced color interval can be called colors with a brighter difference. The color interval demonstrating the relationship between colors, according to N. Volkov, has sufficient "sonority". It uses a concept that is exceptionally musical.

Volkov also compares the concept of a color interval with an interval in music, which is associated with a certain length of the sound wave. The musical gamut is an alternation of tones and midtones, which are the distance between sounds. Color intervals form color series, which are located at different steps, because they contain color changes. The color scheme consists not just of intervals, but of specially ordered color intervals, and is associated with a certain set of colors and the presence of a color dominant.

Synesthesia also took an especial place in the sphere of worldwide literature. Writers who experience synesthesia can use their feelings to embody colors and shapes into a huge variety of metaphors and constructions, although it's necessary to admit that synesthesia also influence a person's worldview in a great way, opening more ways of inspiration and imagination. There are many talented writers and poets who used their synesthesia in work on literature heritage. Russian novelist Nabokov also was a synesthetic and with a deep interest and curiosity explored how this unusual feeling influences his minds and works. In his autobiography "Speak, Memory" Nabokov lists the colors he saw for each letter. Among the greens are "alder-leaf f, the unripe apple of p, and pistachio t." In the same section, he specifically mentions a set of old blocks he was building with one day as a child. Their colors, he told his mother, were "all wrong." She turned out not only to have synesthesia, but also to share some color-letter combinations with him. This new study makes me wonder whether he had been exposed to a set of colored blocks—perhaps the same set, or a similar set—that his mother had encountered as a child, one that had formed his sense of what color went with a given letter.

Many artists understand that even though the two-dimensional art production is restricted to the static frame of the canvas or piece of paper, their images need to catch the eye of the public and force it to move. Because of this, many play with rhythm and movement within their images. The two terms, frequently associated with music, entered the arena of the visual art field thanks to the research of synesthesia in art.

Next to the famous examples of synesthesia art of the past, such as the celebrated animated movie "Fantasia" by Walt Disney, or the numerous paintings by Kandinsky, Van Gogh, or even Henri Matisse, who linked the intensity of the blue shade used in "Blue Nudeto" the stroke of a gong, the growing world of technology and the digitally based art techniques are offering exciting and original examples of synesthesia in art. We can also mention Alexander Scriabin's "24 Preludes, Op. 11" for piano are presented in a special solo performance by Andrew Burashko, where each of the preludes is bathed in an immersive colorfield experience, crafted by esteemed lighting designer Kevin Lamotte, corresponding to Scriabin's synesthetic correlation of color to music. Presently, many examples of installation art pieces fuse the world of music, sound and movement. Abandoning form, video installations are known to use motion data from various dance genres and turn it into moving colors and forms which are the dominant factors of the pieces. Such works not only expand the definition of art but also explore the audience's perception and force the re-examination of both the definition and nature of art and of the world.

Historically, two very different distinction definitions of synesthesia in art were born. The first prompted artists to attempt to evoke synesthetic associations with their work, as it is evident in the early examples of paintings. Presently, and with the help of the scientific research that confirmed the fact that the brain in the four percent of the population for sure perceives the world in a unique way, uses such personal synesthetic perceptions to create works of art and the other stream attempts to evoke synesthetic associations with their work. Regardless of the origin of that main spark which prompts the artist to fuse various sensations, contemporary art production continues to merge technology, science and imagination thanks to the ideas of synesthesia in art.

In a contemporary world synesthesia attracts not only the visual kind of art and the world of music industry. One of the most popular representative of colorful combination of senses, colors and sounds in extraordinary and emergent way in the key of modern times and technologies is 'TeamLab Planets TOKYO' – a new art museum in Toyosu, Tokyo, which attracts crowds of tourists to enjoy the fantastic interpretation of our universe through people's five senses. The seven sensory-filled artworks here lead visitors into an artistic world accented with lights, water, and sound.

It is full of immersive exhibits inviting visitors to explore a world of art through sight, touch, and sound. Borderless and other internationally-renowned exhibitions, Planets has seven artworks. The distinct, unique artwork here is sensory-based, closing the gap between art, sense and viewer.

One of the best known pieces at Planets is "The Infinite Crystal Universe," a space filled with changing lights and colors. The reflective surfaces are stunning, making visitors feel like they are wandering through a never-ending chasm of space crystals, it can give people an especial feeling, which is close to synesthesia.

This museum provides a big variety of fascinating installations. "Drawing on the Water Surface Created by the Dance of Koi and People - Infinity" is a water-based artwork with brightly colored, interactive koi and flowers. Visitors wade through calf-length to knee-deep water while being surrounded by swimming fish and floating flowers on the surface of the water. Light-filled spheres of different hues create a maze-like space for "Expanding Three-Dimensional Existence in Transforming Space - Free Floating, Flattening 3 Colors and 9 Blurred Colors." Visitors experience this area by physically moving the spheres with a light touch. The spheres change color when physically contacted. The twelve colors of the spheres include hues representing those found in nature in Japan, from underwater blues to sunset and floral tones. The soft colors and moving spheres in such kind of exposition let a human understand the feeling of synesthesia – for instance, feeling how colors and associations harmonically combine with physical feelings and perceptions.

The combination of artists' intellectual resources and digital expertise with the new sensory reproduction technologies with the opportunity to provide well-rounded remote access to collections can be a revolution in contemporary art. Using the full palate of sensory tools, museums could go beyond augmented reality, and beyond just sharing artifacts via 3D digital scans. Can museums provide digital libraries of historic smells? Can an immersive virtual museum enable visitors to see, handle, smell, taste and hear a reconstructed world? The understanding of how can synesthesia influence the development of art is a key to help people to find a new way to improve entertainment and art spheres.

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阿奇霉素抗菌治疗急性细菌性鼻窦炎的临床疗效
THE CLINICAL EFFECTIVENESS OF AZITHROMYCIN ANTIMICROBIAL THERAPY USED FOR THE TREATMENT OF ACUTE BACTERIAL SINUSITIS

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抽象。 本出版物的目的是报告评估用于治疗细菌性急性鼻鼻炎（ARS）的阿奇霉素（Sumamed）抗菌疗法的临床有效性的结果。 描述了研究组患者中细菌ARS临床症状逆转的动态。 既没有不良副作用，也没有并发症。 在治疗开始后7天内，有98.6%的患者从疾病中康复。 结论是，在门诊患者的基础上使用阿奇霉素（苏门答腊）进行抗菌治疗可提供很高的效率。

关键词：急性鼻窦炎，抗菌药物，阿奇霉素。

Abstract. *The objective of the present publication was to report the result of the evaluation of the clinical effectiveness of azithromycin (Sumamed) antimicrobial therapy used for the treatment of bacterial acute rhinsinusitis (ARS). Dynamics of the reversal of the clinical symptoms of bacterial ARS in the patients of the study group is described. Neither adverse side effects nor complications in response to the treatment were documented. 98.6% of the patients recovered from the disease within 7 days after the onset of the treatment. It is concluded that antimicrobial therapy with the use of azithromycin (Sumamed) based at the outpatient settings provides a highly efficient.*

Keywords: *acute sinusitis, antimicrobial therapy, azithromycin.*

Bacterial acute rhinosinusitis (ORS) is one of the most common diseases. All age groups of patients are exposed to ORS. Recently, there has been an annual increase in the incidence of 1.5-2% [1,2].

If we try to briefly formulate the main objectives declared by modern clinical guidelines for the management of patients with ORS, then they are obviously to achieve recovery and reduce the cost of a course of therapy for ORS. For this reason, antimicrobial therapy is an important component in the treatment of bacterial ORS, since the eradication of the pathogen significantly reduces the severity of clinical symptoms, reduces the duration of the disease, prevents the development

of complications, and optimizes treatment costs. Starting therapy of bacterial ORS is empirical in nature, taking into account the information that the most common pathogens of ORS are streptococcuspneumoniae, Haemophilusinfluenza, Moraxellachatarallis.

Compliance with the modern approach to antimicrobial therapy requires the appointment of an antibiotic with adequate antimicrobial activity, good tolerability and proven safety. For patients with bacterial ORS receiving basic therapy of related diseases, it is important that the antimicrobial drug has optimal pharmacodynamic / pharmacokinetic characteristics and no clinically significant interactions with other drugs.

Traditionally, interest in antimicrobial drugs of the macrolide group is due not only to the suitable spectrum of antimicrobial activity and their high efficiency against typical and atypical pathogens of ORS, but also to pharmacokinetic characteristics and safety profile. Analysis of the practice of antimicrobial drugs in ambulatory patients with ORS in different regions of the Russian Federation shows that 10.5% of doctors use azithromycin[2].

Along with β-lactams and respiratory fluoroquinolones, modern macrolides, in particular azithromycin (Sumamed), are included in the treatment protocols of patients with respiratory tract infections. The efficacy and safety of macrolides are confirmed by numerous clinical studies [1-5].

Azithromycin has a mechanism of action inherent in macrolides, but it has unique differences [6]. The drug has a dose-dependent effect and an extended half-life (about 60 h), which is higher than that of other macrolides [7]. Pharmacodynamic parameters of azithromycin correlate with the ratio of the area under the pharmacokinetic curve and the minimum suppressive concentration [8]. The drug creates long-term high tissue concentrations. While tissue and serum concentrations of penicillins are approximately the same, azithromycin remains in serum in small amounts. Tissue level of azithromycin is 10-100 times higher than its concentration in the blood [3]. It is important that in conditions of inflammation, the concentration of the drug in the focus of infection increases significantly. Most of azithromycin is concentrated in neutrophils and macrophages, which migrate to the focus of inflammation and create a high concentration of the drug here.

An important element of the pharmacokinetics of macrolides is the presence of two peaks of concentration in the blood; this is especially clearly seen in azithromycin. The appearance of the second peak is associated with the primary deposition of most of the drug in the gall bladder, which subsequently enters the intestine and is absorbed. In parallel with the second peak in blood serum, there is a re-rise in the concentration in other biological fluids, and previously unrelated neutrophils and macrophages antibiotic molecules interact with them to migrate to the focus of inflammation [3, 9].

With oral administration (500 mg daily for 3 days) , the concentration of azithromycin in leukocytes exceeds plasma concentrations by 300-600 times and remains at a high level for 5-7 days [7, 10]. Azithromycin has anti-inflammatory activity, the molecular mechanism of which is actively investigated.

Under our supervision there were 72 patients with the main clinical diagnosis "bacterial ORS" who underwent examination and treatment with azithromycin (Sumamed) GBUZ Republican clinical hospital of Nalchik in the mode of outpatient observation. The original version of azithromycin was chosen for the study, since the attitude of doctors to the original drugs and generics is ambiguous [11].

The aim of the study was to assess the clinical efficacy, tolerability and safety of the drug azithromycin in the treatment of patients with bacterial mors.

Research problem:

Establish the timing of the onset of the effect (the rate of relief of objective and subjective symptoms) on the background of antibiotic therapy. Assess portability and safety.

The study included patients diagnosed with "bacterial ORS mild/moderate severity" after familiarizing the patient with the essence of the study, set out in the information card. Prerequisite: intolerance to antibiotics penicillin series. Patients underwent the same type of treatment with azithromycin on the background of traditional local therapy.

Azithromycin (Sumamed) patients took daily 1 time a day at a dose of 500 mg for 3 days. The use of vasoconstricting intranasal drugs and irrigation of the nasal cavity - from 5 to 7 days. The total observation period is 7 days.

Each patient was examined during treatment four times (when included in the study, as well as on the 3rd, 5th and 7th day) with an assessment of clinical status and laboratory parameters.

The study group of patients included 72 patients from 26 to 69 years (35 men and 37 women). The median age was 28.5±9.3 years. The structure of clinical forms of bacterial ORS according to the localization of the pathological process is represented by acute purulent polysinusitis-31 patients, acute unilateral purulent sinusitis-17 patients, acute unilateral sinusitis-16 patients, acute catarrhal frontitis-8 patients. Mild severity of ORS was diagnosed in 6 cases in patients older than 50 years. The appointment of systemic antimicrobial therapy in cases of mild bacterial ORS, we believe justified due to the age of the observed.

Table 1. *The severity of symptoms during the primary evaluation, M±t*

Symptoms	Stages of examination			
	1	2	3	4
Pain on palpation (PPN)	1,62+1,05	0,88+0,09	0,30±0,06*	0,03+0,04*
Headache	1,84±0,9	1,02±0,09	0,41+,007*	0,02+0,02*
Data of examination of the nasal cavity	2,29+0,07	1,55+0,12	0,63+0,08*	0,06+0,05*
Radiographic signs of sinusitis	2,06+ 0,78	-	-	-

*Note. * - p<0.05 compared to the primary examination*

Table 2. *Quantitative indicators at the stages of survey, M±t*

Symptoms	Stages of examination			
	1	2	3	4
Fever	37,3 + 0,08	36,7 ± 0,29	36,6 + 0,04*	36,5 + 0,01*
Leukocytosis (- Yu'/l)	9,03+0,3	8,2+0,21	7,34+0,22*	7,22+0,12*
Accelerated ESR (mm / h)	18,4+1,24	14,04+1,21	10,5+**1**,02*	8,08+1,07*

*Note. * - />0.05 compared to the initial survey.*

Table 3. *The number of patients with no symptoms of sinusitis at the stages of the study,%*

Симптомы синусита	Stages of examination							
	1		2		3		4	
	abs.	%	abs.	%	абс.	%	abs..	%
Pain on palpation (PON)	49	68,1	69	95,8	70	97,2	71	98,6
Headache	12	16.7	8	11,1	3	4,2	2	2,8
Pathological changes in rhinoscopy	0	0	44	61,1	67	93,1	71	98,6
Increased body temperature	34	47,2	69	95,8	72	100	72	100
Leukocytosis above 9-109/l	9	12,5	65	90,3	70	97,2	72	100

At the time of inclusion in the study, the estimated duration of the course of orss Was from 5 to 16 days. In all cases, bacterial ORS was preceded by an acute respiratory infection of mild or moderate severity, which patients treated at home: 79% of patients under the supervision of a district therapist, 21 % - independently.

The patient's condition was assessed on a verification score scale. Pain on palpation in the projection of the paranasal sinuses (PNP): 0 points - absence; 1 point-weak; 2 points-moderate; 3 points-pronounced. Headache in the forehead: 0 points-absence; 1 point-rare and short-term, quickly passes on its own; 2 points-strong, easily relieved by analgesics; 3 points-strong, long - term, little amenable to pharmacotherapy.

Data rhinoscopy: swelling of the mucous membranes of the turbinates, track Muco-purulent discharge in the nasal passages, congestion of the mucous membrane of the nasal cavity, secretions in the nasal cavity - a mucous, Muco-purulent, purulent, purulent-hemorrhagic: 0 points - no pathology; 1 point - mild; 2 points - moderately expressed; 3 points - very pronounced.

Radiological signs of the LFS considered the change in pneumatization, the presence of the horizontal level of the liquid in the projection of okolonosovyh sinus: 0 points-pneumatische paranasal sinuses saved; 1 point-inhomogeneous darkening okolonosovyh sinus/sinuses; 2 points - homogeneous total blackout okolonosovyh sinus/sinuses or the presence of fluid level.

The severity of clinical symptoms in the primary and second examination was in the range of 0-3 points; in the third and fourth examination-in the range of 0-2 points. The averaged indicators are presented in table. 1.

Fever at the primary examination was detected in 38 patients, while subfebrile fever was detected in 23 patients, febrile fever-in 15 patients. Peripheral blood leukocytosis above 9-109/l was determined at the primary examination - 63 patients (maximum index - 20-109/l), at the second examination - in 7 patients (maximum index - 15-109/l), at the third-in 2 patients (maximum index -11-109/l). Acceleration of ESR above 15 mm / h at primary examination was determined in 34 patients (maximum index-53 mm / h), at the second examination - in 16 patients (maximum index - 27 mm/h), at the third examination - in 4 patients (maximum index - 23 mm/h), at the fourth examination - in 5 patients (maximum index - 25 mm/h). Averaged indicators of fever, peripheral blood leukocytosis and ESR acceleration are given in table. 2.

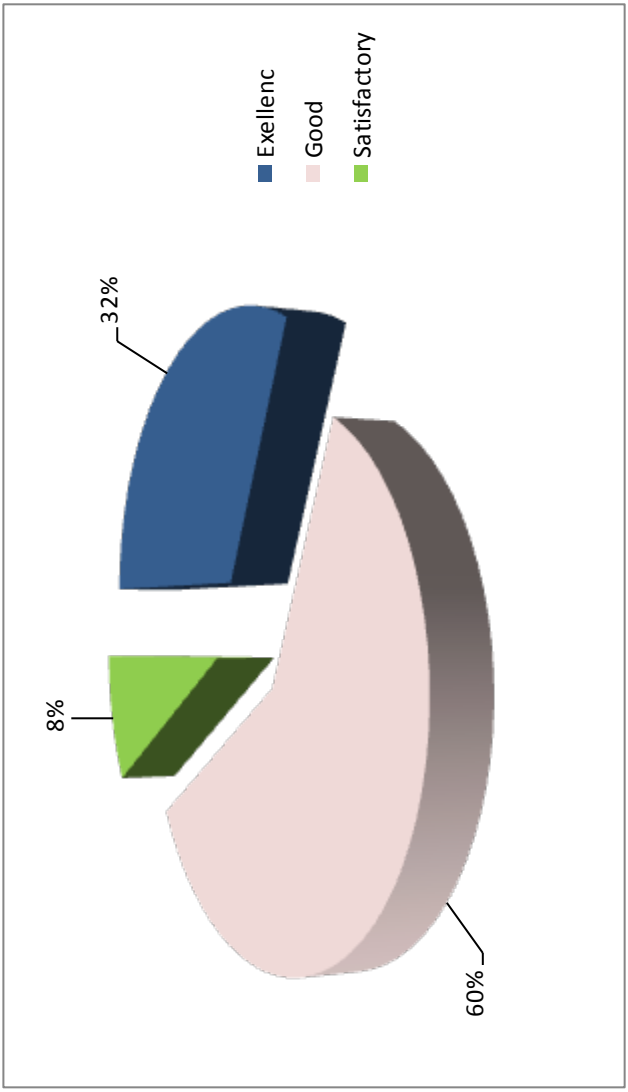
The reverse dynamics of symptoms of bacterial ORS in the observed group on average corresponded to the usual terms of relief of symptoms (table. 3). In 98,6% of cases on the 7th day recovery is stated.

Adverse side effects of treatment and complications during treatment were not revealed. In the course of treatment, all patients underwent a dynamic (according to the Protocol of the clinical trial) study of blood and urine, side effects of the drug on these indicators were not revealed. Thus, at the medical assessment on the 7th day, the clinical efficacy of therapy was established in 98.6% of cases.

Patients were asked to evaluate from their point of view the effectiveness, comfort of therapy and compliance of the actual reverse dynamics of symptoms with the expected improvement according to the following criteria:

"Excellent" - therapy is highly effective, from the first day of antimicrobial therapy there was a stable significant improvement in health.

"Good" - therapy is effective, stable significant improvement was noted with 2-3 days of antimicrobial therapy.



***Pic** Effectiveness of therapy according to patients*

"Satisfactory" - a slight but stable improvement was observed during the entire follow-up period (7 days).

"Unsuccessfully" - positive changes in symptoms did not occur.

"Unsatisfactory" - the deterioration of the symptoms. The results of the survey are presented in a picture.

Thus, evaluation of the results of therapy of bacterial ORS with antimicrobial drug azithromycin (Sumamed) in outpatient mode demonstrated high clinical efficacy in outpatient follow-up of patients.

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身体危害的综合影响导致煤矿工人的职业风险
COAL MINERS' PROFESSIONAL RISK FROM COMBINED EFFECT OF PHYSICAL HAZARDS

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抽象。分析了影响煤矿工人的矿山物理灾害综合体的典型结构及其对职业风险的意义。当估计物理工业危害的剂量时，影响煤矿工人的生物效应对时间因素的依赖性更大。研究表明，对于每种物理因素的影响，没有足够的关于身体特定反应的数据，无法充分预测疾病的风险。在这方面，有必要考虑到身体不同功能系统对这些因素的综合作用的敏感性（非特异性反应），要考虑到物理工业因素的异质性和不清楚的特征。通常，观察到亚加和独立类型的结合作用。所获得的关系被用于创建矿工职业病风险增加的概率标准的基础。

关键词：煤矿工人身体危害职业风险职业病

Abstract. *The typical structure of complex of mine physical hazards, influencing upon the coal miners and its significance for the professional risk were analysed. When estimating doses of physical industrial hazards, affecting the coal miners the greater dependence of biological effects from the time factor was revealed. As was shown by the study, there is not enough data about the specifical reactions of the body in response to the influence of each physical factor for the adequate prediction of the risk of diseases. In this connection it is necessary to take into account the sensitivity (non-specific reactions) of different functional systems of the body to the combined effect of these factors, considering heteregenenous and unclear character of physical industrial factors. As a rule, there were observed the subadditive and independent types of their combined effect were observed. Obtained relationship were used in for creation of the basis for probabilistic criterions of increased risk of occupational pathology in miners.*

Key words: *coal miner, physical hazards, professional risk, occupational diseases.*

Labor activity of coal miners is influenced by a set of numerous harmful and dangerous factors and associated professional risk. In studies of combined hygienic analysis of underground environment the rank distribution of the main harmful factors remains the same - as far as hygienic significance is concerned the top four factors are the physical ones, namely: increased dust content in the air in the working zone, heating microclimate, increased noise and vibration levels[1].

It is clear from comparison of formalized assessments of the abovementioned factors, obtained by means of questioning experts*, the hygienic concept underwent changes: weight and significance of energy factors have increased. Comparison of qualitative indices, obtained practically from the same board of experts 18 years later, is given below.

Factors	Weight, in parts of unit	
	acc. to Sukhanov (1982) [2]	acc.to Sukhanov et al. (2000) [3]
Materials,	0,564	0,43
including coal and rock dust	0,348	0,27
Energy factors,	0,374	0,55
including microclimatic ones,	0,180	0,22
noise,	0,066	0,17
Vibration	0,050	0, 13

* 11 experts in the field of labour hygiene and safety engineering in coal mining industry from 3 organisations were polled

As it seems, this trend is going to stay. The changes, observed in hierarchy of the underground environment and connected with introduction of new equipment and techniques, individual respiratory organs protection means, etc., influence functional state of the miners organisms. Adequate evaluation of this state for prevention of diseases as results of professional risk, maintaining high working ability is quite important.

PURPOSE

Purpose of this paper was to analyze professional risk due to combined action of physicalfactors in relation to coal miners.

MATERIAL AND METHODS

Hygienic studies were conducted in underground workings of 30 deep coal mines in Donetsk Coal Basin different in geological conditions, technology used and industrial engineering[4]. Measurements and assessment of major physical factors of production process (dust, parameters of microclimate, noise and vibration), accompanying factors (illumination, natural radioactivity of coals and rocks, increased barometric pressure, etc.) and outburst hazards on coal seams were performed using traditional techniques. Only intrinsically safe equipment was used[5].

Selection of methods of the human body functional condition study were based on literature available [6,7] on their information capacity under the action of different combinations of factors studied. 300 miners were subjected to physiological inspection. These miners were then polled and data of routine medical inspections was analyzed.

A retrospective analysis of data obtained during inspectionof 100 miners having professional vibration pathology and 30 miners having noise pathology.

On the basis of data obtained by means of the miners polling and of the miners professional route equivalent (average or a shift) levels and exposition doses of physical production factors which existed during the length of service.

Datawere statistically processed using a personal computer and methods of multiple correlation, regression and factor analysis.

RESULTS AND DISCUSSION

The most important feature of the system "production environment of deep coal mine - man" is the fact that fluctuation of parameters are extremely large not only when a miner performs his principal labour operations, but also when he is on his way to his working place and back (see Fig.).

Working environment which influences the miners 8 hours on average and which includes not only labour operations, but also all the stages of their way from the surface of the mine to their working places is characterized by lack of natural lighting, unsatisfactory and ununiform illumination (2-90 lux).

On most of coal mines coal winning and driving districts

Already during man-riding the miner is influenced, though only temporarily (3 to 5 min), by a set of factors, which differ greatly in their parameters from the usual, everyday background. To this set belongs the noise which varies from 60 to 90 dBA at different phases of the cage descent. During this time organisms of miners are subjected to powerful whole-body vibration. The feature of this type of vibrations lies in their combination withaperiodical accelerations (1,65-3,44 $m \cdot s^{-2}$) due to non-uniform motion, braking and acceleration of the cage. In cases when working levels of the mines are at the depth of 1000 m and more, barometric pressure increases significantly (up to 13,3 kPa, or 100 mm Hg). Barometric gradient is 1,2kPa (9 mm Hg) at the depth of 100 metres.

When miners move to the mechanized transport means (see Fig.) or directly to their working place they are still influenced by increased barometric pressure typical for this depth. Besides, when miners move through the air doors which serve to ensure rational air distribution, they are subjected to sharp pressure differentials (up to 1,5 kPa). On this background they are still subjected to noise due to operation of local ventilation fans (without a silencer up to 105-108 dBA), leakase of compressed air from the air ducts, underground traffic, etc.

Figure. *Typical structure of complex of mine physical hazardsare, as a rule, situated rather far from the mine shaft (1 to 4 km). The workers get there using underground transport. This defines the second set of transient influencing factors.*

0		
Man-riding		-noise -whole-body vibration -an abrupt change in barometric pressure -accelerations*
3-5		
A walk from the shaft (to the shaft) to the mechanized transport means		-noise -unfavourable microclimate -air dust loading -increased barometric pressure -an abrupt change in barometric pressure'*
10-15		
A walk to the working place (and back) by means of underground transport		-noise -whole-body vibration -unfavourable microclimate -air dust loading -increased barometric pressure -electromagnetic radiations*
35-45		
A walk to the working plase (and back)		-noise -unfavourable microclimate -air dust loading -increased barometric pressure -an abrupt change .in.barometric -pressure*
45-65		
Work		-noise -vibration - whole-body* \ local* -air dust loading -unfavourable microclimate -increased barometric pressure -ionized radiation -electromagnetic radiation* -an abrupt change in acoustic and barometric pressure*
405-425 Time, min		

* ..- this factors is characterized only for certain mines and professions or this : factor isn't used for the whole period of time

absence of natural light, deficit light

There are no constant sources of dust in the main workings of the coal mines; however, high dust content may still be present in the return air. Significant dust content in the air is due to rising of dust from the floor and structures surrounding the working by mine cars carrying mined rock. Simultaneously, the workers are affected by unfavourable microclimate. During this period of time it, as a rule, is integrally considered to be cooling, which is determined principally by high velocity of the air flow. The use of underground transport for carrying people results in low-dose, yet high-intensity vibrational loads acting on the body; the worser the state of the rail-track (rail-joints, etc.), the higher the loads. Recently locomotives powered by UHF-energy came to be used underground. This leads to exposure of the miners to UHF-field irradiation, and not only those riding the train but also people walking along the current conductors.

Judging by the number of influencing factors, their acuteness and time of action, the most unfavourablelabour operations are those performed at the working place.

Numerous studies of the dust situation in the mines witness to the fact that when modern equipment and techniques or coal winning and driving are used, even when dust-suppression efficiency is quite high (95-97 per cent), the dust content in the air of the working aone generally by far exceeds the maximum allowed level.

Unfavourable parameters of the heating microclimate in the development workings are commonly registered at the depth of 500-700 m, and in the faces - beginning from the depth of 700-900 m. At the same depth of workings the air temperature of the working zone in development headings is 1-2 °C higher, than that in the faces. The most unfavourable working conditions as far as the heat is concerned are observed in the steep seam mines. As a rule, the air flow velocity at the working places is the highest at the working level depth less than 300 m and more than 700 m, with reduction in between, which is due to ventilation regime of deep coal mines, etc. The same is true in for relative air humidity. In winter the air temperature differential relative to the surface of the mine may reach 50 to 60 °C; relative humidity - 30 to 40 per cent. Baric differentials were mentioned above[8].

In this connection of great interest are prediction and prevention of meteotropic reactions, which are the forerunners of industrial stress.

For medical predictions in climatology the so called medical classifications of the weather are used. In recent years the most widely used classification is that by Ovcharova[9]. Its merit lies in the fact that a wide range o indices is applied - 7 types of weather, which are determined by synoptic situation, trend in principal meteorological components and extent of their day-to-day change.

While on the surface of the mine -the weather is characterized as stable indifferent (1st type), combination of industrial and climatic factors during man-riding and consequent working shift is nearer to the 3rd type of the weather (spastic), and on the miners way to the shaft at the end of the shirt, during ascent and walking home - to the 5th (hypoxic). In all cases great extent of day-to-day change in meteorological components is observed. It is necessary to note "that this classification does not take into consideration such meteorological factor as air velocity, does not consider possibility of an increase in air temperature in cold period for spastic type of weather and temperature and baric differentials which are observed in deep mines and which exceed 5-fold and more the like differentials during 24 hours on the surface.

Fluctuations of meteorological conditions have the most drastic effect on cardiovascular system and progress of diseases. The number of meteoliable people varies between 10-30 % and 80-100 % (patients with different pathologies). The most sensitive are persons with unstable reactions from vegetative nervous system; their meteoreactions are viewed as desadaptativemeteoneurosis.

In relation to time industrial noise is regarded as non-constant. Equivalent noise levels at the working places vary from 80 to 100 dBA and more depending on ocupation, geological conditions, coal winning and driving technique, form of industrial engineering. Thus, $L_{Aeq}$is equal to 96-98 dBA when pick hammers are used (inore than 6000 % of relative dose), noise levels reach 110 dBA and more when drilling is performed with pneumatic hammer drills, and the relative noise dose during the shift exceeds 10000 %.

Perception of noise in the mine has some specific features which are to be taken into consideration. First, for miners non-constant noise is the source of information. Evaluating it, they judge of their personal safety and safety of their colleagues predicting possibility of a sudden outburst, roof caving and so on. Polling showed that 68±6,6% of miners use this information. It seems that the same reason - a necessity to hear energetically weak natural noises on the background of more loud technological ones - is responsible for miners refusal to use individual organs of hearing protection means. Second, the main part of the miners work takes place in conditions of unsatisfactory and non-uniform lighting. Therefore, the bulk of information, including communicative, passes through audio communication channel. This increases the load on the hearing organs of a man during his work. Third, non-constant noise affects the miners' organisms, as was shown above, on the background of significant differentials of barometric pressure during man-riding, passing through the air doors, blasting operatios. Taking into consideration high percentage of colds and chills with temporary loss of working ability and large number of rinites associated with this, we can conclude that in some cases acoustic load affects the miner on the background of a baroimpulse, formed due to disturbances in Eustachian tube conductance.

Calculations performed in accordance with the international standard ISO 1999, show that for most unfavourable acoustic conditions (cutters using pick hammers, operators of pneumatically powered driving shields, drifters working with hammer drills and others) the hearing impairment hazard amounts to 35-37 % even when the length of service is 10 years (which entitles to favourable pension conditions).

Subjected to increased levels of vibration are mainly miners who use equipment which generates noise and creates local vibration affecting hands of the worker. To this group belong cutters working with pick hammers on steep seams, face miners and drifters who perform blasting drilling with the use of hammer drills and electric drills. When all abovementioned types of manual mechanized tools are used, vibration exceeds allowed level 1,4-8 fold. Exceeding of maximum allowed levels is most clearly seen in low frequency portion of the spectrum, and in the medium frequency portion it is less evident.

Whole-body vibration of working places is less important

for coal mines, since the main part of mining equipment is controlled by an operator standing or lying on the floor of the working. Transport vibration, the source of which is self-propelled zail-track transport, and transport-technological vibration, generated by rock loading bucket-type machines controlled from special footboard, have hygienic importance [4].

Natural radioactivity of mine rocks is higher than that of coals, though concentrations of natural radioactive elements in all samples are clarkian, i.e. extremely low for sedimentary rock [10].

In scientific literature it is a common practice to give information on isolated biological action of individual physical factors; combined action is described less frequently. As a rule, specific characteristics of the body functional conditions are discussed.

We studied the influence which exposure doses of physical production factors involved have on biological effects. Thus, the length of service noise dose is determined using formula by Burns and Robinson (1970) [1]:

$$D = L_{Aeq} + 10Ig\ T/T_o \quad (1),$$

where Leq - equivalent noise level, T - length of service, years, T_o-1 year

Calculated langer of hearing deterioration is several times lower at high noise levels and short length of service, than at lower levels and longer service, even if the length of service doses are equal in these cases. It is necessary to underline the fact that when exposure exceeds 10 years, the length of service noise dose practically completely determines specific effects of noise action (table), the data obtained are comparable with materials of international standard [11].

Table

Risk or hearing impairment(%)depending on the length of service

Dose,	**Noise exposure, years**										
dBA	**1**	**3**	**5**	**7**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
101	1	7	7	11	13	13	12	12	10	10	10
106	2	9	14	22	24	26	26	26	21	21	21
111	3	12	25	31	35	35	32	32	32	29	29
116	4	20	30	45	46	46	43	43	43	41	41

Importance of combined effect of harmful industrial factors of coal mine environment is evident in an analysis of non-specific indices of functional state of coal miners" body with diagnosis of one of the forms of occupational pathology, when influencing one of the factors. Blood circulation system is used as an indicator of adaptative reaction of the body to the professional risk [6]. For example, among the cutters with different degrees of vibratory pathology 37 per cent patients with high arterial pressure, 14 per cent of which have hypertension were revealed. In-group of drillers respective values are 48 and 28 per cent. According to ECG study in 36 percent cutters and 25 per cent drillers the changes in heart rhythm (bradicardia) were revealed; in 31 per cent of cutters and 29 per cent of drillers the failure of conductance by type of delay (up to the bundle-branch block) in the right were revealed. By rheoencephalography data in 92 per cent cutters the changes filling of blood vessels and in 89 per cent the changes in vessel tones were revealed. In group of drillers the analogous indices make 92 per cent. Test results based on express-techniques suggested by Lastkov et al. (1992) show that 90 per cent of inspected miners which were subjected to both whole-body and local vibration might have vestibular analyzer disturbances[7].

CONCLUSIONS

Professional risk of vestibular disorders in coal miners is due to combined effect of occupational hazards, in particular those of physical nature.

When estimating doses of physical hazards, affecting the coal miners the greater dependence of biological effects from the time-factor was revealed.

Obtained relationship and developed techniques were used for creation of probabilistic criterions of increased risk of occupational pathology in coal miners.

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技术精矿，棉签，Siyazan粘土和地热水的应用
THE APPLICATION OF TECHNOLOGICAL CONCENTRATE, COTTON SWABS, SIYAZAN CLAY AND GEOTHERMICALLY WATER

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抽象。 该文章指的是使用植物废料和天然矿物质，但也可以用于恢复失去肥力，变成盐渍，石化，侵蚀和沼泽的土壤，以及生产生态纯净的高产小麦和草木。 浓缩。
关键词：棉签，珍珠岩，采矿和地热水，固相，液相。

Abstract. *The article refers to the use of plant waste and natural minerals, but can also be used in the restoration of soils that have lost their fertility, become saline, petrified, eroded and swampy, as well as in the production of ecologically pure high yields and concentrate.*
Key words: *Cotton swab, perlite, mining and geothermal water, solid phase, liquid phase.*

It is known that cotton is grown in more than 160 Southern and subtropical countries of the world, 1,200 different technical units are purchased from it. At present, cotton is grown on hectares in the southern and subtropical regions of Azerbaijan, so there are 100-110 thousand garbage in cotton grown on one hectare, and there are five times more nuts. According to 2016, cotton production in Azerbaijan was 89442 tons, 214661 tons of cotton waste was obtained from it. In 2022, when the production of raw cotton in the Republic reaches 500,000 tons, the amount of garbage from it will be 2.5 times higher. At present, cotton is used as the cheapest fuel in the regions where it is planted, or it is burned in the places where it is planted, and fuel is used [1].

The flowers formed during the burning of cotton litter pollute the soil and prevent the development of the plant growing there. On the other hand, smoke obtained as a result of combustion pollutes the atmosphere, hydrosphere and lithosphere. Despite this, cotton is rich in macro - and microelements, is a multicomponent nutrient-containing material for soil fertility, is one of the cheapest and one of the most active and waiting to be solved today.

The other material we use in the research work is geothermal and mining water. There are enough of them. These waters are rich in micro - and macroelements. There are enough Co, Zn, Mn, B and other elements in the waters that we will use in our intended research work. In this research work, local mineral waters were used. However, another objective of the research work is to use plant residues. Therefore, many types of these plants are excessive in our country, and there is also a need for their use in many areas. Specifically, it should be noted that the use of plant residues for the development of the non-oil sector is one of the main factors. Plants such as these are mainly the following, which until now have not been given the importance of their use. On the other hand, the content of the work is mainly due to the fact that when using macro - and microelement residues in various aggregate States, soil fertility required the use of a large amount of fertilizers, meliorants and plant preservatives. This is achieved by using various types of enema or was very expensive [2-5].

At the same time, it should be noted that the total area of the lands suitable for planting in the Republic of Azerbaijan is 1 mln. 454 thousand. 42– 43% of this soil is eroded to some extent, gives little or no harvest. At the same time, a certain part of the soil becomes saline and saline. The areas exposed to salinization are 12.5% in general and the salinized areas 11.2%. On the other hand, 30,000 hectares of land became unusable as a result of the exploitation of minerals.

Useless land in Absheron is 3.000 ha. Its 15,000 ha is on the balance sheet of the state oil company, while 3,2 ha is contaminated with oil waste and has fallen into the unused volume.

Taking this into account, the leadership of the Republic of Azerbaijan issued an order on September 29, 2006 on “complex measures for improvement of Ecology in the Republic of Azerbaijan for 2006-2020” in order to solve ecological problems in a planned manner. Based on this order and the law of the Republic of Azerbaijan on fertility of lands issued on 07.07.2010, our main goal in this work is to use plants and remains in the country, which are inexhaustible by developing the non-oil sector, rich in cheap, nutritious elements, having anti – bacteriological properties, intensifying various technical, technological and geoecological processes, these are also used in the regulation of soils, in the improvement of fertility and fertility [6-7].

To achieve this goal, it is necessary to determine the composition, chemical composition of the compound, to study the physical and chemical properties of the constituent elements of the soil and the quality of the products grown in this soil.

MATERIAL AND METHOD

The main purpose of the work was to use Siyazan clay and geothermal or mineral water as a natural mineral compound from the garbage of cotton plant. Their composition is given in table 1 and 2.

Table 1. *Chemical composition of the cotton swab residue, %*

The number name	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Cl	YTİ
Cotton swab	0,54	4,9	1,25	9,51	3,84	5,42	4,19	23,23	0,19	0,06	3,25	0,76	42,1

At burning mineral composition of cotton wool at 600°C:
1) $[MgO_{64}(Ca_{936})(CO_3)]$; 2) SiO_2; 3) $Ca(PO_3)_2$

Table 2. *Mineralogical composition, %*

CaO	KCl	$K_3CaH(PO_4)_2$	$K_2Mg(SO_4)_2$	Organic matter
0,82	0,52	2,84	1,36	94,0

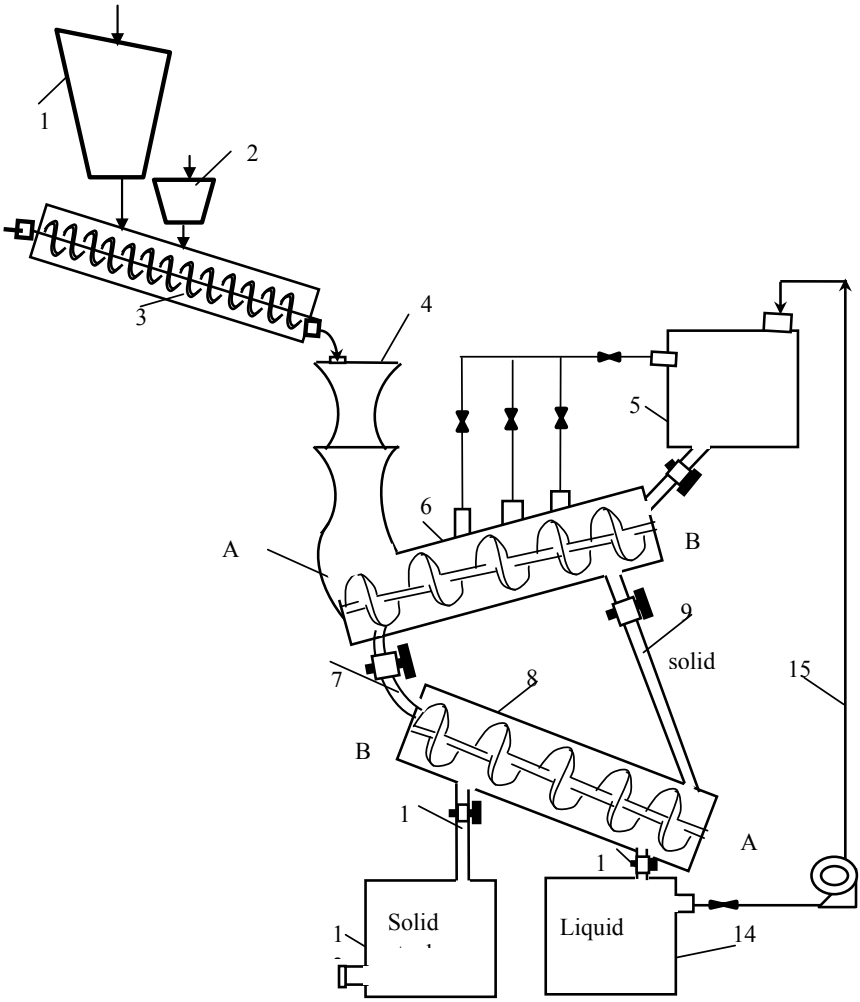
Chemical composition of Siyazan clay, %

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3	KT	CƏM
2,0	2,9	10,5	62,0	1,6	4,40	1,80	0,90	0,15	1,70	0,75	99,9

In the process, geothermal, mining or technical water was also used. In carrying out the research, it was taken into account that these waters are close to cotton-growing regions. The chemical composition of mineral waters in the territory of cotton-growing regions is given below, (q/l): Cu − 16; Zn – 15; Co – 5,0; SiO_2 – 0,22; Mn – 7,0; B – 4,0; remains H_2O.

The experiment and the devices used in the laboratory were carried out on the following principle.

Explanation of the technological scheme. The necessary amount of crushed cotton is filled to the bunker (1), while the Siyazan clay is filled to the bunker (2). The lower doors of both are opened, where the garbage, the cocoon and the Siyazan clay shne (1) are given. The mixture of garbage and silica clay is filled into the reservoir (4). At the same time, geothermal or mineral water is opened by a tap under the jaw (5), the liquid in it is inserted into the pipes, as well as into the B side of the shnekin (2). At that time, a mixture of cotton wool and Siyazan clay is also included by shnegin (2) A. Both combinations are carried out face to face in the Shnek (2). Then, the solid mixture Tube (2) coming out by the shnegin (9) B enters the shnegin (3) A side by the line. This disambiguation page lists articles associated (2) with the title Shnek (3) B. At the end, the composition of both solid and liquid is checked and sent for use.



The equipment included in two knegs: 1 – bunker for cotton and cocoon; 2 – bunker for Siyazan clay; 3 – sneg (1); 4 – dozator for mixture (storage) of cotton and Siyazan clay; 5 – geothermal or mining DEP reservoir; 6 – sneg (1); 7 – sneg (2) to sneg (3); 8 - sneg (3); 9 - sneg (2 solid mixture from) to snek (3); solid mixture from 11 – snek (3); solution from 12 - snek(3) to common liquid line; 13 - solid mixture to use; 14 - liquid to use; 15 – liquid product to reuse.

The table below lists the quantities of components included in the process and the materials received after processing when conducting experiments.

Table 3. *Quantities of incoming components and materials received after processing*

№	Components included in the device, (qr)			Materials purchased after processing	
	Cotton swab	perlite	Mining and geothermal water	Solid phase	Liquid phase (K, Mg, P, Cu, Zn)
1	100	20	40	54	106
2	100	30	25	52	103
3	100	25	20	48	97
4	100	20	25	45	100
5	100	20	20	41	99
6	100	35	25	49	111
7	100	25	20	43	102

At the same time, studies are continuing with the remains of other plants, as well as with the addition of other minerals.

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纳扎尔-艾洛克矿床的高岭土研究
THE STUDY OF KAOLIN CLAYS OF THE NAZAR-AILOK COAL DEPOSIT

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抽象。 在工作中提出了Nazar-Ailok矿床煤层中高岭土的化学，元素和硅酸盐分析结果。 黏土的物理化学研究表明，它们属于矿物原料的主要类型，可用于生产氧化铝和耐火制品

关键词：Nazar-Ailok矿床，煤层，矿物原料，高岭土，组成。

Abstract. *In the work presents the results of chemical, elemental and silicate analysis of kaolin clays of coal seams of the Nazar-Ailok deposit. Physico-chemical studies clays, showed that they belong to the main type of mineral raw materials, and can be used in the production of alumina and refractory products*

Key words: *Nazar-Ailok deposits, the coal seams, mineral raw materials, kaolin clay, composition.*

The Nazar-Ailok coal deposit is confined to the undivided Lower-Middle Jurassic coal-bearing formation, spread over a small area among the Paleozoic sedimentary-metamorphic formations of the Karategin ridge. Structurally, Jurassic sediments fill an asymmetric graben, which extends in the sub-latitudinal direction for 10-15 km and has a width of 1-3.5 km. In throughout the area, Jurassic deposits are complicated by tectonic disturbances and low-amplitude faults [1,2].

Various rocks participate in the structure of Jurassic deposits: boulder conglomerate breccias (lower sections), different-grained gravelites, sandstones and

siltstones with different thicknesses of the strata. Kaolin clays are associated with coal-bearing clay deposits of the Lower Jurassic and facies accumulation conditions relate to lake and lake-bog depositions. Kaolin clay is a redeposited product of weathering crust. Productive strata of clays are interbedded with coal seams and are represented by carbonaceous clays. The total thickness of the productive coal-clay stratum is 300-350m [3].

The aim of this work is a detailed study of kaolin clays of the Nazar-Aylok deposit. For this, several furrow and 5 technological samples were selected from the open-pit clay productive quarries, each weighing 100 kg each, covering the thickness of clay layers of the productive stratum.

In laboratory conditions, chemical and physico-chemical studies of the technological sample of clays were carried out to establish their chemical, mineralogical and elemental compositions, the results are given in tables 1 and 2.

Table 1

The chemical composition of the technological sample of the Nazar-Ailok deposit (technological sample No. 1)

Sampling Place	**The content of components, in wt.%**											
Nazar- Aylok (technological sample No 1)	LOC	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	Mn_2O_3	Fe_2O_3
	14.336	0.09	0.60	34.43	41.68	0.10	0.03	1.21	0.24	1.37	0.16	5.75

The mineralogical composition was determined on a high-tech D2 Phazer diffractometer (Germany) with the Diffrac.Eva V3.2 software Cristallography Open database (Rev 173445 2018.01.04), the content of oxides and elements was determined on a high-tech wave-dispersive X-ray fluorescence spectrometer (WD X-ray FS) Germany S8 Tiger), and the content of the main component of Al_2O_3 by WD X-ray FS and chemical methods.

Sample preparation on WD X-ray FS is carried out by fusion. Dissolution and decomposition of part of the sample using flux (flux) and obtaining a uniform glass completely neutralize the effects associated with the particle size and heterogeneity of the test sample.

The meltdown method has several advantages and allows you to:

a - dilution of the sample to reduce the matrix effects;

b - introduce additional substances such as absorbers or internal standards to reduce or compensate for matrix effects;

c - the possibility of preparing standard samples of the required composition.

Table 2

Elemental and silicate analysis of kaolin clays (technological sample No. 1) (carried out on a WDFR spectrometer S8 Tiger (Germany))

Oxide Analysis		Elemental analysis		Silicate analysis	
Na_2O	0.09 %	Na	0.0928 %	Na_2O	0.09%
K_2O	1.134 %	K	0.945 %	K_2O	1.21%
CaO	0.241 %	Ca	0.172 %	CaO	0.24%
MgO	0.60 %	Mg	0.361 %	MgO	0.60%
P_2O_5	0.10 %	P	0.0437 %	P_2O_5	0.10%
Fe_2O_3	5.71 %	Fe	3.993 %	Fe_2O_3	5.75%
TiO_2	1.3848 %	Ti	0.829 %	TiO_2	1.37%
Al_2O_3	34.45 %	Al	18.227 %	Al_2O_3	34.43%
SiO_2	42.74 %	Si	19.972 %	SiO_2	41.68%
ZrO_2	0.189 %	Zr	0.1131 %	ZrO_2	0.192 %
Mn_2O_3	0.171 %	Mn	0.124 %	Mn_2O_3	0.16%
SO_3	546 ppm	S	148 ppm	SO_3	0.03%
Cl_2	636 ppm	Cl	333 ppm	LOI	14.336%
As_2O_3	319 ppm	As	177 ppm		
CuO	314 ppm	Cu	238 ppm		
Cr_2O_3	293 ppm	Cr	112 ppm		
NiO	171 ppm	Ni	117 ppm		
ZnO	160 ppm	Zn	112 ppm		

Essentially, the fusion procedure consists in heating the sample mixture with the flux at a high temperature (from 800 to 1200 ° C), the flux melts and the sample dissolves. On the whole, the composition and terms of cooling should be such that, after cooling, the final product is a single glass phase.

The heating of the sample mixture with flux was carried out on special plants in crucibles made of platinum alloys.

Sample preparation for the S8 Tiger spectrometer for producing fused disks, according to the Geo-Quant program, includes the following: determination of the loss mass on calcination (LOC) and the addition of flux to the test sample. The flux consists of 3.14 g of lithium tetraborate ($Li_2B_4O_7$) and 3.14 g of lithium metaborate ($LiBO_2$).

It has been established that the main clay mineral is kaolinite, and the illite mineral accompanies it as an impurity. The results of x-ray phase analysis are shown in Fig. 1.

It is known that this type of clay is a technological raw material for producing alumina and making refractory products.

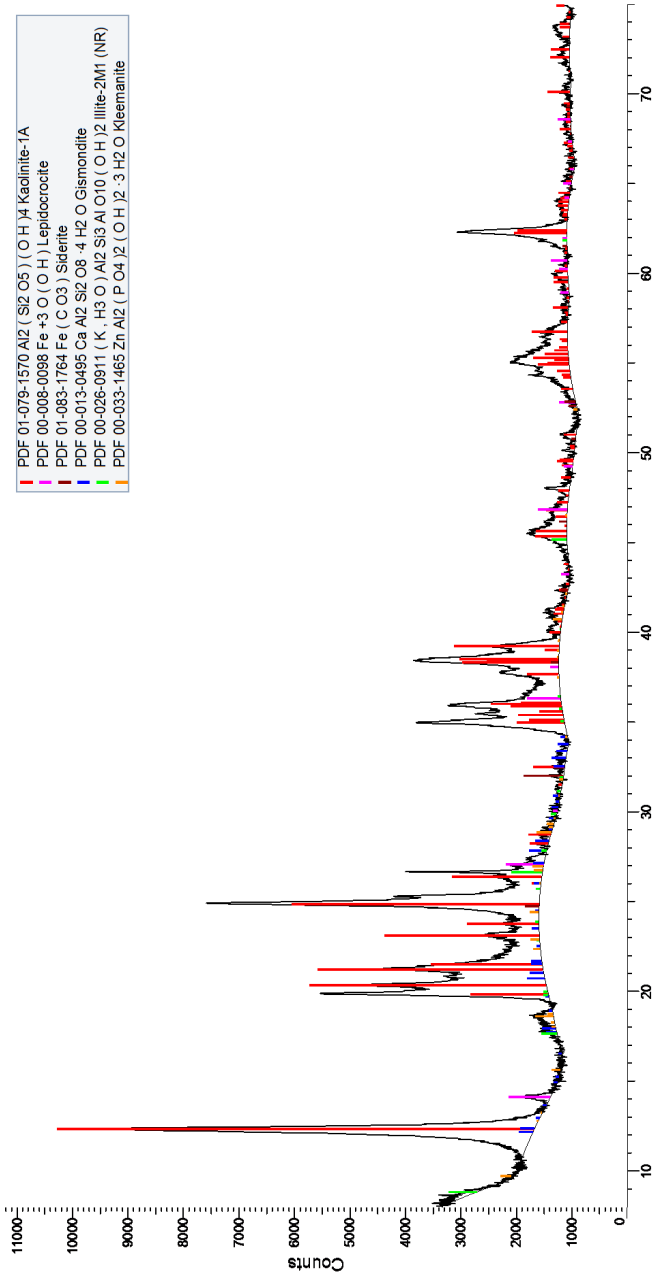

***Figure** - 1. X-ray phase analysis of kaolin clays (technological sample No. 1)*

As can be seen from the above data, the productive clays of the Nazar-Ailok coal deposit in terms of the content of the main components: Al_2O_3 -34.431%, coloring oxides Fe_2O_3 + TiO_2 7.12%, the mineralogical composition and the clay fraction yield of more than 50% correspond to the average dispersed hydromica-kaolinite raw material. Other physical properties of these clays show that: by their non-wetting properties, sintering temperature, refractoriness, and quartz composition (SiO_2-90%), they can be classified as moderately dispersed main clays. Some physical properties of technological sample No. 1 of productive clay clays of the Nazar-Aylok coal deposit are shown in Table 3.

Table 3

Mineralogical composition and some physical properties of technological sample No. 1

Breed type	Fine mineral composition	The mineral composition of the coarse fraction,%	Sintering temperature, ° C	Water absorption of the calcined shard,%	Softening point, ° C
Kaolin clay	Hydromica-kaolinite	Quartz (SiO_2-90)	1300	6.5	1600

By the method of semi-dry pressing, 100 pcs of bricks were made, which, after drying, were fired in an oven at 1300 ° C.

The control analyzes of brick samples showed that the content of: Al_2O_3 - 37.6%, mechanical strength - 180-210 kgf / cm^2 and porosity 10-15% correspond to refractory products.

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使用对数图模拟酸的两组分混合物中所有颗粒的平衡浓度

MODELLING OF EQUILIBRIUM CONCENTRATIONS OF ALL PARTICLES IN TWO-COMPONENT MIXTURES OF ACIDS USING LOGARITHMIC DIAGRAMS

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抽象。强和弱电解质的水溶液和非水溶液的理论和实践领域的研究仍然非常重要。在大多数研究中，酸碱相互作用仅被视为溶液pH值变化的函数。众所周知，溶液中的离子强度会受到系统中所有离子的影响，这些离子的浓度在水溶液和更复杂的非水溶液的相互作用过程中会发生变化，其基本特性（介电常数，介电常数，离子积，偶极矩，粘度等）。根据质量作用定律，以及表示等Lesnye过程，溶剂的离子积，电子中性和电解质体系中的母体平衡的方程式，我们提出了一种方法来考虑电解液浓度的影响。系统中所有带电粒子（不仅是氢离子–pH）的溶液离子强度，活度系数，因此还取决于解离的热力学常数，还表示从溶液中所有带电粒子的平衡浓度的依赖性。通过电位计法确定的溶液的酸度，以简便，客观的对数标度为准，从而可以评估滴定中任何一点上所有颗粒的浓度。

关键词：酸碱相互作用，氢离子浓度，对数图，流平溶剂。

Abstract*. Research in the field of theory and practice of aqueous and non-aqueous solutions of strong and weak electrolytes is still very relevant. In most studies, acid-base interactions were considered only as a function of changes in the pH of the solution. It is known that the ionic strength of the solution is influenced by all ions present in the system, whose concentration is variable in the process of interaction in aqueous and more complex non-aqueous solutions, which differ significantly in their basic properties (dielectric permittivity, ionic product, dipole moment, viscosity, etc.). On the basis of the law of mass action, as well as equations expressing equal-Lesnye processes, the ionic product of the solvent, electroneutrality and mother-cial balance in electrolytic systems, we have proposed a method to consider the influence of the concentrations of all charged particles in the system (not only of hydrogen ions – pH) for ionic strength of solution, activity coefficients and, consequently, on the thermodynamic constant of dissociation, and also to Express the dependence of the equilibrium concentra-*

tions of all charged particles from the acidity of the solution, determined by the potentiometric method, in an easy and objective a logarithmic scale, enabling the evaluation of concentrations of all particles at any point in the titration.

***Keywords**: acid-base interactions, hydrogen ion concentration, logarithmic diagram, leveling solvent.*

Introduction

A lot of articles and monographs have been devoted to questions of acid-base interactions; a large number of posts on forums of various levels have been heard [1 - 4]. Most works devoted to acid-base equilibria based on potentiometric measurements of the acidity or alkalinity of solutions give ideas about the values of the concentration of only hydrogen ions with the subsequent calculation of dissociation constants [5 - 9].

Meanwhile, to determine the thermodynamic constants of electrolyte dissociation, it is necessary to take into account not only the concentration of hydrogen ions (pH of the solution), but also all charged particles that significantly affect the ionic strength of the entire system and, as a consequence, the quantitative characteristic in the form of an activity coefficient and K_{diss} [10 - 14]. Sometimes a significant difference was observed between the concentration (apparent) and more accurate thermodynamic constant, more acceptable for theoretical studies of the acid-base strength of electrolyte solutions.

Purpose of the study

The study explores the behavior of a two-component mixture in water, develops a model for estimating the equilibrium concentrations of all particles in a system using logarithmic diagrams "pH of the solution — equilibrium concentrations of the components of the mixture", graphical and mathematical expressions of diagrams to determine the thermodynamic dissociation constants of hydrochloric (non-salt, cooked saturation of bidistillate with gaseous hydrogen chloride) and chloroacetic acid.

Experimental part

Research methods

The integral curve of a mixture of hydrochloric and chloroacetic acids corresponding to the joint neutralization of both acids with dissociation constants differing by a small difference in pK ($\Delta pK < 3$) was constructed by potentiometric titration. A logarithmic diagram is constructed for estimating the equilibrium particle concentrations at any titration point; examples of evaluating the mentioned concentrations depending on the volume of the added KOH/HOH titrant are given.

Mathematical and graphical expressions of logarithmic diagrams

Let us consider an example of the reaction of the interaction of a weak monobasic acid with water

$$HA + HOH \leftrightarrow H_3O^+ + A^- \quad (1)$$
$$HOH + HOH \leftrightarrow H_3O^+ + OH^- \quad (2)$$
$$HA + 3HOH \leftrightarrow 2H_3O^+ + A^- + OH^- \quad (3)$$

In the following text, for simplicity of reasoning and subsequent calculations, we denote the hydroxonium ion H_3O^+ simply as H^+.

To calculate the equilibrium concentrations, it is necessary to compose a system of four equations with four unknowns:

1. An equation based on the application of the law of masses to dissociate a weak acid [reaction (1)]:

$$(C_{H^+}) \cdot (C_{A^-})/C_{HA} = K_a, \quad (4)$$

where K_a - is the acidity constant of the weak acid HA.

2. The expression for the ionic product of water in accordance with the reaction (2):

$$(C_{H^+}) \cdot (C_{OH^-}) = K_W, \quad (5)$$

where K_W - autoprotolysis (ionization) constant, or ionic product of water. 3. The equation obtained on the basis that protons cannot be in a free state in aqueous solutions and the number of hydrated protons given up by monobasic acids is equal to the number of hydrated protons accepted by monoacid bases. In other words, the total concentrations of all formed monobasic acids and monoacid bases of this system are equal to each other. This is reflected in the right-hand side of reaction (3), whence it follows:

$$C_{H^+} = C_{OH^-} + C_{A^-} \quad (6)$$

4. An equation based on the application of the law of conservation of mass (material balance) to acid or base, respectively:

$$C_0 = C_{HA} + C_{A^-} \quad (7)$$

where C_0 – is the total concentration of acid (or base). The total concentration is constant with a constant volume of solution, this condition is usually well consistent with practice (for example, during titration).

The usual integral titration curves that can be constructed by calculating the pH at each mo-ment of titration do not give an idea of the equilibrium concentrations of all particles in the titrated solution [15]. But to assess the acid-base equilibrium (in polyelectrolytes or mixtures of strong and weak electrolytes), it is necessary to know exactly these quantities. This possibility is given by logarithmic diagrams [16 - 17]. For their construction, the pH values are plotted on the abscissa axis, and the decimal logarithms of the concentrations of all particles are plotted on the ordinate axis.

The relationship between the lgC-*pH* diagrams and titration curves greatly simplifies the con-struction and analysis of the titration curve.

Figure 1 shows the integral titration curve of an aqueous solution of a mixture of 0.05 M hy-drochloric ((HA_1) and chloroacetic (HA_2) acids with an aqueous solution of KOH. As you can see, the mixture is titrated with one jump, corresponding to the simultaneous neutralization of both ac-ids. In this example, water is a leveling solvent with respect to the mixture in question.

The curves (rows) shown in the lgC – *pH* diagram (Fig. 2) are constructed on the basis of equations in which the concentration of C_{HA} and C_A- is a function of *pH*. These dependencies are derived by combining the equations (4), (5), (6) and (7). When solving them with respect to C_{HA} and then with respect to C_A- the following equations are obtained:

$$C_{HA} = C_0C_H^+/(C_H^+ + K_a) = C_0/(1+K_a/C_H^+) = C_0/[1+10^{(pH-pKa)}] \quad (8)$$

$$C_A- = C_0K_a/(C_H^+ + K_a) = C_0/(1+C_H^+/K_a) = C_0/[1+10^{(pKa-pH)}] \quad (9)$$

Logarithm of equation (8) leads to (10)

$$lgC_{HA} = lgC_0 - lg[1+10^{(pH-pKa)}] \quad (10)$$

and equations (9) - to the expression (11)

$$lgC_A- = lgC_0 - lg[1+10^{(pKa-pH)}] \quad (11)$$

The following figure (Fig. 2) presents a graphical expression for this process in the form of a logarithmic diagram using calculation equations (10), (11) for different neutralization sites HA_1 and HA_2. So row 1 characterizes the course of the change in the equilibrium concentration of the first component HA_1, row 2 corresponds to a change in the equilibrium concentration of the base acid A_1^- conjugated to the acid. Similarly, row 3 corresponds to a change in the equilibrium concentration of the second component of HA_2, and row 4 corresponds to a change in the equal concentration of A_2^- (conjugated with chloroacetic acid base $ClCH_2COO^-$).

The acid strength, which is characterized by the dissociation constant K_a, is determined by the equation $pH = pK_a$, taking the *pH* value along the parallel branch of HA, starting from which (at the same scale along the axes of abscissa and ordinate) the acid line deviates at an angle of 45^0 down to the right (row 1), and the base line at the same angle - down to the left (after the intersection of rows 2 and 3). At this point $C_{HA} = C_A^-$, $lg\ C_{HA} = lg\ C_A^- = lg\ C_0 - 0{,}301$.

The equality $pH = pK_a$ can be shown from the equation for the equilibrium constant of the weak acid dissociation process

$$HA \leftrightarrow H^+ + A^-$$

$$K_a = [C_H^+] \bullet [C_A^-]/[C_{HA}],$$

When $[C_{HA}] = [C_A^-]$, i.e. half of the acid is titrated.

When comparing Fig. 2 and 3, it can be stated that, in contrast to the integral curve, the loga-rithmic diagram is much more informative, since it is possible to estimate the equilibrium concen-trations of all particles in the system under consideration.

Table 1 shows fragments of potentiometric titration data for a mixture of HCl and $ClCH_2COOH$ with concentrations of 0,05 *M* KOH aqueous solution, equilibrium concentrations of all particles of the system, ionic strength and acid activity coefficients for estimating the thermody-namic dissociation constants of the mixture components using the derived calculation equations for different sections neutralize HA_1 and HA_2.

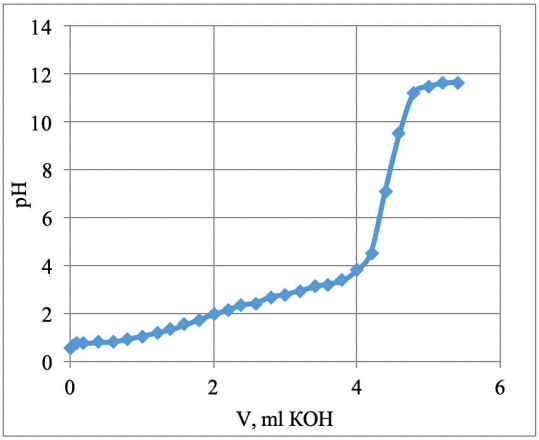

Fig. 1. *The integral titration curve in water of a mixture of HA_1 and HA_2 acids with an aqueous solution of potassium hydroxide (the abscissa axis is - V ml KOH, OH, the ordinate axis is the pH of the solution)*

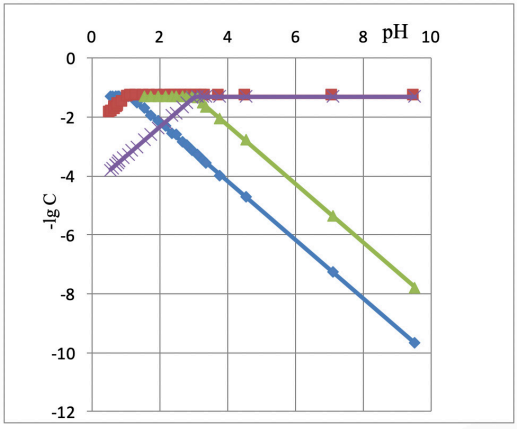

Fig. 2. *Logarithmic pH-diagram of a mixture of 0.05 M HA_1 and 0.05 M HA_2. K (HA_1) = 10^{-1} mol/L; K (HA_2) = 10^{-3} mol/ (abscissa axis –pH values; ordinate axis – logarithm of the concentrations of all equilibrium particles). Row 1 – lg[HA_1]; Row 2 - lgC(A_1^-); Row 3 – lg C(HA_2); Row 4 – lgC(A_2^-).*

Table 1

Some data of potentiometric titration of a mixture of HA_1 and HA_2 with an aqueous solution of potassium hydroxide (columns 1, 2), parameters for constructing a logarithmic diagram and calculations of pK_1, pK_2 (columns 3 – 11)

V, ml NaOH	pH	$[H^+]$	lg $[HA_1]$	lg$[A_1^-]$	lg$[HA_2]$	lg$[A_2^-]$	I	lg f	pK_{HA1}	pK_{HA2}
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
0,01	0,55	0,2818	-1,301	-1,871	-1,301	-3,771	0,08254	-0,1198	1,377	3,276
0,05	0,69	0,2041	-1,301	-1,731	-1,301	-3,631	0,09698	-0,1284	1,377	3,276
0,1	0,71	0,1949	-1,301	-1,711	-1,301	-3,611	0,09924	-0,1297	1,379	3,279
0,2	0,74	0,1819	-1,301	-1,681	-1,301	-3,581	0,10273	-0,1316	1,383	3,283
1	1,05	0,08912	-1,301	-1,371	-1,301	-3,271	0,14679	-0,1531	1,426	3,326
1,6	1,51	0,03090	-1,691	-1,301	-1,301	-2,811	0,16054	-0,1590	1,438	3,338
2	1,95	0,01122	-2,131	-1,301	-1,301	-2,371	0,16471	-0,1608	1,441	3,342
2,6	2,45	0,00354	-2,631	-1,301	-1,301	-1,871	0,17813	-0,1662	1,452	3,352
3	2,79	0,00162	-2,971	-1,301	-1,301	-1,531	0,19930	-0,1742	1,468	3,368
3,6	3,24	0,00057	-3,421	-1,301	-1,521	-1,301	0,22361	-0,1828	1,485	3,386
4	3,78	0,00016	-3,961	-1,301	-2,061	-1,301	0,22361	-0,1828	1,485	3,386
4,2	4,52	3,02E-05	-4,701	-1,301	-2,801	-1,301	0,22361	-0,1828	1,485	3,386
4,4	7,1	7,943E-08	-7,281	-1,301	-5,381	-1,301	0,22361	-0,1828	1,485	3,386
4,6	9,5	3,162E-10	-9,681	-1,301	-7,781	-1,301	0,22361	-0,1828	1,485	3,386

Statistical processing of the values of the indices of the thermodynamic constants of dissociation (columns 10 and 11) for 28 points (in the full table) leads to the following results: $pK_{HA1} = 1{,}443$ and $pK_{HA2} = 3{,}344$.

As can be seen from the table, the equilibrium concentrations (columns 4-7) are significant and therefore affect the values of ionic strength *I* (column 8), activity coefficients *f* of ions (column 9) and, as a result, the indices of thermodynamic dissociation constants of acids HA_1 and HA_2 (columns 10 and 11).

Discussion of the results

As can be seen from Fig. 1, the potentiometric titration curve of a mixture of acids of different strengths is characterized by the presence of one jump in *pH*. The second jump is absent, since acids are characterized by fairly close acidity constants ($pK_{HA1} = 1{,}00$ and $pK_{HA2} = 3{,}00$). It is known that differentiation of electrolytes is possible when the ratio of dissociation constants $K_{HA1} / K_{HA2} \geq 10^3$. Therefore, water in this case is a leveling solvent. More objective calculations taking into account all equilibrium particles in the analyzed system are somewhat different from those known in the literature (compare $pK_{HCl} = 1{,}00$ and 1,443,

$pK_{ClCH2COOH}$= 3,00 and 3,344). That is why, for more convincing reasoning, it is preferable to take into account the equilibrium concentrations of all particles in the analyzed solutions to obtain objective thermodynamic dissociation constants of the components of the analyzed system.

Fig. 2 and Tab. 1 make it possible to estimate the equilibrium concentrations of all particles in the acid-base system under consideration. So, when added to a titrated system:

a) 0,05 ml of KOH titrant equilibrium concentrations are: $lg[HA_1]$ = -1,301; $lgC(A_1^-)$ = - 1,731; $lg\ C(HA_2)$ = -1,301; $lgC(A_2^-)$ = - 3,631;

b) $V_{KOH/HOH}$ = 1,4 ml: : $lg[HA_1]$ = -1,501; $lgC(A_1^-)$= - 1,301; $lg\ C(HA_2)$ = -1,301; $lgC(A_2^-)$ = - 3,001;

c) $V_{KOH/HOH}$ = 2,0 ml: : $lg[HA_1]$ = -2,131; $lgC(A_1^-)$= - 1,301; $lg\ C(HA_2)$ = -1,301; $lgC(A_2^-)$ = - 2,371.

Conclusions

1. Interactions of a mixture of electrolytes in a leveling water solvent are considered, based on the laws of effective masses, the ionic product of the solvent, electroneutrality, mass conservation (material balance), model equations are derived for estimating all equilibrium particles in the system under consideration.

2. The application of the derived model equations of state of ions and molecules in electrolyte solutions leads to the presentation of a diagrammatic dependence of the concentrations of all equilibrium particles on the pH of the system (in buffer regions).

3. In contrast to the integral curve corresponding to the joint neutralization of both acids, the representation of the process in logarithmic coordinates leads to an estimate of more acceptable and objective values of the equilibrium concentrations of all particles in the titrated system, which greatly facilitate the calculation of ionic forces, activity coefficients and, as a result, to obtain more exact, more justified thermodynamic constants of dissociation of hydrochloric (not saline) and chloroacetic acids in a leveling solvent water.

4. From the diagram "negative logarithms of the concentrations of all particles — the pH of the studied solution" (Fig. 2), it can be seen that the difference in the indices of the thermodynamic dissociation constants of both components of hydrogen chloride (at the intersection of rows 1 and 2) and chloroacetic (intersection of rows 3 and 4) acids does not reach (example: $\Delta pK = pK_{ClCH2COOH} - pK_{HCl} =$ 3,344 – 1,443 = 2,901). This is a sign of the leveling effect of the solvent, since ΔpK < 3,000.

5. The possibility of assessing the equilibrium concentrations of all particles (ions and molecules) directly from the graph (or table) is proposed.

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熔融金属温度场和传质的计算
CALCULATION OF TEMPERATURE FIELD AND MASS TRANSFER IN MOLTEN METALS

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抽象。 本文介绍了使用钾，钡和铯的晶种和金属基质计算石墨的温度场和传质的方法。 石墨与一种有前途的纳米电子材料-石墨烯相关联。 用于生产石墨烯的主要现有方法是基于热解石墨对层的机械裂解。 计算的结果表明，反应池中的轴向温度梯度可以由于石墨的整体传质速率而显着变化，石墨的传质速率随金属基材和加热系统的配置而变化。 还计算了钾，铯和钡等金属基质上反应池中的温度场

关键词：温度场的计算，传质，钾，钡和铯的种子和金属基质，石墨烯，热解石墨，纳米电子学。

Abstract. *The article describes the calculation of the temperature field and the mass transfer of graphite using seeds and metal substrates from potassium, barium and cesium. Graphite is associated with one of the promising materials for nanoelectronics - graphene. The main existing method for the production of graphene is based on the mechanical cleavage of layers from pyrolytic graphite. As a result of the calculations, it was shown that the axial temperature gradients in the reaction cell can be substantially changed due to the overall mass transfer rate of graphite, varying by the metal substrates and the configuration of the heating system. Temperature fields were also calculated in reaction cells on substrates of such metals as potassium, cesium and barium*

Keyword: *calculation of the temperature field, mass transfer, seeds and metal substrates from potassium, barium and cesium, graphene, pyrolytic graphite, nanoelectronics.*

1. Introduction

Carbon is one of the most widespread elements in nature. Graphite is one of the main carbon nanoforms, there are also the following graphite precursors: colloidal graphite, nanographite and carbonized paper.

The crystallization of graphite in thermodynamic stability region with metals employed should be classified as a process of carbon phase transitions in molten metals. [1, 2] State that the Strong - Wentorf method developed in 1970–1971 is the main method of growing monocrystal on seed material [3].

This paper aims to calculate temperature patterns and mass transfer when seed material and metal substrates are used to make graphite.

2. Model Description

Graphite is the most stable modification of carbon under standard conditions. There are three types of graphite with almost ideal structure:

• natural graphite;
• pyrolytic graphite;
• synthetic graphite [4].

In laboratory studies, pyrolytic graphite is most often used. The article [5] describes in great detail the method of its production, and it is this graphite that is used in the model for calculations.

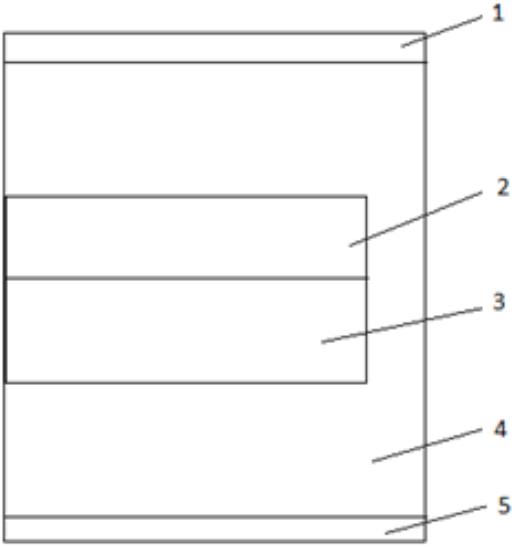

Figure1. *Thermal circuit of the reaction cell (1/2 part of the axial section): 1 - upper heating disk; 2 - graphite film; 3 - metal substrate (potassium, cesium or barium); 4 - bottom heating plate*

The temperature difference between graphite and seed material, the values of axial radial temperature gradients are usually corrected experimentally. The heating element is almost entirely composed of graphite. The resistive properties of graphite of different brands do not differ significantly; hence difficulties arise when setting the parameters of the reaction cell heating sys-tem [1].

The use of dispersed composites to create resistive system of cell heating permits to significantly simplify the process of setting temperature distribution in the reaction volume (cell). Methods of computer modeling of potential thermal patterns are thoroughly described in [6–7]; they allow studying temperature distribution in the reaction cell by means of stage-by- stage modeling.

The schematic diagram of cell for monocrystal growth on seed material is shown on Figure 1. The cell is heated with electrical current. The stationary regime in reaction cell is characterized by stable temperature pattern with 10–40 ◦ C temperature difference. The growth of monocrystal is carried out on seed crystal by means of carbon diffusion. The monocrystal growth rate depends on temperature difference potassium, barium, cesium is chosen as metal of substrates.

3. Operating Principle

The calculation of graphite stationary temperature pattern in the reaction cell implies solving equation of second order (1) with differential derivatives under corresponding boundary conditions:

$$k(x,y.z)\frac{\partial^2 T}{\partial x^2} + k(x,y.z)\frac{\partial^2 T}{\partial y^2} + +k(x,y.z)\frac{\partial^2 T}{\partial z^2} = w(x,y.z) \qquad (1)$$

where: k(x, y, z) is the temperature conductivity; T (x, y, z) is the potential function of temperature; w(x, y, z) is the specific heat capacity.

It is practically impossible to represent a solution to the equation as it is too difficult to configure the growth cell and to set boundary conditions. To calculate thermal field of the reaction cell, the finite element method represented as finite difference method is implemented [7].

At the initial stage of thermal field calculation the cell is considered with required level of detail and boundary conditions for the system are defined.

To calculate diffusion mass transfer and temperature pattern, the synthesis of graphite is carried out by means of thermocatalytic decomposition of hydrocarbon gases on the metal surfaces with different nanocarbon structures formed (CVD).

Calculation of temperature pattern in growth cell and temperature distribution permits to solve the problem of graphite mass transfer; at that, boundary conditions are represented by the values of solubility coefficient for graphite on metal substrates under the temperatures, defined at the previous stage of solving the problem. The diffusion current density can be calculated according to the formula (2):

$$J = D\frac{12}{V}\cdot + \frac{\partial X^a}{\partial T}\cdot \Delta T \cdot \frac{\partial \bar{C}}{\partial n} \quad (2)$$

where: D is the molten metal diffusion coefficient; V is the molar volume of molten metal; X^a is the carbon solubility coefficient for molten metals; ΔT is the temperature difference; C is the dimensionless concentration of carbon; n is the normal to the surface with equal concentration.

4. Results

The calculations we have carried out show that axial temperature gradients can be significantly altered with respect to overall rate of graphite mass transfer, by changing metal substrates and heating system configuration.

Figure 2 shows the temperature distribution in growth cell. The experimental data cited in [1] state that the maximum temperature of graphite is 1530^{O} C, when the temperature at the seed is equal to 1420^{O}C, the maximum temperature of the seed sur-face amounts to 1482^{O}C.

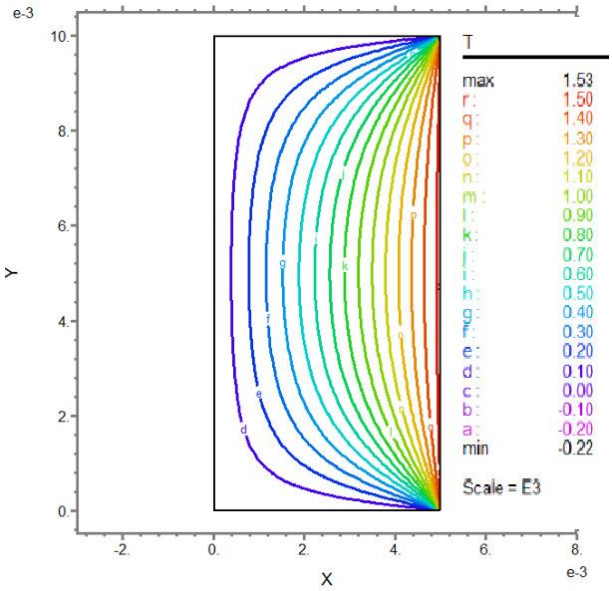

Figure 2. *General graph of temperature field distribution in reaction cell*

Temperature patterns are theoretically calculated for reaction cells on the potassium, cesium and barium metal substrates. Figure 3 shows graphs of temperature curves for the above metal reaction cells compared to the experimental one [1].

When the temperature distribution is compared, it is obvious that the growth of graphite in the reaction cell is parabolic and depends on chemical configuration of metals. Graphite monocrystals on barium and potassium surfaces grow at higher temperatures and are heated to 1727^{O} C ÷ 1927^{O} C, the temperatures are lower, about 1027^{O} C, on barium surface.

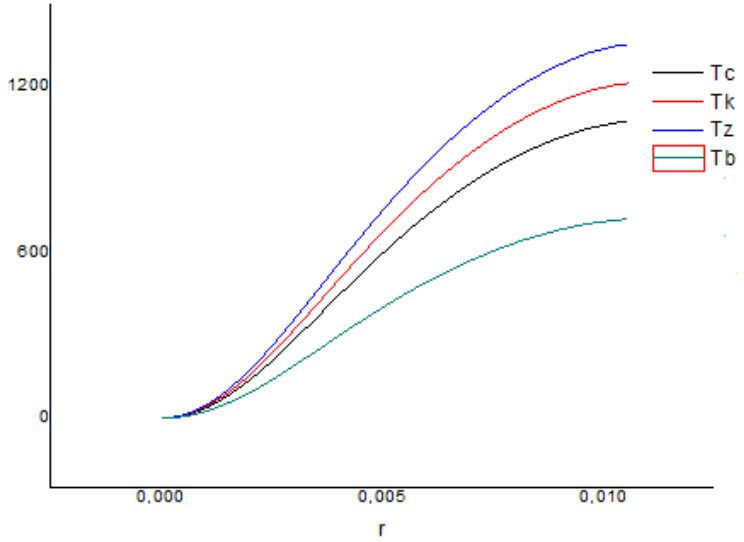

Figure 3. *Temperature curves: Tb - barium, Tk - potassium, Tz - cesium, Tc –maximum temperature of graphite crystal in the center of the substrate to periphery*

It is feasible to calculate the values of graphite diffusion current from the site of the seed

The distance between the central and periphery seed crystals is 5 mm for the reaction cell diameter, equal to 16 mm [1]. Numerical calculations indicate that maximum diffusion current density is to be concentrated in the central part of the substrate amounting to not less than

(1.1 - 1.4) · 10^{-3} mg × mm^{-2} × s^{-1}.

In Figure 4 shows the diffusion flux of graphite into the reaction cell and shows the numerical calculations of the specific heat power, depending on the location of the seed. Graphical results are presented in dimensionless form. The maximum specific power is 650 W.

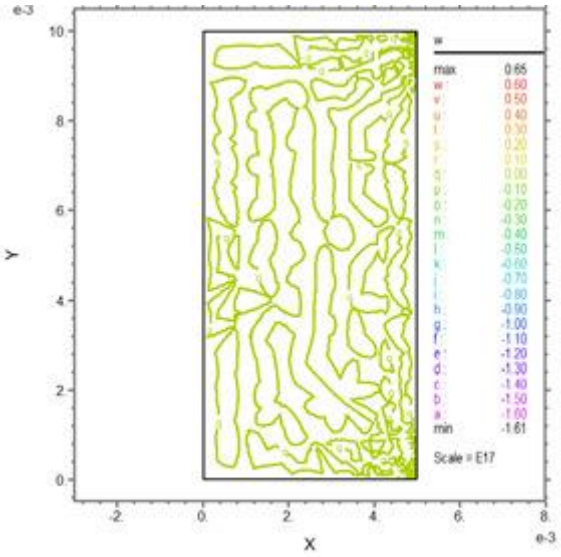

Figure 4. *The diffusion flow pattern of graphite*

If the seed crystal is located on the periphery, the conditions for graphite monocrystal growth ar less favorable - the value of the diffusion current density is from 0,6 × 10^{-4} to 1.4 × 10^{-3} mg×mm^{-2}× s^{-1}. Such scheme of mass transfer is preferable for the growth of carbon monocrystals and its modifications, with the seeds located in the periphery of metal substrate. Hence, to grow one monocrystal with the largest mass, it is advisable to use the scheme with one seed at the center; to grow several monocrystals, the seeds are to be placed closer to periphery.

5. Conclusion

Employing such methods as CVD, Strong-Wentorf method, adsorption and intercalation of carbon and its modifications, it is possible to calculate carbon mass transfer, its direction and current density while growing graphite and diamond monocrytals on seed material by means of temperature gradient. The obtained results give an opportunity to improve the technologies of carbon nanoforms synthesis as well as definition of their main parameters in the future.

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西伯利亚东部南部景观中worm分布的生态和地理特点
ECOLOGICAL AND GEOGRAFICAL PECULIARITIES OF EARTHWORMS' (OLIGOCHAETA, LUMBRICIDAE) DISTRIBUTION IN LANDSCAPES OF THE EASTERN SIBERIA' SOUTH

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抽象。在Minusinskaya洼地，Leno-Angarskoe高原和Irkutsko-Cheremkhovskaya平原的局部（生物大片），拓扑结构（东非西伯利亚东部）土壤worm群落结构及其在土壤中的垂直和空间分布的景观生态学分析相）和区域级别。

对地理站的长期观测已用于构建示意图，描绘景观和区域范围内earth的数量特征和物种组成的变化。

本文考虑了自然因素影响下社区结构的变化规律：植物盲（植被的特殊性），根生和气候（土壤的热液状态）条件和人为因素：消除木材，火灾，牧场的不合理使用，技术污染，娱乐等。

worm群落的生物多样性变化的主要趋势是，随着气候干旱的增加，物种数量减少，并且降温性和人为压力增强。

关键词：earth，群落结构，数量，生物量，土壤，生态因子，分布，人为影响

Abstract. *Landscape-ecological analysis of structure of earthworm communities and their vertical and spatial distribution in the soils of the southern part of Eastern Siberia was carried out in Minusinskaya depression, Leno-Angarskoe plateau and Irkutsko-Cheremkhovskaya plain on the local (biogeocenotic), topological (facies) and regional levels.*

Long-term observations on geographical stations have been used to construct schematic maps portraying the variations in quantitative characteristics and species composition of earthworms in landscape and regional ranges.

The paper considers regularities of transformation of communities' structure under the influence of natural: phytocenotic (peculiarities of vegetation), edaphical and climatic (hydrothermal regime of the soil) conditions and anthropogenic factors: eliminations of wood, fires, irrational use of pastures, technogenic pollution, recreation and others.

The main trend of changes in taxonomic diversity of earthworm's communities is a decrease in the species number in the gradient of an increase of climate aridity, and strengthening of the hypothermal character and anthropogenic pressure.

Key words: *earthworms, structure of communities, number, biomass, soil, ecological factors, distribution, anthropogenic impact*

1. Introduction

The study of the dynamics, functioning and stability of natural systems in the global anthropogenic transformation of landscapes is one of the most actual tasks of contemporary geography and ecology. The scope of the multifaceted cenotic activity of animals is largely determined by the spatiotemporal organization of the communities, by the nature of the intra-landscape relationships, and the geographical limits of their manifestation.

Earthworms, which account for up to 98% of the mass of soil invertebrates, were highlighted as an essential component of forest and meadow zoocenoses. Nowadays, numerous data have been accumulated that attest to the extremely high role of saprotrophic invertebrates in soil-biological processes. Earthworms, the primary consumers of dead organic matter in the network of decomposers, enrich the soil with nitrogen, phosphorus, potassium, magnesium and other elements available for consumption as early as at the initial stages of its decomposition. The trophic spectrum of earthworms includes a variety of organic material: fall of woody and herbaceous plants, dead roots, detritus, and animal excrement. Their nutritional activity leads to neutralization of acid products of decomposition of coniferous litter in taiga ecosystems, and at high abundance to the pH increase in soil as a result of the formation of calcium compounds released by calciferous glands. Significant is the role of earthworms in creating a coprolite structure and improving the water-physical state of the root layer, and, consequently, in increasing the fertility of soil, ensuring a high level of primary productivity.

In addition to biogeochemical functions, the lumbricides have an indicative role. The state of the soil biota is one of the main indicators of the stability of the natural complex and the severity of the ecological situation of the transformed geosystems.

2. Region and methods

A comparative analysis of the qualitative and quantitative characteristics of zoocenoses was carried out on a wide information basis, from the southern taiga of the Central Siberian plateau to the true steppes of the Minusinskaya depression. In the Baikal region, the study was carried out in four key areas, covering (in the landscape-zonal range) the main regional spectrum of geosystems: from the mountain taiga of the Leno-Angarskoe plateau to the forest-steppe landscapes of the Irkutsko-Cheremkhovskaya plain. This territory is characterized by a multi-

component phytocenosis, mosaicism and a wide variety of derivative communities that arise as a result of human activities. In the conduct of field work, structural and dynamic profiling was used, which was carried out taking into account the macrostructure of the territory and with the calculation of the most complete coverage of the diversity of biogeocoenoses and the stages of geosystem transformation.

Podzolic and sod-podzolic soils are widespread on the investigated territory, soddy-gley dark-colored soils form on the bottoms of the catchment depressions. Marsh soils are represented with podzolic-gley, peat, peaty-gley and humus-gley soils. Sod forest lithogenous soils occur at the tops of traps occupying very limited areas. Gray forest, soddy-carbonate and meadow soils, characteristic for subtaiga and forest-steppe, are very small within the taiga areas.

The collection and processing of material were carried out using both traditional and modern approaches and methods recommended for soil-zoological (Quantitative methods …, 1987; Gilyarov, 1975) biogeocenological and landscape-ecological (Bessolitsyna, 2001, 2016) studies. To determine the number and biomass of the inhabitants of soil and litter, 6-8 samples with a depth of 25-40 cm (depending on the limiting occurrence of invertebrates) were taken in each area in a checkerboard pattern on a 25x25 cm with a monolithic drill (Geosystems …, 1991).

3. Results and Discussion

In the soils of the southern taiga landscape, the species diversity of lumbricids is small. Years of research have shown four species and two subspecies of earthworms: *Eisenia nordenskioldi nordenskioldi* (Eisen), *E. nordenskioldi pallida Mal., E. atlavinyteae* Perel, Graph., *E. sibirica* Perel, Graph., *Dendrobaena octaedra* (Sav.) in the undisturbed geosystems. They belong to two morpho-ecological groups, differing in food specialization: consumers of leaf litter on the soil surface and detritus consumers (Perel, 1977, 1979). The mass of earthworms in the soils of the region varies from 0 to 88.5 g / m^2, the number is up to 81.0 ind./m^2.

In soddy-podzolic loamy soils under the canopy of the fir forest with an admixture of cedar, the dominant position is occupied by earthworms of the soil-litter complex: *E. nordenskioldi nordenskioldi* and *E. atlaviniteae*, which account for up to 97.0% of the mass of invertebrates. *E. nordenskioldi nordenskioldi* and *E. atlaviniteae* also predominate in the gley-podzolic loamy soils (cedar-spruce forest) in the valley of the stream, but their quantitative characteristics are significantly lower compared to the more heat-sod-podzolic soil. According to the ratio of morpho-ecological groups, the structure of the zoocenosis of the sod-forest skeletal soil of pine-larch-cedar forest on the top of the trap is significantly different from the dark-coniferous taiga communities. Here the number of *E. nordenskioldi pallida*, which is capable of settling relatively dry loamy and even sandy loam soils with an unstable moistening regime and a low content of organic matter (Dymond, 1997),

is considerably increased. There is reason to believe that the dominant position of this species is due not so much to the physicochemical properties of the soil, characterized by elevated calcium content, but rather to the temperature factor.

A detailed analysis of spatial changes in the biomass of lumbricids in soils of dark-bodied taiga biogeocenoses showed a decrease in this index from the dominant surfaces to the bottoms of the valleys of shallow watercourses. The map-scheme developed on the basis of the area survey of the taiga key region represents the spatial variability of the amount of lumbricids due to the heterogeneity of the abiotic conditions at the topological level: the diversity of the geomorphological structure, the differentiation of the soil-forming rocks, and the local features of the hydrothermal regime.

Among the ecological factors, the heat supply of the soil, associated with the distribution of permafrost, which limits the number and activity of invertebrates, and also largely determines the structure of mesopopulation, is of critical importance here. The distribution of islands of permafrost at a depth of 1.2-2.5 m in the gley-podzolic soil of the pine-spruce forest in the valley of the stream significantly (by 1-2 months) delays the thawing of seasonally frozen soils (Southern taiga…, 1969)**,** which to a large extent determines the lower biomass and the number of earthworms in comparison with biogeocenoses located on the watershed.

The study of the distribution of lumbricids in a relatively homogeneous space of weakly soddy-podzolic loamy soil of the cedar-fir forest and in the sod-medium podzolic soil of the pine-spruce forest on the slope of the northern exposition showed that with a decrease in heat availability and an increase in hydromorphism in the geobium composition, the specific value of lumbricide in the population gradually decreases, the same concerns the frequency in the samples, which is 26 and 15%, respectively, and biomass 16.5 and 8.9 g/m^2.

Local in homogeneity of mesopopulation is affected not only by the heat supply of the soil, but also by other environmental factors. Of particular importance are the features of the phytocenose structure: the maximum mass of lumbricids reaches in biogeocenoses with a high abundance or even predominance of small-leaved species. Concentration of organic matter in the form of leaf litter - the main trophic resource for large phytosaprophages – on the soil surface contributes to a significant increase in the number and biomass of lumbricids.

The boundaries of the vertical distribution of earthworms are largely related to the chemical and physical soil properties. The highest density is recorded in the litter and humus-accumulative horizon, where up to 98% of pedobionts are concentrated. With depth, upon transition to illuvial horizons, the soil is considerably impoverished by organic substances, its density increases, aeration worsens, the temperature of the soil substrate decreases, which leads to a sharp drop in the number and mass of lumbricids.

In the bottom of the stream valley in the cold and moist gley-podzolic soil, the thickness of the habitable layer is 3 times less, while the number of earthworms in the upper horizon is also the lowest. Relatively low temperatures in the gleyed podzolic soils of microthermic facies limit the spreading of lumbricids with a litter layer. The habitable profile is shortened also in skeletal podzolic and lithogenic sod-forest soils of sublithomorphic facies.

Macrogeographic patterns of lumbricid distribution can be clearly traced at the landscape-regional level. As can be seen from the given data, earthworms within the research area live in a fairly wide range of environmental conditions. At the landscape-regional level, the limitation of the number and distribution of earthworms is mainly due to the moisture content of the soil substrate.

High humidity of forest and meadow biogeocenoses combined with a moderate temperature of the upper horizons of the soil and litter is very favorable for them. The biomass of earthworms, the highest in the soils of moist forest biogeocenoses in the stand of small-leaved species, decreases as the transition to steppe forests and dry meadows occurs. The poorest are the weakest podzolic sandy loam and sandy soils of low ridges and terraces, on which pine stands are widespread. Because of the unstable moisture regime of the soil substrate and the deficiency of organic matter in the upper layers of the soil and on its surface, the number of earthworms is minimal, single specimens are found only in the bottoms of small depressions.

Heavily soaked soils are also unfavorable for earthworms. Despite the fact that under sufficient aeration, earthworms can tolerate prolonged flooding, they

avoid excessively wet peaty soils. Only high, well-warmed mounds and marginal parts of marshy massifs are populated.

In Prebaikalia seven species of earthworms are found, among which *Eisenia nordenskioldi* (Eisen) prevails quantitatively. This species is also represented by two subspecies, belonging to different morpho-ecological groups and differing in food specialization. In the soils of dark coniferous taiga forests, as in the Lower Angara region, the earthworms of the soil-litter complex: *Eisenia nordenskioldi typica* (Eisen) and *Eisenia atlaviniteae* Perel, Graph. Dominate, which account for 96.0% of invertebrate biomass.

These are obligate saprophages feeding on decaying plant residues mainly on the soil surface and accumulating the highest abundance in biogeocenoses, where small-leaved species are present in the stand composition. In sod-forest soils, the number of *Eisenia nordenskioldi pallida* Malevic (Vsevolodova-Perel et al., 2014), which are able to colonize relatively dry and relatively poor organic soils increases.

In soils of meadows with an unstable moistening regime, the proportion of the actual subspecies *E. nordenskioldi typica* also increases. In sufficiently warm alluvial-meadow soils, a litter species *Dendrobaena octaedra* (Sav.), characteristic of the intrazonal groupings is found, as well as *E. nordenskioldi pallida*, well adapted to contrasting ecological conditions. The common polyzonal species *Aporrectodea caliginosa* (Sav.) predominates on agricultural lands and cultivated sites, while *Lumbricus rubellus* (Hoffm.) and *Dendrodrilus rubidus subrubicundus* (Eis.) are less common.

Main factors of anthropogenic transformations of natural ecosystems are influence of the technogenic emissions, eliminations of wood, fires, machining of grounds, pastoral loads, as a consequence of disturbances of stability of ecological connections – mass outbreaks of phyllofagans.

Contamination of environments touching all levels of organization of ecological systems causes essential reorganizations in structure of zoocoenoses. The comparison of data in zone of impact of Nazarow heat power station, which has been working for a long time at lignite with high content of calcium, the ingredients are not high toxic for living organisms and even has resulted in increase of earthworms' number in forest and meadow lands.

Deficiency of surface soil moisture at woodcuttings in a combination infringement of a soil cover conditions as a result of wood elimination negative effects on earthworms.

Transformation of a soil cover in the process machining of grounds renders essential influence on qualitative and quantitative structure of animals' population. In agrocoenoses the number predatories and earthworms is minimal.

The similar tendencies in change of lumbricocoenoses are observed at pastures. Overgrazing conducts to degradation of a soil-vegetative cover and decrease of the pedobionts biomass: first of all the number of large auedaphic saprophagus – earthworms.

Comparative analysis of quantitative characteristics of structural-functional groups of invertebrates has allowed us to define basic tendencies of changes, caused by anthropogenic reasons. In the most situations number and biomass of soil invertebrates and also a species diversity are decreased, xeroresistant and eurytopic species appear instead of mesophilous ones.

Thus, the mesopopulation structure, which is formed in accordance with the specific climatic conditions, is largely determined by the degree of the environment-forming effect of vegetation, which is realized through the physico-chemical properties of the soil substrate, its humidity and temperature. Ecologically, this is expressed not only in the soil moisture amount and in the of heat supply increase from the taiga biogeocenoses which are least transformed by humans to steppe and transformed biogeocenoses, but in changing their functioning: reducing the vertical thickness of the cover, reducing the layer and the restructuring of gross-organic organics, the transformation way, and, consequently, the speed of the biogeochemical cycle as a whole.

4. Conclusion

The specific nature of the structural organization of earthworm communities is mainly caused by the latitudinal-zonal position of the landscape. Second-order differentiating factors are the local relationships of heat and moisture supply, determined by meso- and micro relief, exposure features, as well as the composition of vegetation and the physicochemical properties of soils, formed from regional and historical causes. Within the southern taiga landscape, the limiting role of the cryogenic factor is typical, and within the subtaiga and forest-steppe the soil moisture is. The general regularity of the distribution of earthworms in a wide range of ecological conditions is an increase in their number from coniferous forests of the southern taiga and subtaiga types to small-leaved and mixed sufficiently moistened associations and a decrease in the transition to steppificated and steppe biogeocoenoses.

The highest quantitative indicators are representative of mixed and small-leaved forests. The dark coniferous communities with long-frozen glacial soils of the foots of slopes and marshy depressions, as well as pine forests on sandy loams and sandy soils, are pessimistic for earthworms, the first due to heat deficit, the second due to a lack of moisture. Within the ecological series of treeless biogeocoenoses (from mesophytic meadows to steppe and steppe biogeocenoses), gradual displacement of species, showing high sensitivity to changes in hydrothermal parameters, by resistant forms occurs.

Based on from the composition similarity of soil invertebrates' communities, we determined the types of mesopopulation of soils that unite zoocenoses of one structural-taxonomic level. Taking into account the quantitative characteristics, the aggregate of dominant species, the spectra of life forms and the ratio of ecological groups, 4 types and 2 subtypes of soil invertebrates communities have been identified, in which earthworms belong to the mesophilic: boreal typically taiga and boreal forest (lithophilic), hygrophilic - forest-bog; mezoxerophilic: forest (pine forest psammophilous), steppificated-meadow and agrocenotic. Forest-meadow, meadow and forest (psammophilous pine forest) communities belong to the intrazonal, and boreal are typically taiga, and forest (lithophilic) belong to zonal types.

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亚太凹陷的地球动力学演化
GEODYNAMIC EVOLUTION OF THE CASPIAN DEPRESSION

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抽象。 在评估油气潜力时，最重要的任务是确定沉积盆地的遗传隶属关系，即地球动力学类型。 对此，本文对里海盆地的地球动力学演化意义重大。 该作品分析了有关上述地区地球动力学演变的已发表作品的数据。 上述研究的结果使我们建议对地壳的地球动力学演化进行分析，以此作为评估大型复杂区域油气前景的重要标准。

关键词：里海盆地，地球动力学，油气远景评估，沉积盆地分类，演化，全球构造，俯冲。

Abstract. *When assessing the prospects of oil and gas potential, the most important task is to determine the genetic affiliation of the sedimentary basin, i.e. type of geodynamic regime. In this regard, this article on the geodynamic evolution of the Caspian basin is relevant. The work analyzed the data of published works on the geodynamic evolution of the above territory. The results of the above studies allow us to recommend the use of an analysis of the geodynamic evolution of the earth's crust as an important criterion in assessing the prospects of oil and gas in large complex regions.*

Key words: *Caspian basin, geodynamics, assessment of oil and gas prospects, classification of sedimentary basins, evolution, global tectonics, subduction.*

From the positions of global tectonics of lithospheric plates, high prospects of oil and gas content are associated primarily with continental margins, paleorift depressions, zones of intermontane and advanced troughs formed in the final stage of plate collision, as well as with the thrust margins of folded mountain structures. The determining factor of oil and gas formation is primarily the geodynamic regime of the subsoil, and therefore, when assessing the prospects of oil and gas potential, the priority is to determine the genetic affiliation of the sedimentary basin i.e. type of geodynamic regime. In determining the genotype of the sedimentary basin, the type of consolidated crust is extremely important parameter, which is associated not only with the amplitude of tectonic deflection (lowering) and, consequently, the sedimentation rate, sedimentary cover thickness, but also the heat flux that determines the conditions of oil and gas formation.

The formation and development of sedimentary basins is an integral part of the general global evolution of the lithosphere. Only within the framework of the global evolution of the lithosphere can we understand the conditions of occurrence and the nature of further transformations of the sedimentary basin at various stages of geological history, the result of which is a modern oil and gas bearing sedimentary basin. Each stage in the evolution of the lithosphere corresponds to well-defined tectonic types of sedimentary basins, the formation of which is determined by the geotectonic prevailing at this stage (extension, compression, "passive" lowering) and thermal conditions. This, in turn, determines the geological parameters that are characteristic for this type of basin — the type of crust, the rate of sagging and sedimentation, the lithological and facies character and thickness of sedimentary run, geothermal gradients, the nature of deformations and types of traps, the conditions of accumulation, burial and transformation of OM, types oil and gas source rocks, reservoirs and tires, the scale of generation and migration paths of hydrocarbons, the location and nature of the regional zones of oil and gas accumulation. Most of the existing sedimentary oil and gas basins have gone through several stages of development. Usually, when passing from one stage to another, a new tectonic type arises in place of the former sedimentary basin, with its own structural features, thermobaric conditions, etc. Vertical overlap and (or) lateral conjugation of sedimentary basins (or their parts) responding to successive stages of evolution, lead to the formation of the resulting sedimentary basin with a significantly more complex geological structure. In the context of such basins, relics of various previous stages form independent structural floors: in addition, they can participate in the construction of the pool foundation or in its frame.

The basins of the most complex structure and long evolution are the most highly productive in relation to hydrocarbons.

Each stage makes to the total hydrocarbon potential of the resulting pool. Obviously, the last stage of evolution has a decisive influence on the structure and features of the location of hydrocarbons in any modern sedimentary basin. However, in the lower structural floors corresponding to the basins (or their parts) of the previous stages, the oil and gas conditions typical for this type of sedimentary-rock basin can be largely preserved. Each stage contributes to the total hydrocarbon potential of the resulting pool. Obviously, the last stage of evolution has a decisive influence on the structure and features of the location of hydrocarbons in any modern sedimentary basin. However, in the lower structural floors corresponding to the basins (or their parts) of the previous stages, the oil and gas conditions typical for this type of sedimentary-rock basin can be largely preserved. The basis for the geodynamic interpretation of sedimentary basins can be adopted mobilistic concept ¬ tectonics of lithospheric plates. Based on this concept, E.V. Kucheruk, E.R. Aliyev and S.A. Ushakov (1983) [1,2,3] proposed a general scheme for the formation of the main types of sedimentary basins in a logical connection with certain stages of the evolution of the lithosphere.

In the proposed classification of sedimentary basins according to tectonotypes from the position of mobilism, the Caspian depression is assigned to the group of inland seas formed after the closure of marginal seas and the collision of lithospheric plates of the continent-arc type. For the internal (former marginal) seas with their centriclinic intermontane basins, the whole variety of tectonic types of sedimentary basins can be represented as a single evolutionary series. It is based on the geotectonic cycle of the evolution of the lithosphere, which begins with the breakdown of the continent, the opening of the marginal sea with the oceanic crust, the formation of its continental and island arc margins and ends with the collision of plates and orogenesis in the process of compression, convergence and collision of plates and the formation of an intermontane depression with a residual deep-sea basin.

For a detailed study of the deep structure and evolution of the Caspian basin and a correct assessment of the oil and gas prospects of its sedimentary strata, identification of favorable zones for the formation of traps (structural and non-structural) hydrocarbons, it is necessary to find out not only its modern structure, but also its entire geological background, i.e. to identify the geodynamic regime and stages of the formation of various paleotypes of basins with their characteristic sedimentation complexes, zones of oil and gas accumulation and traps.

The Caspian Basin, which appeared at the center of convergence of several plates with different kinematic parameters, is a heterogeneous structure of a very complex deep structure, where the continental structures of different ages are joined: the East European Precambrian platform, the Scythian and Turan epipaleozoic plates, and the Alpine folded structures in the south.

Three large geoblocks are distinguished in the contours of the Caspian: the North Caspian, Middle Caspian (a small fragment of the North Ustyurt geoblock is also considered in its composition) and the South Caspian. From the position of the modern plate-tectonic model, the presence of East European, Scythian, West Turan, Lesser Caucasus, South Caspian and Iranian lithospheric mesoplates is recognized.

These plates are very different in structure, in motion, are not characterized by such a complex picture of the distribution of speeds and vectors of modern horizontal movements of individual blocks.

Different age structures are confined to their boundaries - fragments of the continental or suboceanic crust, which were affected by subduction and collision during the closure of the Tethys paleo ocean. Since the late Miocene, the East European plate is considered to be inactive. The Scythian and Malokavkaz plates move along the azimuth of 18º with a speed of 1.92 cm / year and simultaneously rotate counterclockwise by (2.03–1037)º. The West Turan and Iranian mesoplates move northwest along the collision joints at a speed of 1.7 cm / year, and the South Caspian plate moves in azimuth 319º at a speed of 0.4 cm / year. Regarding the East European plate, it rotates with an angular speed $(0{,}6 \cdot 10^{-7})$º counterclockwise. Thus, the Caspian region was at the center

of convergence of several plates with different kinematics parameters. All this led to the complexity of the stage of geodynamic development and pairing of heterogeneous geostructural elements.

The South Caspian Depression, which includes the Kura, actually the South Caspian and West Turkmen Depression, stretching in a sub-latitudinal direction, is limited in the north by anticlinoria of the Greater Caucasus and the Greater Balkhan, in the west by the Dzirul massif, in the east by the spurs of Kopetdag, in the south by the northern slopes Lesser Caucasus, Talysh and Elburz. The basin is differented by the enormous thickness of the sedimentary cover - 25-30 km, against 12-17 km in other deep-water basins of the Alpine-Himalayan mobile belt. SKB is characterized by a reduction in shelf accumulation and a decrease in the total size of the Cenozoic basin. The basin is especially rapidly contracting in the Pliocene-Pleistocene, which is caused by its location within the tectonic compression zone, which experiences an extreme reduction of the Earth's crust in the Late Cenozoic.

According to the ideas of S. Adamy et al. (1974), M.L. Bazhenov et al. (1991), I.P. Gamkrelidze (1988, 1989), I.S. Dotduev (1986, 1989), L.P. Zonenshayne with co-authors (1987, 1990), M.L. Kopp (1989), V.E. Khain (1984), P.Z. Mamedov (2003, 2008), Rustamov M.I. (2005), A.R. Knipper, M.G. Lomize, and others. In the geological past, on the site of the Caucasus-South Caspian segment of the Alpine-Himalayan belt, there was a complex of structures and geological bodies characteristic of the active margin of the continents, consisting of The Lesser Caucasian branch of the Mesotetis ocean (the relics of which are ophiolites), a volcanic island arc, the back-arc (marginal) Greater Caucasus region and passive elements on the edge of the Eurasian continental margin. These structures were formed in the oceanic space of Mesotetis, where the Afro-Arabian and Eurasian platforms interacted with the microcontinent located between them (Anatolian, Iranian, South Caucasian, Nakhchivan, Makersky, etc.). The tectonic evolution of this segment of the Alpine belt in the Mesozoic is characterized by the opening of the marginal Bolshekavkazsky Sea and the formation of the South Caucasian volcanic island arc, which many researchers associate with the subduction of the oceanic crust of Mesotetis (Middle Jurassic - Early Cretaceous), its complete absorption in the Caucasian segment. The drift of the Afro-Arabian platform to the north led to the closure of the Lesser Caucasus branch of Mesotetis. The ocean closure process began in the Cenon and ended at the end of the Cretaceous (Zonenshine et al., 1990).

By the end of the Eocene in the Caucasus region, the entire crust of the Mesotetis ocean was completely absorbed, and the Anatolian and Iranian microcontinent collided with the Transcaucasian microcontinent located north of them and pressed against Eurasia. As a result, compression structures of the Lesser and Greater Caucasus were formed, as well as the East Paratetis basin, separated from the World Ocean, with an oceanic crust and stagnant conditions, in which black non-carbonate and low-carbonate clay sediments accumulated in the Oligocene-Miocene.

In the Pliocene-Quaternary, the growth of mountain structures in the frames of the megavalley is accompanied by a rapid subsidence of the crust within the Southern Caspian, its shallowing and a reduction in the area of the sedimentation basin. The thickness of precipitation accumulated over this period reaches about 9-10 km, of which the Lower Pliocene - Productive Thickness (PT) accounts for 6-7 km. With a PT century length of 2–2.5 Ma, the average sedimentation rate here is about 3–3.5 km / Ma, and at some stages it becomes hurricane at a speed of 6–7 km / Ma. The maps of isochrones constructed for PT indicate that in these intervals sedimentation occurred in a subsiding basin, which did not experience active deformation during deflection. The eastern (Turkmen) part of the basin sank at a lower rate, and the accumulation of precipitation was less powerful. The increased thickness of precipitation in the western and northern parts of the basin indicates that the source of sedimentation was the predecessor of the Kura in the western part and the Paleo-Volga in the north. Thus, in contrast to the peripheral areas of the sea basin, which experienced strong tectonic deformations and folding, the South Caspian basin, clamped on all sides, remained relatively slightly deformed.

The Pliocene age for the beginning of the stage of rapid subsidence and deformations of the Earth's crust of the Southern Caspian corresponds to the time of the discovery of the Red Sea, which led to a rapid and sharp movement to the north of the Arabian platform, accelerated plate convergence, an extreme reduction in the SCW and mountain structures of the framing, and increased folding processes in its sedimentary cover.

An analysis of materials from super-deep seismometry in SC (Knappetal., 2004), as well as seismometry and gravimetry (Allenetal., 2002) showed that the sinking of the South Caspian in the northern direction occurs according to the subduction model.

However, there is another point of view on the rapid immersion of the consolidated crust of the SCB, based on the plumotectonic concept that is developed by M.I. Rustamov (M.I. Rustamov, 2005), A.D. Ismailzade et al. (A.D. Ismailzade et.al.,2004) and others. According to M.I.Rustamov, the main events in the SCB plumotectonic processes are the mantle absorption and resurgence of the crust, the occurrence of deep-seated fault zones of the waveguide at the crust-mantle boundary and the crustal level, and the dip of the basin. Cenozoic sedimentation in the South Caspian basin occurs in a regional collisional geodynamic setting, accompanied by a consistent thinning of the consolidated crust. The resurgent crust of the South Caspian basin, the author believes, only in terms of geophysical parameters corresponds to the basalt layer, and it should not be taken as a relic of the spreading oceanic crust of the geological past. The SCB crust was revived at the regional collision geodynamic stage in the Cenozoic as a result of mantle diapirism, decompaction and heating of the upper mantle, accompanied by intense high-temperature fluid flows similar to modern intraplate rifts - Baikalian, Krasnomorian, etc. (M.I. Rustamov, 2005).

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土耳其地震过程的动力学
THE DYNAMICS OF THE SEISMIC PROCESS IN TURKEY

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抽象。 基于对1974–2012年仪器化时期土耳其地震总能量的时空分析，我们揭示了震中场某些地点的地震序列，并确定了地震活动迁移率（最初的几公里–最初的数百 每年公里）。 对于不同的地球动力学条件，有序地震序列在结构上是不同的。 我们得出了关于迁移特性与地震活动环境准粘度的联系的结论。

关键词：迁移率，地震，地震活动，土耳其，北安那托利亚断层，震中场。

Abstract. *Based on the space-time analysis of the earthquakes' total energy in Turkey during the 1974–2012 instrumental period, we revealed sequences of earthquakes at some sites of the epicentral field, and determined the seismic activity migration rate (first kilometers – first hundreds of kilometers per year). Ordered earthquake sequences are structurally different for different geodynamic conditions. We made a conclusion about an association of the migration peculiarity with the seismoactive environment quasiviscosity.*

Key words: *migration rate, earthquakes, seismic activity, Turkey, North Anatolian Fault, epicentral field.*

Introduction

The nature of the earthquake migration phenomenon has not been determined ultimately so far, and there are a number of hypotheses to elucidate it. The most common viewpoint is the assumption about the wave nature of the deformation front propagation from a regular seismic event in the crust, in the lithosphere, and in the lower mantle, which is a trigger effect for subsequent events, and also a superposition of such waves (Nikonov, 1975; Bykov, 2005; Kuz'min, 2012; Sherman, 2005, 2011). The deformation waves are subdivided into two main types: the remote interaction waves extending along tectonic belts or separate faults, and foreshock and aftershock interaction waves passing within the locus of a large earthquake (near interac-

tion waves). According to other researchers, migrations are caused by stress transfer in the earth crust through elastic and elastic-viscous transfer of stresses consistently from one integral block to another, as a result of fault interaction (Chéry et al., 2001).

In our investigations, we endeavor to characterize migrations at the local and sub-regional levels, to estimate their rates, and also to see their association with formation of strong earthquakes' centers. Our technique also allows us to record larger-scale migrations, which enables to obtain a fuller picture for the migration phenomenon.

Studying the seismicity in Turkey is interesting to study migration, because Turkey is known for order of large earthquakes' distribution along the North Anatolian Fault. Many studies address consecutive emergence of events with $5.9 \geq M \geq 7.8$ magnitude East-to-West (Westaway, 1994; Ross et al., 1997) within 1939–1999 (Until the 1999 Izmit event, M=7.6) (Armijo et al., 1999; Stein et al., 2001). The North Anatolian Fault is a consequence of the Anatolian Plate motion along the Euroasian Plate, as a result of the South African and Arabian Plates' forcing from the south. The rate of the interplate motion within the North Anatolian Fault is about 2.5 cm/yr. Thus, these studies allowed us to obtain the migration parameters for shear zones.

Method

Seismic activity chains are visualized on the space-time diagrams made for specified projection zones presented in Figure 1. Such zones are superimposed on seismic structures within which a migratory process is investigated. The values of the used parameter are summarized in the rectangle meshes for certain periods (30 days, in this case). For analysis, we used the ISC-GEM Global Instrumental Earthquake Catalogue within the M=2.0–7.6 range. The energy in each mesh was calculated as $\mathrm{lgE_{sum}} = \log \sum_n E_n$, where n is the number of earthquakes, E is the energy of earthquakes in joules. Previously, we recalculated the magnitudes of earthquakes into energy from the Gutenberg-Richter Relationship: lgE=1.5M+4.8.

The rectangle size is determined by the length and width of the epicenter concentration zone. The length is 200–500 km, with the width for large zones being about 100 km, for spatial specification of joint area between the San Andreas and Calaveras Faults, the width of zones is 20–30 km.

Figure 1 shows the seismic data projection zones. The diagrams for these zones were made with the MathJL software, where the $\mathrm{lgE_{sum}}$ parameter values were interpolated into a window 4 to 4 points, with the result that the energy peaks of the greatest earthquakes were smoothed. The $\mathrm{lgE_{sum}}$ scale reflects the smoothed values on the provided space-time diagrams.

The relation of the used parameter maxima chain projection onto the distance axis to the projection onto the time axis determines the migration rate. The used technique allows us to detect slow migrations measured in kilometers per year. Detecting displacements at a higher rate requires a more detailed temporal scan, which this technique is unable to perform.

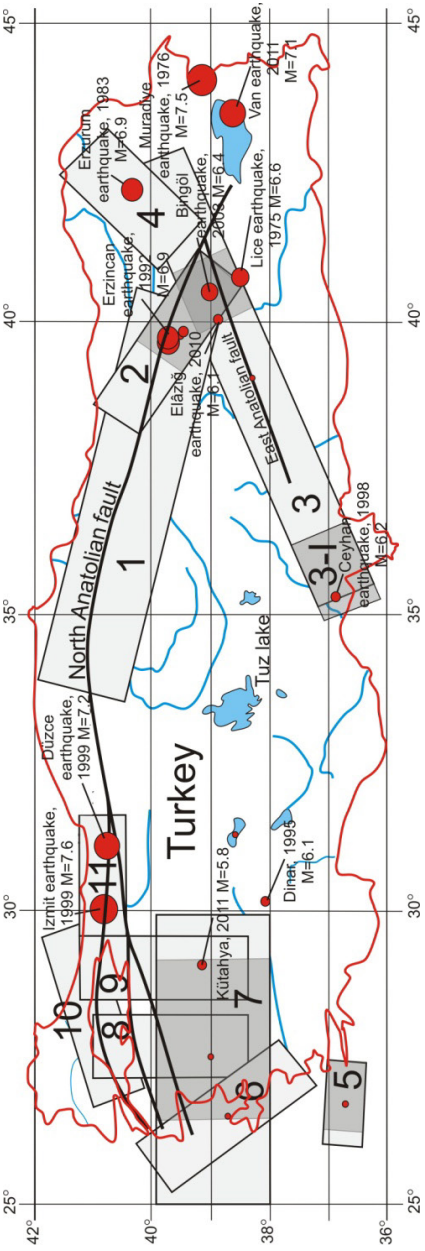

Figure 1. *Seismic data projection zones (rectangles). Dark gray color highlights the areas where slow migrations of seismic activity are recorded. Red dots of different diameters are strong earthquakes of different force*

Research results

Analyzing the diagrams allowed us to obtain the following results. The eastern and south-eastern parts of the Turkey epicentral field feature the migratory chains comprising strong and moderate events, and weak events almost do not fill in the gaps between them (Zones 1 – 3 in Figure 1, Diagrams A, B, C in Figure 2). It is this peculiarity of migrations that is characteristic of earthquakes in Turkey. Tectonically, this phenomenon in the given part of the epicentral field is associated with the joint zone between the North Anatolian and East Anatolian Faults (Zone 2 in Figure 1, Diagram A in Figure 2), with which a number of large earthquakes within the instrumental period are associated, such as the 1975 Lice (M_w=6.6), the 1992 Erzincan (M_w=6.9), the 2003 Bingöl (M_w=6.4), the 2010 Elâziğ (M_w=6.1), and also the south-eastern termination of the East Anatolian Fault (Zone 3 in Figure 1, Diagrams B, C in Figure 2), with which the 1998 Ceyhan (Mw=6.2) earthquake focus is associated. The migration in these zones manifests itself as both a preceding and subsequent phenomenon in relation to a strong seismic event, which may reflect the dynamics of stress redistribution in their interaction region in the joint area of tectonic structures and for parallel zones.

In the 1995 Erzincan earthquake (M_w=6.9) focus area, one can observe ordered sequences of opposite orientation comprising 9–10 moderate events decades prior to the very event: 1976–1979 (3.4 years at the rate about 30 km/yr) and more than 100 km long, and 1984–1990 (6–7 years at the rate 25–30 km/yr) more than 150 km long (Figure 1, Figure 2, A). Here, the migration chains are a long-term precursor of a strong event.

In Figure 2, A, on the diagram for Zone 2, one can see the migration chain including the 2003 Bingöl event that also gets in another projection into Projection Zone 3 located angularly in Zone 2. On Diagram 2, B, the migration chain with the Bingöl event participation is not visible in this projection, and the earthquakes uniting into a migration chain in Zone 2, while scanned in the Zone 3 projection, have a spatial spread of more than 100 km. This means that the width of the "corridor", through which migrations can pass, is about 100 km and more, which spatially corresponds to the width of the region where various-force earthquakes disperse within the dynamic influence area of the active North Anatolian Fault, along which Zones 1 and 2 are specified (see Figure 1). The projection technique is aimed to encompass this area. If the migration chain earthquakes were localized in a more narrow area, then, at the space-time scan in Zone 3, the indicated seismic events would be aligned parallel to the abscissae axis, or would have a smaller degree of dispersion along the distance axis.

In the northern part of the East Anatolian Fault (Zone 3 in Figure 1, Diagrams B and C in Figure 2), there passes the 1998–2004 chain including more than ten strong and moderate events. Its rate is about 22 km/yr: 85 km for four years. It begins with the 1998 Ceyhan earthquake, M=6.2 (Figure 2, B). Figure 2, B presents a migration chain for a larger spatial scale. One can see on the diagram that the Ceyhan event is at the beginning of the migration sequence of subsequent moderate earthquakes.

To the south-western (Zone 5 in Figure 1, Figure 2, D) and to the western (Zone 7 in Figure 1) parts of the epicentral field in Turkey, intrinsic are the migration sequences of weak and moderate events similar to the migrations in the Pribaikalye (Near-Baikal) Region (Novopashina, Sankov, 2018). Their rate varies within 62–0 km/yr.

The seismic data Projection Zones 4, 6, 8, 9, 10 in Figure 1 also contain space-time concentrations of earthquakes, but there are no well-defined migrations of seismic activity in these zones. Building the diagram for Zone 11 associated with the 1999 strongest events, Izmit (M_w=7.6) and Düzce (M_w=7.2), allows us to see multiple aftershocks in these earthquakes' foci areas. The aftershocks are concentrated within small time intervals, and propagate inconsistently.

Discussion (and Conclusions)

Analyzing different parts of the epicentral field in Turkey shows different character of migrations corresponding to the difference in the geodynamic situation of this region separate parts. Migration episodes are recorded in the seismic data projection zones made for epicenter concentrations in the North Anatolian and East Anatolian Faults' joint area, the south-eastern termination of the East Anatolian Fault region, to which migrations of strong and moderate events at the rate of 25–30 km/yr are intrinsic. The 90 km/yr migrations comprising denser chains of moderate and weak earthquakes are characteristic of the western and south-western seismic concentrations.

Like in other investigated regions where migrations are recorded locally in zones of large faults' joints, migration sequences can precede a strong earthquake long before the latter, propagating consistently within its focus area (Figure 2, A), but may be a consequence of a strong event (see Figures 2, B, C). The seismic activity migration manifestations, in this case, are most likely a reflection of the fault interaction processes in the earthquake epicenter field. High-speed interplate motions in the zones of the North Anatolian and East Anatolian Faults create conditions for a fast accumulation of stress in the places of adjunction and diverging of fault structures, whose discharge occurs at one level, in the form of energy clusters' slow migrations and moderate events. At the other, higher level, there occur large earthquakes, whose aftershocks participate in fast migrations.

We associate the difference in the migration character of different seismic structures in Turkey with different viscosity of the seismoactive medium. Migration chains that involve a number of weak events (see Figure 2, D) are recorded in the places of the increased fractureness of the earth crust, and, correspondingly, of smaller viscosity. Sequences of moderate events, together with strong and strongest earthquakes, are, most likely, characteristic of more viscous (in other words, brittler) medium. A similar regularity is observed for the Baikal Rift System region, where the places of migration passage are also associated with the faults' increased density zones that represent the lowered quasiviscosity areas.

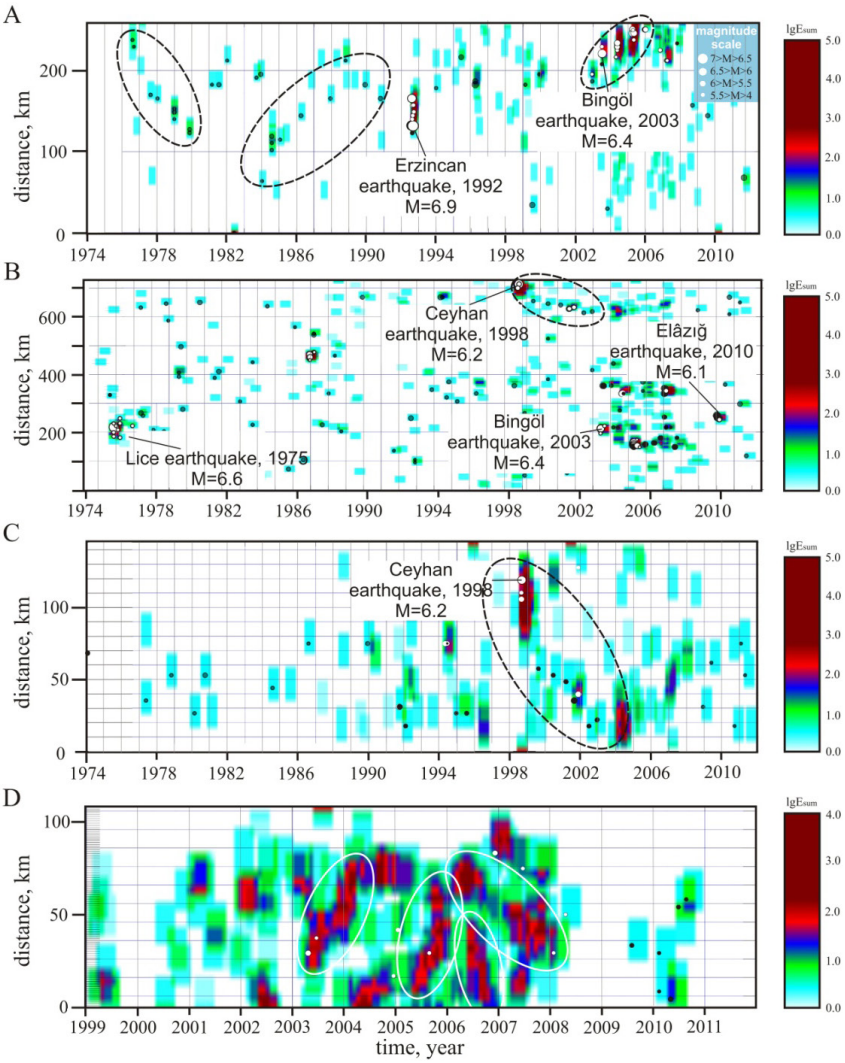

Figure 2. *Space-time diagrams for the projection zones: A is for Zone 2 (1974–2012), B is for Zone 3 (1974–2012), C is for the 3–I Specification Zone (1974–2012), D is for Zone 5 (1999–2012 time specification)*

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车辆无级脉冲式传动的动力学
DYNAMICS OF THE VEHICLE'S STEPLESS IMPULSE TYPE TRANSMISSION

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注解。 在这项研究中，在MATLab – Simulink可视化编程环境中，介绍了以ATV为例的脉冲无级传动中动力学和运动学操作过程的理论研究结果。 结果表明，所提出的脉冲式机械无级变速器方案具有自动调节速比的特性。 变速箱可提供平稳的加速度和车辆的均匀运动。

与现有的自动变速器相比，脉冲式机械无级变速器的结构明显更简单，更便宜，内部功率损耗更小，在小型车辆中的应用潜力很大。

关键词：机械无级变速器，脉冲变速器，CVT，小型运输，全地形车，仿真，matlab，simscape，动力学，操作程序，CVT效率。

Annotation. *In this investigation, the theoretical research results of the dynamics and kinematics operating processes in impulse stepless transmission on the example of an ATV are presented in the MATLab – Simulink visual programming environment. The results showed that the proposed scheme of mechanical stepless transmission of impulse type has the property of self-regulating the velocity ratio. The transmission provides smooth acceleration and uniform motion of the vehicle.*

The construction of the mechanical stepless of impuls type is significantly simpler and cheaper than existing automatic transmissions, has smaller internal power loss and a high potential of application in small-sized vehicles.

Keywords: *mechanical stepless transmission, impulse transmission, CVT, small-sized transport, all terrain vehicle, simulation, matlab, simscape, dynamics, operating procedure, CVT efficiency.*

The advanced motor transport is a huge segment of small-sized vehicles, which includes motorcycles, scooters, mopeds, ATV, snowmobiles, jet skis and other equipment for household purposes. Motorcycles by famous brands, have steadily improved, hitting its variety and innovation. There is nothing surprising therefore that motobikes , ATV, snowmobiles are very popular in these latter years. ATV (All Terrain Vehicle) and UTV (Utility Task Vehicle) are the vehicles intended for traveling and transportation of goods in cross-country conditions, out of reach for the usual car or motorcycle.

High cross-country capability and maneuverability of such vehicles is provided by using an advanced chassis components and mechanical continuously variable transmission (CVT) with automatic control (Duramatic type, [1]). The latter includes, as a rule, clutch and V-belt CVT electronically controlled which provides a stepless torque transmission from engine to the driving wheels depending on traffic conditions.

The disadvantages of vehicles with CVT are well known:

1. The narrow range of torque transformation and necessity of the introduction of additional speed gearbox.

2. The intensive deterioration of tires and reducing its service life that takes place by reason of the circulation of parasitic power (the interaxle differential is absent).

3. The unavailability of a self-regulation gear ratio and the necessity of an electronic control system of CVT that is not fully to satisfy the working conditions.

The novelty of engineering project consists in theoretical basis of an efficiency of an alternative stepless self-regulated impulse transmission (instead of CVT [2]) for small-sized vehicles. The various designs of mechanical impulse transmissions are known at present time [3, 4, 5, 6]. They are based on the conversion of rotation of the drive shaft into angular oscillation of intermediate link, amplitude of these oscillations changing automatically or manually at change of loading on driven shaft. Then an angular oscillations of intermediate link are transformed to the unidirectional rotation of the driven shaft by means of a free wheeling clutch (FWC), the velocity of rotation of a driven shaft will be greater the more the amplitude oscillations of intermediate link.

The use of an impulse transmissions for vehicles increases their efficiency, notably:

- additional speed gearbox is not required due to a wider range of torque transformation;

- the manoeuvrability and cross-country ability are increased due to internal automaticity (self-regulation of gear ratio);

- the permanent wheel drive without the circulation of parasitic power with automatic compensation of the kinematic discrepancy is provided in that transmission;

- the transmission is simplified and reduced in cost by eliminating the use of imported components and simple design implemented in an accessible technological level;

- the maximum efficiency is ensured due to the refusal of the friction variator (CVT) and the transmission of a torque by self-braking friction in FWC instead of friction-slip like CVT.

Analysis shows, to raise the technical and economic efficiency of modern small-sized vehicles it would be advisable to use the simple self-regulating mechanical stepless transmissions, having a compact, simple design and low cost. According to the published evidence [4, 7, 8, 9] it is known that the changes of gear ratio in impulse transmission may be obtained not only by changing the amplitude of oscillations but also due to the elastic deformation of the links, for example of torsion shaft, connected with the FWC. Such engineering solution used simplifies the design of impulse transmission and allows to arrange the parts of transmission in the overall dimensions of existing CVT (Duramatic).

The research of vehicle dynamic characteristics with such transmission, namely the joint operation of engine, clutch and stepless impuls transmission during acceleration and uniform motion, is the aim of this work. Let us now show the kinematics of an elementary impulse type transmission for all-wheel drive (ATV) by way of example (Fig.1). At the heart of such transmission is the principle of the gear ratio regulating to load changes by automatically changing the swirl angle of torsion shafts 6 connecting the driven links of FWC 5 with the output shafts 7. Transmission operates as follows. The rotation from the engine 1, centrifugal clutch 2 and reducer 3 with an angular velocity ω is transmitted to the hinged-lever mechanism 4, generating angular oscillations of the driving parts of the FWC 5 a constant amplitude φ_0. In the case of harmonic oscillations it angular speed is equal to $\omega_1 = \varphi_0 \cdot \omega \cdot \sin(\omega \cdot t)$

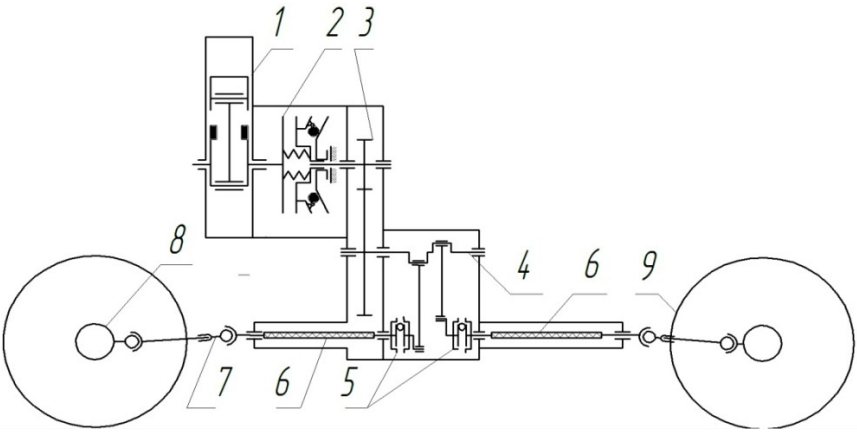

Fig.1 *The kinematics of an elementary impulse type transmission for all-wheel drive (ATV)*

1 - engine; 2- automatic centrifugal clutch; 3- reducer; 4 - hinged-lever mechanism (generator of mechanical oscillations); 5 - free wheeling clutch (FWC); 6 - torsion shaft; 7 - cardan drive; 8 - differential; 9 - driving wheels

If resisting moment on the driving wheels 9 is absent (theoretically), the torsion shafts 6, connected through a cardan drives 7 and differentials 8 with the drive wheels 9, are not loaded by torque. Their swirl angles for a cycle oscillation is theoretically equal to zero, and gear ratio due the deformation of torsion shaft 6 i = 1. If the angular velocity of the driving wheels 9 and cardan drive 7 becomes smaller by resisting torque, the swirl angles of torsion shafts vary with the proportional to the load; in the case of the maximum deformation of torsion shaft 6 on the "stale condition", the internal gear ratio will be equal to i = 0. In operating procedure, the smaller gear ratio i, the earlier switched on and later switched off FWC 5, greater maximum and average swirl angles of torsion shafts 6, and the average torque transmitted to the driving wheels 9. In this case, the transmission of torque from engine 1 through FWC 5 to the front and rear axles is carried out with a phase lag 180 deg.

The clutch 2 is used for smooth breakaway and acceleration with a necessary intensity. Reducer 3 is required to lower the engine speed with a view to decreasing the frequency of FWC engaging. Reverse motion at this scheme, is provided by the reverse operation of FWC (not shown). The procedure of determination of tractive-dynamic characteristics for ATV and the results of theoretical modeling are presented below.

Initial data:

Gross vehicle weight - 550 kg; maximum speed - 80 km/h; engine capacity - 38 kW; type of driving-wheels AT25h8-12 (26h8-14); wheel arrangement - 4x4;

traffic conditions: coefficient of motion resistance f = 0.015, and coefficient of traction $\mu = 0.65$, without considering the wind load; upgrading - at least 25 degrees.

The simulation of operating procedures of the mechanical impuls transmission had made in MATLAB-SIMULINK. The block diagram of powertrain, consisting of several subsystems, is shown on fig. 2.

Here: 1-engine; 2- clutch; 3-reducer; 4.1 and 4.2 - generators of mechanical oscillations in the front and rear power circuit, respectively; 5.1 and 5.2 - free wheeling clutches; 6.1 and 6.2 - torsion shafts (taking into hysteresis losses); 7.1 and 7.2 - cross-axle differentials in front and rear axles; 8.1 and 8.2 - driving wheels of front and rear axles; 9 – body ATV. An inertial properties of rotating shafts and gears are take into accounted by means of the blocks “Inertia”. The inertial properties of engine, clutches, driving wheels and ATV chassis options are embedded in the parameters of the relevant subsystems. Sensors of angular velocity and torque, as well as the signal receivers are not shown.

SIMULINK block diagram is made up of several subsystems:

1. Subsystem 1- "Engine": type of engine - petrol, the maximum power of 50 hp, the maximum speed of 6500 rev/min; moment of inertia of 0.1 $kg \cdot m^2$.

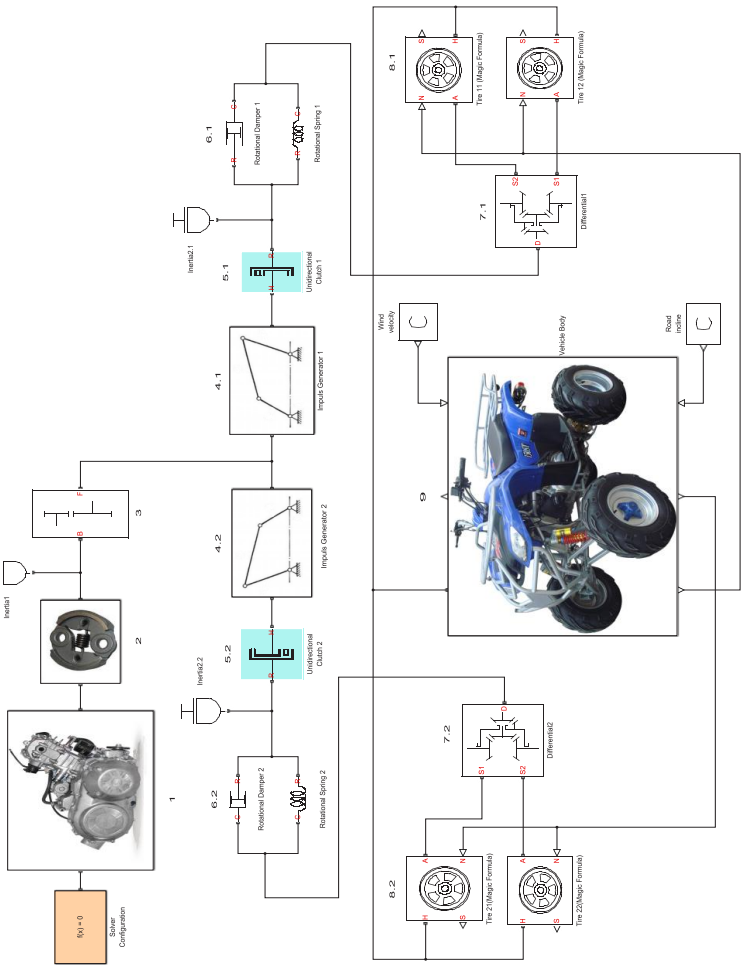

Fig. 2. *SIMULINK block diagram of the ATV with simplest stepless mechanical transmission*

2. Subsystem 2 - "Clutch": type - disk, the effective radius of the friction discs - 60 mm; number of discs - 2; type clutch - hydraulic; area of the piston actuator cylinder - 0.005m^2; the coefficient of friction (static / dynamic) - 0.7 / 0.55.

3. Moments of inertia of rotating masses: inlet transmission «Inertia1» and on the outlet of FWC «Inertia2.1» and «Inertia2.2 are respectively 0.5 and 0.0001 kg·m^2.

4. Reducer (3) - a standard bloc «Simple Gear» with a ratio equal to 3.

5. Hinged-lever mechanisms «Impuls Generator» (4.1 and 4.2) form the mechanical harmonic oscillations with a constant amplitude φ_0 = 0.35 rad in two power flow (front and rear axles) with a phase lag 180 degrees.

6. FWC «Unidirectional Clutch» (5.1 and 5.2) convert a harmonic oscillations into unidirectional motion of torsion shafts .

7. Torsion shafts «Torsional Spring - Damper» (6.1 and 6.2): angular stiffness of 2100 N·m / rad, damping coefficient of 0.01 N·m / (rad / sec).

8. The cross-axle differential mechanisms 7.1 and 7.2 «Differential» - distributes torque to the driving wheels of the front and rear axles with a ratio of 0.7

9. The driving wheels 8.1 and 8.2 - form a longitudinal traction force is proportional to the weight and coefficient of traction. The radius of the wheels - 0.32 m, the load on the wheel in a static position - uniform. Longitudinal linear stiffness of the tires - 1000 kN / m; longitudinal tire damping coefficient - 1000 N / (m / s). The moment of inertia - 0.5 kg·m^2.

10. Subsystem 9 - «Vehicle body»: mass – 550 kg; number of wheels per axle – 2; front area – 1.5m^2;drag coefficient – 0.4; coordinates of the center of mass – 0.6/0.6/0.5 m.

The simulation results of the stepless transmission's operation parameters in accelerating from stop to maximum speed are shown in Fig. 3 ... 4.

In initial time (smooth switching on of the clutch and increasing the fuel feed) the engine torque is transmitted through a reducer 3 to the second intermediate shaft. Next, by means of unregulated hinged-lever mechanisms 4.1 and 4.2 the rotation is being converted into the angular oscillations of FWC leading links 5.1 and 5.2 with phase bias 180 degrees (Fig. 3).

Two FWC (one for each exle) transmit torque only one direction. In another direction is carried out idle running. Therefore, they convert the angular oscillations in unidirectional rotation, which is being transmitted by means of torsion shafts 6.1, 6.2 and cross-axle differentials 7.1 and 7.2 to the front and rear driving wheels.

The larger the oscillation amplitude, the higher the speed of the driving wheels' rotation. In this case the speed of wheels changes automatically according to the resistance movement at constant amplitude of FWC' oscillation.

Fragments of operating curves of transmission - the input torque (links 4.1 and 4.2, Fig. 2) and output torque (links 7.1 and 7.2) in timing are shown at Fig. 4.a.

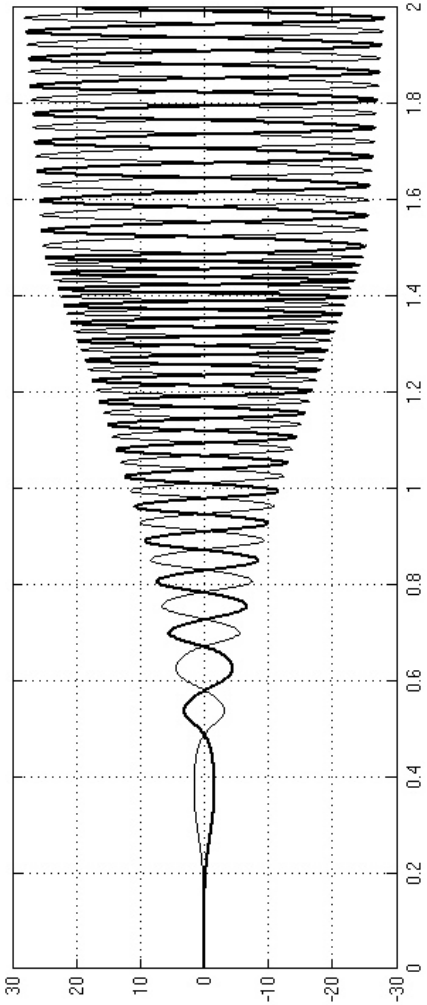

***Fig.3** Angular speed (rad/sec) of the driving links of FWC formed by generator of mechanical oscillations in the initial period of acceleration in the interval from 0 to 2 seconds*

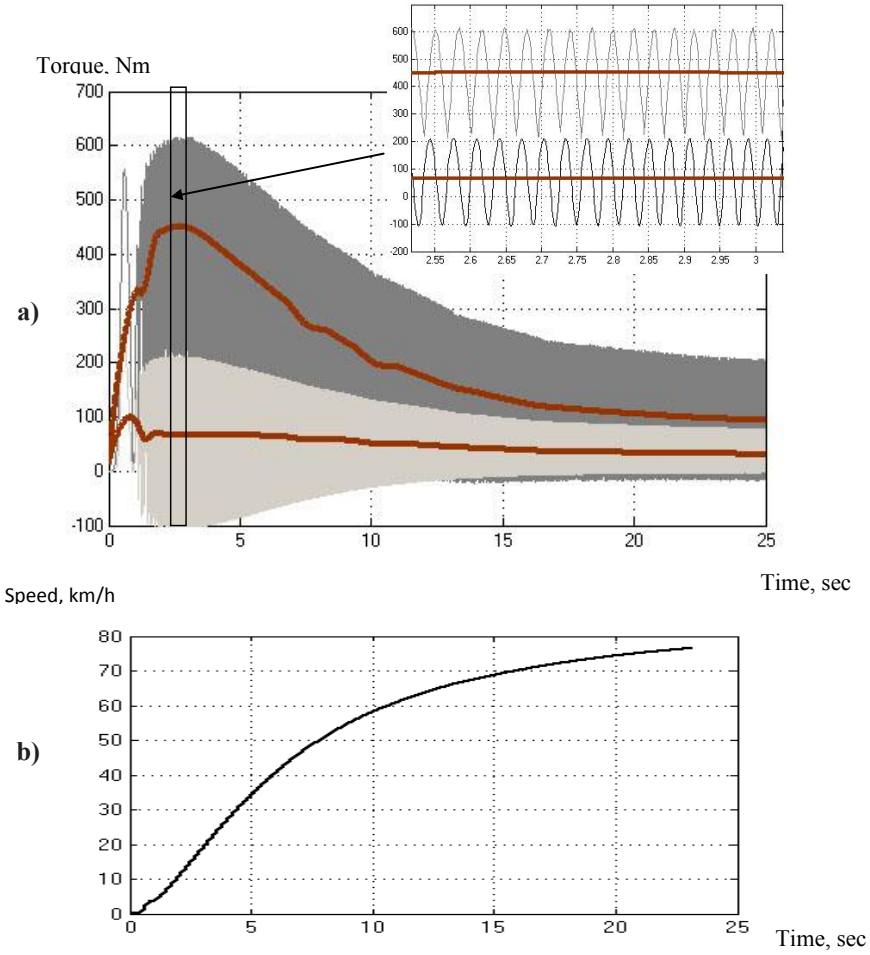

Fig. 4 *Dynamic parameters of ATV acceleration*

a - momentary and average values of torque (N·m) at the input (white background, black curve) and aggregate momentary and average values of torque on output shaft of impulse transmission (dark background, the black curve) during the time interval from 0 to 25 seconds;

b - change of ATV's speed (km/h) during from 0 to 25 seconds.

The power range of transmission d (output to input torque ratio) is:

$$d = \frac{mean\left[(2 \cdot M81 + 2 \cdot M82)_{\max}\right]}{mean(M3_{\max})} = \frac{400}{65} = 6.2$$

That exceeds the range of torque transformation of existing continuously variable transmissions. Here the subscript «max» means the maximum average value of torque over the whole range of gear ratios.

The amplitude oscillation of intermediates' torque (at a frequency of 10 to 30 cycles/sec) and traction of driving wheels (20 - 60 cycles/sec), filtered, and provides smooth acceleration and uniform motion of ATV (Fig. 6, c) due to the inertia of the vehicle and damping properties of chassis.

The graph shows that the ATV is smooth accelerating to a speed of about 80 km / h in 25 seconds. The slip of the driving wheels at constant engine speeds is of the order 1%.

As a result of theoretical study was determined:

1. The proposed scheme of simple mechanical stepless transmission of impulse type has the the property of self-regulation control. So, for the period of ATV acceleration from a standstill to 80 km/hour with an increase in angular velocity of engine from 75 to 600 rad/sec, the average angle of twist of torsion shafts is changed from 15 degrees in the initial phase up 5 degrees - at the end, i.e. transformation ratio is 3. At the same time, with a glance of acceleration engine and tire traction the total average tractive force of driving wheels is changed from 400 to 100 N. This transmission provides smooth acceleration and uniform motion of the ATV.

2. The driven links of FWC are not connected to each other kinematically, and therefore, the power to the driving wheels of the front and rear axles is transmitted independently in accordance with the elastic characteristic of torsion shafts, i.e. driving wheels can rotate with different angular velocities; the torques, transmitted to the driving axles, are determined by elastic characteristics of its own torsion shaft. Appling the center differential is not required. When wheels of one driving axle will slip, another driving axle will transmit tractive force up to the limit of traction. Therefore, the locking of central differential to improve traction properties the driving wheels is not required.

3. The construction of the self-regulating mechanical impuls transmission is significantly simpler and cheaper than existing automatic transmissions, has smaller internal power loss and a high potential of application in small-sized vehicles.

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UDC 621.311:535.215

实现光热选择性辐射转换器的问题
ISSUES OF IMPLEMENTATION OF A PHOTOTHERMAL CONVERTER OF SELECTIVE RADIATION

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抽象。 本文提出了一项研究结果，以寻求将太阳光高效转换为电能的方法。指出了创建将光能和热能转换为电能的高效转换器的设计的效率。 介绍了使用惠更斯–菲涅耳原理计算衍射图中光强分布的基础和结果。 指出了解决与选择性光热转换器的设计特征有关的问题的方法，其效率根据温度和重量以及尺寸特性和指示器而降低。 通过光电转换器的最佳放置来执行光轴对准的软件计算。

关键字：光电转换器，热转换器，效率，光谱分布，组合，选择性，辐射。

Abstract. *The paper presents the results of a study on the search for highly efficient converters of sunlight into electrical energy. The efficiency of creating designs of combined highly efficient converters of light and thermal energy into electrical energy is indicated. The basics and results of calculating the distribution of light intensity in the diffraction pattern using the Huygens – Fresnel principle are presented. Ways to solve problems associated with the design features of a selective photothermal converter are indicated, with a decrease in its efficiency depending on temperature and weight and size characteristics and indicators. The software calculation of the alignment of the optical axis by the optimal placement of the photoelectric converter was performed.*

Keywords: *photoconverter, thermoconverter, efficiency, spectral distribution, combination, selectivity, radiation.*

Introduction

In this booming 21st century of engineering and technology, the issues of using alternative sources of electrical energy are becoming more specific and relevant. The principle of development of the use of new energy structures is based on their large energy reserves, environmental friendliness, resource-saving indicators, innovative nature, intellectual properties and the widespread availability of energy supply. The main type of alternative energy source that meets the above requirements is solar energy.

Interest in solar energy has been shown for a long time, and today a lot of work has been done in this regard to create and design solar units for various purposes. A large amount of work is being done in the field of electric energy production. The main element used to convert solar energy into electrical energy is semiconductor photoelectric converters [1]. As a result of rigorous research, a large army of scientists of the world, on the creation of highly efficient converting devices of light energy into electrical energy, elements were obtained that successfully operate on solar power plants operated in several developed countries of the planet. However, the results so far are not encouraging, since the expected effects have not been obtained. The present work is devoted to the presentation of methods for creating and researching solar energy converters of combined design, which in terms of performance and efficiency surpasses individual semiconductor solar energy converters into electrical energy and is a cost-effective material.

Formulation of the problem

Several factors contribute to the inhibition of the development of the construction and operation of solar power plants. Firstly, the technology of manufacturing solar cells is quite complicated, requires expensive equipment. Secondly, semiconductor materials that allow obtaining relatively large values of the coefficient of performance are either rare in nature or dangerous to human health (for example, AsGa). Thirdly, the physical properties of materials are limited in terms of the formation of electron-hole pairs in order to infinitely generate carriers of electrical energy. Fourth, the electrophysical parameters of semiconductor devices are highly dependent on temperature, as a result of which it does not always give the expected effects when used under various operating conditions. In addition, the latter reason requires the use of expensive cooling systems.

All these listed reasons need to be addressed. Without eliminating these causes, it is practically impossible to widely and efficiently introduce solar power plants into operation.

As is knowns, despite its attractiveness according to the testimony of efficiency gallium arsenide heterojunction solar cells (SC) [2-4] is not used at ground operated solar power plants. The main material for this purpose is silicon [5-7].

Therefore, in recent years, researchers have joined in the creation of heterojunction solar cells made of silicon [8-10]. The most interesting results were obtained in the study of solar cells made of heterostructured silicon based on thin films [11-12]. However, the efficiency equal to 25.6% received by the authors of the above works, also cannot be a decisive incentive for the prosperity of solar energy. In this regard, in our opinion, some research work should be aimed at creating combined photothermoelectric converters (PTC) of light and thermal energy into electrical energy [13]. The principle of operation of the PTC is based on the simultaneous conversion of the energy of sunlight and heat into electrical energy.

It should be noted that the idea of creating photothermogenerators (PTG) is not new, and a certain work has been done by the authors of this article in this direction. Research assumptions have revealed other capabilities of these combined transducers [14]. As a result, the design of the PTG selective radiation was developed. The most attractive side of a selective radiation photothermogenerator is the expected high efficiency of the device and a positive solution to the problem of eliminating thermal heating of the solar cell. Achieving this goal is carried out by distributing the intensity of solar radiation using a diffraction lattice to the spectra of light waves along the length and direction of the photoactive radiation to the surface of the solar converter, and the rest is not photoactive (or, say, long-wave) to the hot junctions of the thermoelectric converter.

Theoretical studies of calculating the distribution of light intensity in the diffraction pattern were carried out using the well-known Huygens-Fresnel principle [15].

To the question of how much it is really possible to implement this design of a combined device - a photothermogenizer in practice, one can answer as follows. According to the results of numerous studies of physicists, it was found that for all transparent solids (glass, quartz) from which prisms are made, the refractive index n in the visible light range decreases with increasing wavelength λ, therefore, the prism most deviates blue and violet rays from the original direction and least red. Modern technology allows you to easily break light fluxes into spectra. For this, one can successfully apply high-class spectral instruments consisting of a diffraction lattice.

The theory proved that in order for the interference maximum to be observed on the screen (or photographic plate) on which the radiation is focused, the path difference Δ between the waves emitted by neighboring slits should be equal to an integer number of wavelengths:

$$\Delta = d \sin \theta m = m\lambda \quad (1)$$

Here d – lattice period, $m = 0, \pm1, \pm2, \ldots$ - order of diffraction maximum. In the focal plane of the lens, the distance y_m from a maximum of zero order ($m = 0$) to the maximum of m-th order at small diffraction angles it is equal to:

$$y_m = m\frac{\lambda}{a}F, \quad (2)$$

where F – focal length.

It is known that, at each point of the focal plane of the lens, interference occurs of N waves arriving at this point from N slots of the lattice. The reason for this is a lot of wave (or "multipath") interference. When passing from the main maximum to the neighboring minimum, the path difference $\Delta = d \sin \theta$ should change λ / N. From this condition, we can estimate the angular half-width $\delta\theta$ of the main maxima:

$$\Delta\delta = \delta(d \sin\theta) = d \cos\theta\delta\theta \approx d * \delta\theta = \frac{\lambda}{N} \quad (3)$$

In a theoretical study, to simplify the calculations, it was assumed that the diffraction angles are sufficiently small. Consequently,

$$\delta\theta = \frac{\lambda}{Nd} \quad (4)$$

where Nd – full grid size. The obtained ratio is in complete agreement with the theory of diffraction in parallel rays, according to which the diffraction divergence of a parallel beam of rays is equal to the ratio of the wavelength λ to the transverse size of the obstacle.

An important conclusion can be made: in the diffraction of light by a lattice, the main maxima are extremely narrow. The severity of the main maxima changes with an increase in the number of lattice slots. The use of diffraction lattice formulas shows that the position of the main maxima depends on the wavelength λ. Therefore, the lattice is capable of decomposing radiation into a spectrum, that is, it is a *spectral device*.

A general view of a selective photothermogen generator is shown in the figure. 1[14].

Study of the optical properties of a photothermogenerator

The operating conditions of any newly developed design dictates the need to determine the possibility of their effective application, technical and economic indicators, simplicity of design, compactness and of course advantages and disadvantages. With regard to technical and economic issues, here you can also see with the naked eye that complex structural transformations are not necessary. The same photoelectric converter and the same thermoelectric converter are used. In one or another of their applications, the same technology is retained with minor changes. In contrast to [13], in this case, it is not required to compose them into a single design. In addition to the diffraction lattice and prisms, no additional devices and setups are required. The rest, most of these requirements are based on the accuracy of alignment of the device along the selected optical axis. Now, *there is a different task*: the correct location of the photoconverter in a single optical axis with selective (photo-ac-

tive) radiation, maximum concentration and full direction of the cut off other rays to the hot junctions of the thermal converter. These tasks are associated with one problem - with different sensitivity of photoconverters from various semiconductor materials! In addition, it is necessary to take into account the influence of SC fabrication technology and their structures on their spectral sensitivity.

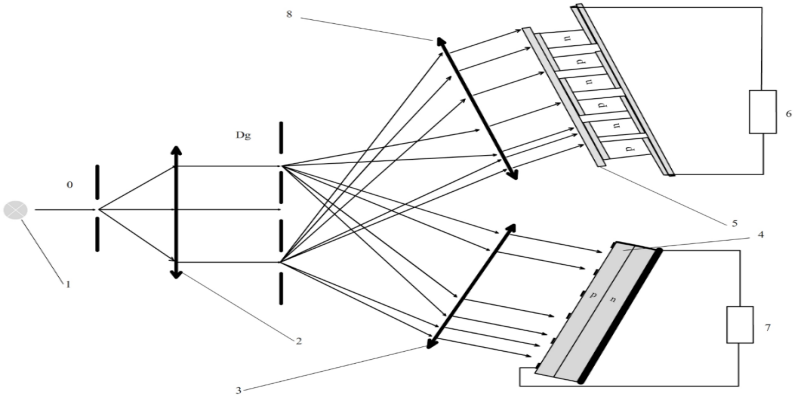


Fig. 1 *[14]. The distribution scheme of light radiation on the surface of photovoltaic and thermoelectric converters*
1-light source, 2, 3, 8-set of optical glasses, 4-photoconverter,
5-frontal surface of the thermoconverter, 6-load of the thermoconverter,
7-load of the photoconverter, 0-slit, Dg-diffraction lattice

As for the influence of the photoconverter manufacturing technology on its photo sensitivity, it is possible to solve this problem by preliminary measuring the spectral sensitivity. Then, as a consequence of this, establish a specific range of SC operation. The most important is the accurate alignment of the solar cell along the optical axis. In this regard, the authors of this work have developed several types of photothermogenerator [16]. In them, the PTGs differ among themselves in the configuration of the arrangement of photoelectric and thermoelectric converters on the front surfaces in shape (Figure-2).

One of the reasons for the ineffective operation of such a device may be the difficulty of accurately positioning the photoelectric converter at an optimal distance from the emitter and the absence of an exact border of light waves of different lengths. In the band theory of semiconductors, this plays a significant role. Therefore, the main goal of the authors of this work was to develop calculation methods to determine the optimal location of SC working on selective radiation. Light from the emitter can reach the prism at different angles (see Fig. 3). In laboratory experiments, this can be done on a horizontal plane. However, it is neces-

sary to take into account the fact that in natural conditions this is not so. In most cases, the radiation to the prism arrives at some angle (in Fig. 3, this is indicated by α). In order to ensure the accuracy of the optical system, we have developed an algorithm for mathematical calculation of determining the location of system elements. This program can easily be embedded in a computer. This work allows us to determine the distances *l, l′* of the locations of the prism, focusing lens, the front surface of the photoelectric converter *h, h′*, the shape of the phototherm generator and the degree of shadowing of the surface of the emitter by the intermediate links. The program was implemented for laboratory research.

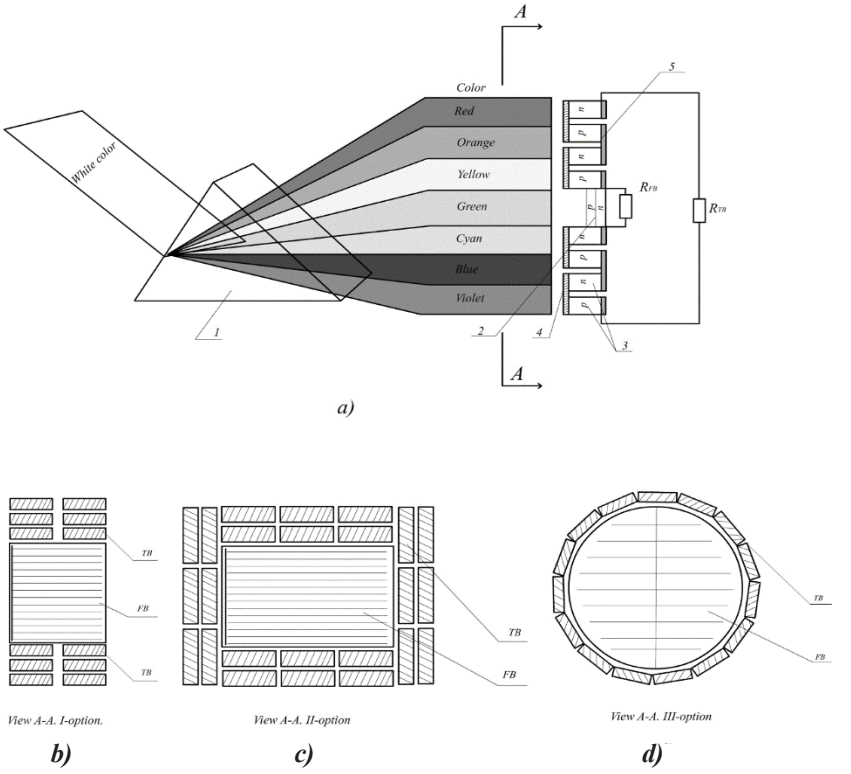
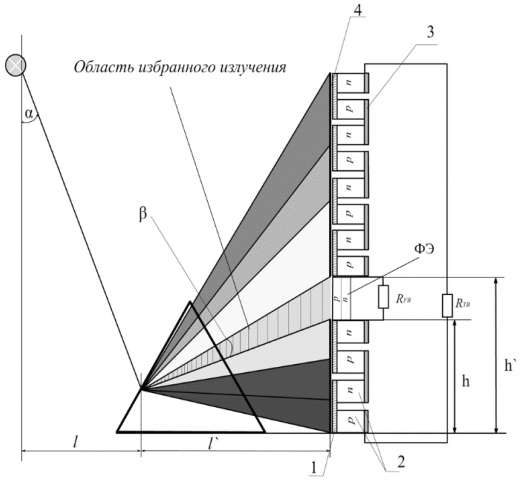
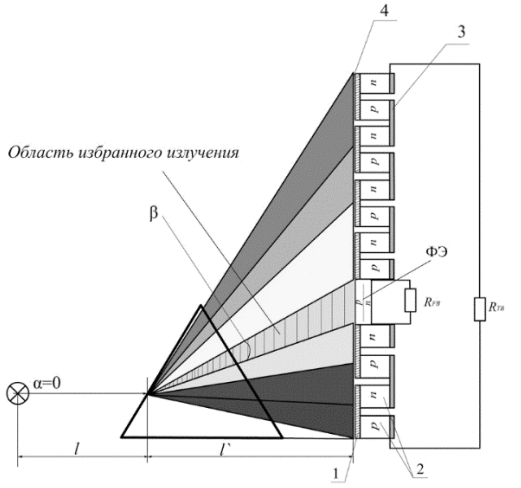


Figure 2 *[16]. Optical layout of a selective photo thermal converter*
a) 1-prism, 2-photoelectric converter (PC), 2-p- and n-branches of the thermal converter (TEC), 3-hot switching plates of the TEC, 4-cold switching plates of the TEC, b, c, d): - respectively , three options for the location of the photovoltaic battery (PC) and thermopile (TP) along section AA: I, II, III variant.



a)



b)

Fig. 3. *The design scheme of the optical system*
a) The radiation comes from the light source at an angle α.
b) The horizontal arrangement of the light source at which α = 0:
1,3- respectively hot and cold junctions of the thermoelectric converter,
2-p- and n branches of the thermocouple, 4-heat-conducting gasket.

Research results

The measurements were carried out on samples with hetero structures and homogeneous transitions. Therefore, their efficiency at room temperature it was 23% and 17%, respectively. These values corresponded to non-selective radiation. In order to increase the light intensity, a parabolic mirror concentrator was used. It had a diameter of 98 cm and during the measurement period the samples were placed at a certain distance from the focus. Since the focus was expected to be a very high temperature, in order to prevent the soldering from melting and destruction of the transducers, the optimal remote distance from the focus was selected by photometric measurement of the light spot.

The results of experimental studies have shown that a selective photoelectric converter is indeed highly efficient compared to a photoelectric converter operating under equal conditions. In addition, it surpasses in energy performance the same combined energy converter [13]. The obtained temperature dependences of the output parameters of solar cells give intriguing results, that is, the temperature of the test sample (while the hot junctions of the thermoelectric generator reached up to 96°C) exceeded only 4.7°C. This made it possible to maintain constant values of the output operational parameters in a wide range of temperatures and light intensities. This can be explained by the absence of non-photoactive light rays among the light flux entering the front surface of the photoconverters, which could be converted into heat in the volume of elements. The temperature dependence of the hot junctions of thermoelectric converters has a traditional character. That is, it grows with increasing light intensity and therefore temperature.

Studies have shown that when using structures with the arrangement according to the third embodiment of Figure 2, it is possible to obtain the most efficient selective energy converter, since in most cases the light flux arrives at the surface in the form of a light spot (almost round!). However, the slots formed during the installation of rectangular thermoelectric branches around a round solar cell can be additionally heated as a result of light radiation. This phenomenon creates a parasitic effect associated with a decrease in the difference between the temperatures of cold and hot junctions. The only way out of this situation can be the use of a common light-reflecting material on hot junctions of a thermogenerator made of well heat-conducting substances. The use of other forms of mounting transducers somewhat distorts the illumination of the SC surface with selected photo-active radiation.

Conclusion

According to the results of theoretical and experimental studies, the following conclusions can be drawn. The most effective and cost-effective is the use of photothermogenerators of selective radiation. This design does not require additional complex technological changes. By changing the direction of non-photoactive radiation, it allows photoelectric converters to be kept at a reduced temperature and helps to eliminate the negative dependence of the electrophysical parameters of the semiconductor converter. Additional contribution to the overall efficiency carries a thermoelectric converter. Lowering the temperature of the cold junctions of the thermal converter leads to an additional increase in the efficiency of the device. In order to achieve minimal energy losses, the spectral sensitivity of each solar cell should be determined and the distribution of selected radiation on the light spot should be determined.

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光电空气湿度传感器
OPTOELECTRONIC AIR HUMIDITY SENSOR

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抽象。 在这项研究中，研究了用于测量空气相对湿度的光电传感器，所连接的微处理器设备。 给出了空气湿度传感器的描述和示意图，用于连续监视受控对象中空气湿度的微处理器设备的框图，用于校准湿度传感器的设备以及用于校准湿度传感器的算法。

关键字：测量信息，模拟电子产品，数字电子产品，数字测量仪器，相对空气湿度，微气候，光电湿度传感器，参考值和测量仪器的校准。

Abstract. *In this study examined the optoelectronic sensor for measuring the relative humidity of air, the connected microprocessor device. A description and diagrams of an air humidity sensor, a block diagram of a microprocessor device for continuous monitoring of air humidity in a controlled object, a device for calibrating humidity sensors, and an algorithm for calibrating humidity sensors are given.*

Keywords: *Measuring information, analog electronics, digital electronics, digital measuring instruments, relative air humidity, microclimate, optoelectronic humidity sensors, reference value, and calibration of measuring instruments.*

Measurement and regulation of relative humidity, creating a microclimate is an essential condition in a number of industries and technologies. [1, 2, 3].

The necessary microclimate in these objects is provided by an automatic temperature and humidity control system in which various sensors are the primary converters of relative air humidity: optoelectronic, absorption, capacitive, etc. [2, 3].

In rooms with high humidity, the sensitivity of absorption sensors rapidly decreases during continuous operation. To restore the normal performance of the latter, it is necessary to periodically dry and calibrate them.

Optoelectronic relative humidity sensors, in contrast to absorption sensors, do not require such complicated technical maintenance. In many works, various types of optoelectronic sensors of relative air humidity free from the effects of external factors to a sufficient degree have been proposed [2 - 17].

Various circuit solutions have been proposed to reduce the influence of external factors such as contamination of the aperture of the measuring transducers, temperature, electrostatic field, etc.

This work is devoted to one of the methods for measuring relative air humidity and the sensor of the optoelectronic relative air humidity that implements this method with reduced effects of external factors.

An optoelectronic installation is proposed, equipped with a microcontroller for measurement and continuous monitoring, as well as an automated remote control of the relative humidity of the selected closed object, a structural and functional diagram, which is shown at the bottom in Fig. 1

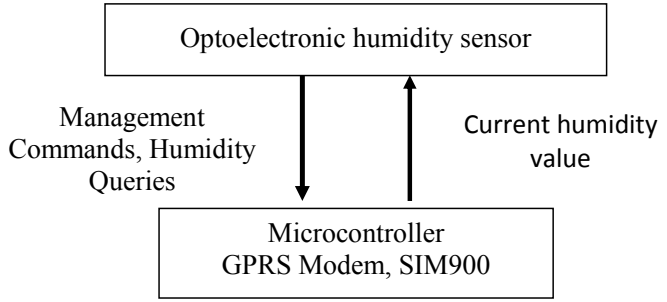

Fig. 1. *Structural and functional diagram of a transmitting device for continuous monitoring.*

Consider the principle of operation of the optoelectronic relative humidity sensor constructed by the method of direct lighting

As is known, the integral of measurement methods on the clearance lies Equation Bouguer - Lambert - Ber [2,3] , according to which, the flux of monochromatic radiation with a wavelength ƛ passing through some object on which the flux F0 is directed is equal to: $F_1 = F_0 \exp(-D_1)$

where: D_λ is the optical density of the object.

In the literature, there are numerous options for highlighting useful information implemented using optoelectronic primary converters. According to the information conversion algorithm of these converters can be divided into the following types:

1. measuring devices with logarithmic amplifiers that perform the linearization function;

2. measuring devices with a functional scan in the receiving part, while the linearization function is performed by a photo detector, the power of which is inversely proportional to the law of variation of the radiation flux F_1

3. measuring devices with a functional scan in the receiving part, while the linearization function is performed by a radiation source that generates radiation fluxes according to the corresponding law of the change in optical density depending on the measured parameter of the studied object.

In [3], the advantages and disadvantages of these transformation principles are considered in sufficient detail.

Here, for the purpose of spectral compatibility and to exclude the influence of external illumination, we select the same LED as the receiver that is used as the radiation source.

With the development of microprocessor technology, it became possible to implement the conversion function programmatically, as well as with the development of microelectronic technology, the power of emitting diodes increased to several watts, the sensitivity of photo detectors increased to a certain extent. Under these conditions, the linearization of the analog signal is no longer necessary. This circumstance allows simplifying the primary converter, excluding all those elements, except the converter itself of the measured value to voltage. This voltage is directly fed to the analog input of the microcontroller. Next, digital processing of the measurement information by the appropriate algorithm in the microcontroller takes place. Typically, this algorithm is based on a mathematical description of the measured parameter in relation to the measured voltage, i.e. signal at the input of the ADC.

In fig. 2 shows such a simplified circuit of a primary measuring transducer.

The sensor works as follows: D1 receives a current pulse from U1, and emits light. The light passing through the TO is weakened - encoded by the information contained in the TO. The encoded optical signal is fed to a D2 - receiver, an electrical impulse is formed, which also has information about the KO - controlled moisture-containing object. Next, an electrical signal in the form of a pulse voltage is fed to the input of U2 - the operational amplifier, then to the analog input of the microcontroller. Further, the processed signal, i.e. the selected information about the humidity of the controlled object is transmitted to the indicator or to the database for further processing.

The calibration process of any measuring device, including optoelectronic sensors for relative air humidity, requires many reference values or reference samples with previously known measured values. In our case, samples with known concentrations of relative air humidity cover the upper and lower limits. In practice, this limit varies from 25% to 90 % by volume.

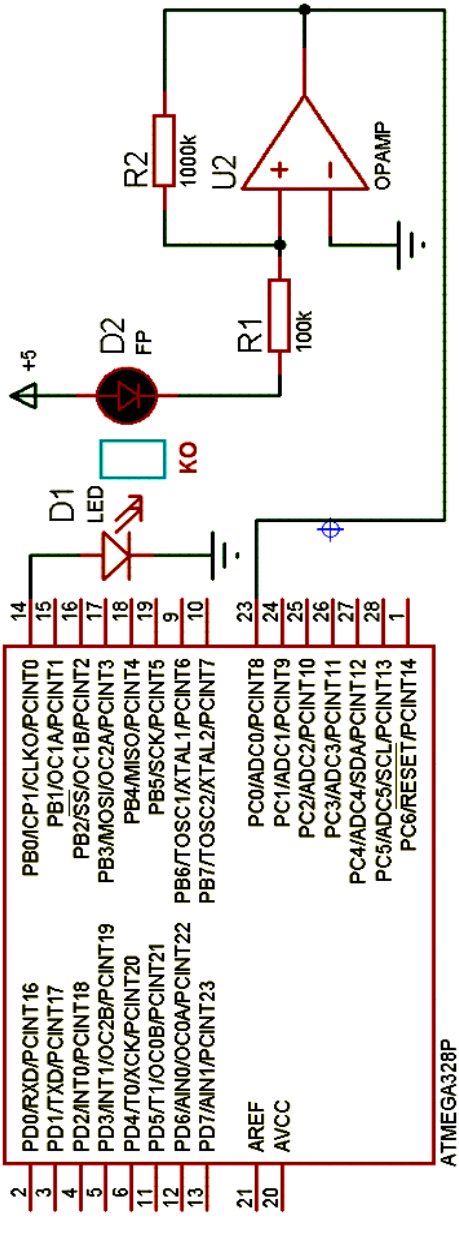

Fig. 2. Relative humidity sensor

Where:

- *U1 - Atmega328P microcontroller,*
- *D1 - emitting diode,*
- *D2 - the receiver,*
- *KO - moisture controlled object,*
- *R1 - R2 - mode resistors,*
- *U2 is an operational amplifier.*

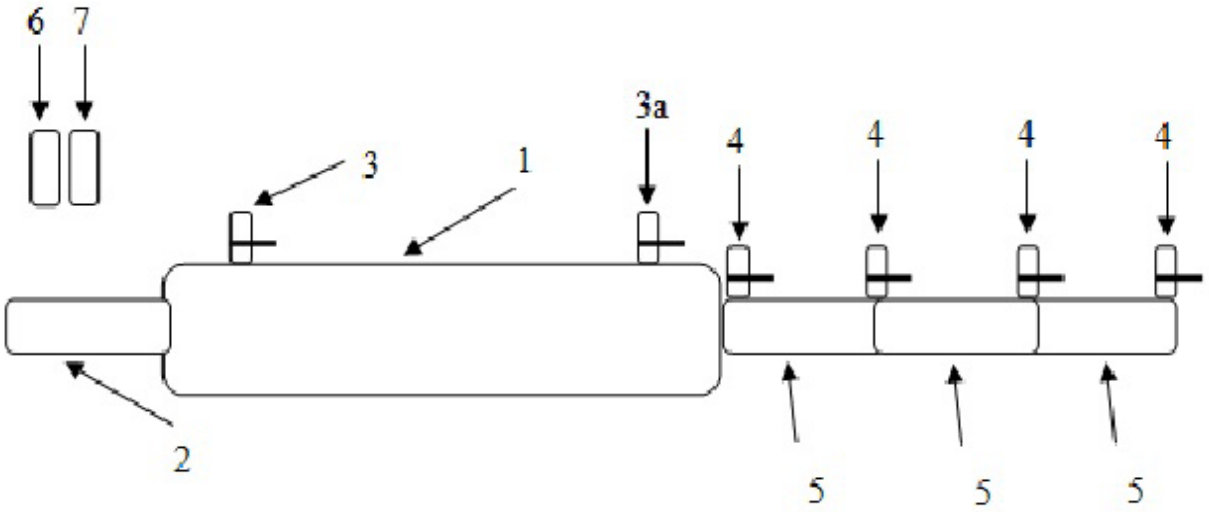

Fig. 3. *Device for forming working reference values of relative humidity.*

1 - Tube, the volume of which is designed for the upper limit of relative humidity.
2 - Quartz tube (cuvette);
3 - 3a - tubes and valves for filling the system with moist air;
4 - Taps for connection, the next volume;
5 - Calibrated volumes filled with dry air;
6 - Temperature sensor,
7 - Air humidity sensor.

A device was developed that forms several reference values of air humidity for calibrating optoelectronic humidity sensors, a schematic image of which is shown in Figure 3.

This Device is used as follows.

To ensure the accuracy of the formation of reference concentration values, it is necessary to pre-calibrate the reference volumes in the following order:

- Each volume is poured separately to the control risks on a glass tube with a reference amount of water, the mass of which is previously measured with a precision weighing device;
- If the reference amount of water is not filled up to the control risks, it is necessary to reduce the calibrated volume by tightening the calibration screws.
- If the reference water volume to be filled is larger than the calibrated, then it is necessary to increase the calibrated volume by unscrewing the calibration screws.

Thus, the prepared Device can provide with sufficient accuracy the reference volumes.

Using a tube with valve 3, heated water vapor is launched into the system, with valve 3a open, the remaining valves are closed, and then we will close valve 3a. Thus, in the first compartment and in the cuvette from the quartz tube connected to it, we have 100% relative humidity. We measure and record the first point of the calibration curve using sensors 6 and 7. Open the valve 4 of the next compartment, filled with air. The formation of a new concentration of moisture occurs. We take a measurement and record the second point of the calibration curve. Open the valve 4 of the next compartment, filled with air. The formation of the following moisture concentration occurs. We take a measurement and record the next point of the calibration curve. Thus, we record the reading of the calibrated sensor corresponding to all available reference values of the measured parameter - relative humidity, thereby forming the reading of the calibrated sensor corresponding to each reference value of the measured parameter.

Thus, the following table No.1 is formed.

Table № 1

No.	Humidity reference value	Instrument reading
1	H_{e1}	U_{e1}
2	He_{e2}	U_{e2}
3	He_{e3}	U_{e3}
...	...	...
n	H_{en}	U_{en}

Now using the least squares method , we can build an empirical mathematical model of our measuring device, i.e. based on the above measurement experiments, as a result we have a mathematical model (calibration curve) of the sensor under study. Next, we programmatically implement the processing of the sensor signal using a mathematical model to obtain the humidity value at the output of the measuring device.

This Device allows you to repeatedly obtain reference values of air humidity with sufficient accuracy and reproducibility and allows you to calibrate humidity sensors and evaluate their accuracy.

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利用矿渣污泥和有机化合物制备有机矿物复合肥料

PREPARATION OF ORGANIC MINERAL COMPLEX FERTILIZERS USING SLAG-SLUDGE WASTE WITH THE ADDITION OF ORGANIC COMPOUNDS

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摘要：本文的主要目的是通过添加固体废物燃烧过程中形成的炉渣，在燃烧过程中形成的污泥的混合物，开发一种技术，以恢复失去肥力，盐分，化石并变成沼泽的土壤。 开发油井，以及用5-10％HNO３处理过的富钾，氧化钾辉石岩。 发现100克。 50-60克城市固体废物燃烧过程中形成的炉渣。 含10-20 gr的石油钻探污泥。 可以获得富含矿物质和微量元素（尤其是钾和氮）的有机矿物质复合肥料。 本文报道了获得具有羰基桥的多功能四卤代双环化合物及其在分析化学中的应用的研究结果[1-4]。

关键词：矿渣，污泥，磷矿，精矿，方沸石，四卤代双环化合物，羰基桥。

Abstract. *The main purpose of this article is to develop a technology for the restoration of soils that have lost their fertility, saline, fossilized, and turned into swamps, by adding a mixture of slag formed during the combustion of solid waste, sludge formed during the development of oil wells, and potassium-rich, potassium-oxide phonolite rock treated with spent 5-10% HNO_3. It was found that of 100 gr. slag formed during combustion of municipal solid waste, 50-60 gr. oil drilling sludge with the addition of 10-20 gr. it is possible to obtain an organo-mineral complex fertilizer enriched with macro-and microelements, especially potassium and nitrogen. This article reports the results of the study of obtaining multifunctional tetrahaloidbicyclic compounds with carbonyl bridges and the use of the latter in analytical chemistry [1-4].*

Key words: *slag, sludge, phosphorite, concentrate, phonolite rock, tetrahaloidbicyclic compounds, carbonyl bridges.*

As you know, it is necessary to radically improve the processing and use of metallurgical slags. Slag-a byproduct of metallurgical industries, which as well as the metal should be fully used in the national economy. With the growth of production of ferrous metal, as well as the burning of municipal solid waste

in our country, the yield of slag increases accordingly. Thus, as domestic and foreign experience shows, slag is a valuable raw material for the production of a wide range of materials for the industry of housing, road construction, as well as for use as a fertilizer in agriculture. Products obtained from slags, slurries, as well as residues and waste in their physical and mechanical properties are not only not inferior in some cases and exceeds the quality of natural materials substituted by it.

In recent years, the demand for products made from metallurgical slag, began to significantly outstrip its production. This obliges metallurgists to continuously develop slag processing not only by commissioning new facilities, but also by constantly improving slag processing equipment and technology. Significant assistance to production workers in this important matter must + ' provide scientists.

The role and importance of slags in metallurgical processes are widely covered in the literature. Works covering the technology of complex processing and use of metallurgical slags are much less [1-3].

Rational and full use of slags received at processing and burning of solid household waste in a national economy increases complexity of processing of natural mineral raw materials, reduces Prime cost of the received materials and cheapens production in the branches consuming production from slags [4-6].

There are vast areas of land with high, harmful to most crops acidity. Such soils contain little nutrients, have poor physical properties and structure and are therefore infertile even with sufficient moisture, and sometimes with the application of mineral fertilizers. Liming eliminates soil acidity harmful to agricultural plants and enriches it with calcium, has a deep and versatile effect: reduces excess acidity by neutralizing the soil; significantly reduces the content of harmful mobile aluminum ions for plants; the soil becomes looser, better retains moisture; increases the activity of microorganisms useful for agricultural plants and especially legumes, on the roots of which form a kind of nodules containing bacteria that can absorb atmospheric nitrogen and enrich the soil with it. On acidic soils without liming, the use of other fertilizers is ineffective, they even have a negative impact. Liming enriches the soil with nutrients available for plants, increases the efficiency of organic and mineral fertilizers by 23-30%.

When reviewing the literature on the use of slag formed during the combustion of municipal solid waste, no data were found. Taking this into account, in the framework of this work, we also used slag formed during the combustion of solid waste. The slag used by us is a material obtained by incineration of municipal solid waste in the Baku village of Balakhany. The composition is given in table 1.Composition of slag (ash), %: Na_2O 5,82; MgO 2,42; $A1_2O_3$ 4,12; SiO_2 14,86; P_2O_5 2,12; SO_3 2,56; K_2O 2,27; CaO 33,47; TiO_2 0,85; МпО 0,21;

Fe_2O_3 10,31; C1 2,07; YTI 19,48. When considering the chemical composition of slag, it becomes obvious as the main condition — the possibility of obtaining a highly nutritious soil fertilizing product [7]. In this research work, along with slag, sludge was used, the reserves of which in our Republic are inexhaustible and increase every day during the development of oil wells, and which is not used in any area, but is disposed of without being neutralized, polluting the environment. There are currently 2,500 wells in operation. During the operation of each well, 80-100 m3 of sludge is formed, which is collected as waste. The composition is given below.

Table 1. *The chemical composition of the slurry (%), which is formed when drilling oil wells*

№	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	MnO	Fe_2O_3	YTİ
1	1,58	2,10	17,04	55,06	0,022	0,034	3.25	2,58	0,802	0,051	6,72	9,7
2	1,51	2,12	17,11	55,28	0,019	0,036	3,23	2.65	0,814	0,055	6,76	10,4
3	1,46	2,23	17,17	55,00	0,024	0,031	2,98	2,75	0,879	0,047	6,30	11,1

Number of components evaporating at 950°C.

Table 2. *Mineralogical composition of sludge (%) formed during drilling of oil wells*

SiO_2 α quartz	Natural spar	Montmorillonite	Illite	Caolinite	$CaCO_3$	Fe_2O_3	Volcanic ashes
29,6	13,5	14,6	9,2	9,7	5,8	6,7	10,9
28,4	13,8	14,2	10,1	10,5	6,1	6,7	10,2
29,5	14,0	14,5	9,1	9,4	6,8	6,3	10,4

Along with this, it is known that our Republic is called the second Urals in terms of reserves of natural mineral resources. One of these natural mineral resources, the reserves of which are unlimited and which hitherto has not been used, is phonolite. Its composition is as follows (% , masses.): SiO_2 56,42; TiO_2 0,85; $A1_2O_3$ 16,98; Fe_2O_3 3,25; MnO 2,51; CaO 1,69; Na_2O 1,93; K_2O 9,6; P_2O_5 0,55. Also, as an additive that accelerates the reaction of slag interaction, a nitrogen-containing solution was used, which is a waste of the production of electropolishing of steel and alloys of the machine-building plant of the following composition (%, masses.): HNO_3 — 27-35; F — 0.01; Си — 1.1; Ni — 1.1; Cr — 1.2; CrO — 0.3; Mo — 0.3; Co — 0.1; $A1_2O_3$ — 0.03; organic impurities — 0.1-0.4; H_2O — the rest.

Table 3. *Results of the analysis of the presented slag*

Nome. about.	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	MnO	Fe_2O_3	Cl	YTİ
Waste Furnace №1	5,82	2,42	4,12	14,86	2,12	2,56	2,27	32,47	0,83	0,21	10,31	2,07	19,48

Note: YTI-shows the number of components evaporating at 950°C.

In the course of the work were also used waste production of phosphoric acid - phosphogypsum the following composition (%, masses.): CaO - 33,0; SO_3 - 47,0; P_2O_5 total - 0,6; P_2O_5 solution - 0,6; F_2O_3 - 0,2; MgO - 0,5; F - 0,34; the rest - 17,9. Sulfuric acid, which was a waste product of oil refineries, was also used here. Composition (%, masses.): H_2SO_4 - 66,5; H_3PO_4 - 9,5; the rest - H_2O.

As can be seen from the above data, in our Republic there are enough slags, slags and natural mineral compounds obtained in various fields of industry. This means that the non-oil sector can be developed in this area. And basically, fertilizers, meliorants and plant protection products, which Azerbaijan buys at a high price in foreign countries. However, the conducted research works and the collected materials show that 56-65°/o of these compounds necessary for the country can be produced on the basis of waste of local industry and natural mineral compounds.

Table 4. *Quantity of materials coming to the plant and products formed during the process*

№	Material involved in the process, grams					The resulting products		Coefficient decompositions, %
	Slag produced during combustion	Sludge, formed during the development of oil wells	Organizirali	HNO_3 acid	Lime $CaCO_3$	Solid part, kg	Liquid part, kg	
1	100	60	10	80	10	180	80	86,4
2	100	55	15	75	5	175	75	84,6
3	100	50	20	70	10	170	80	82,8
4	100	60	10	70	5	150	75	83,6
5	100	50	15	70	5	160	80	85,6
6	100	50	10	80	10	175	75	85,5
7	100	50	15	75	5	170	75	84,3

Thus, in this research work, the task was to obtain fertilizers, meliorants and plant protection products based on slag formed in various areas of the metallurgical industry, during the combustion of solid waste, sludge formed during the development of oil wells, and natural mineral compound-phonolite, the use of which allows to fertilize the soil and increase yields.

Currently, the attention of synthetic chemists continues to attract the chemistry of multifunctional compounds of cyclic series, as many of them have a number of valuable properties (drugs, herbicides, bactericides, etc.).

To improve this process, the results of the study of obtaining multifunctional tetrahaloidbicyclic compounds with carbonyl bridges were used.

This article presents the results of the study of obtaining polyfunctional tetrahaloidbicyclic compounds with carbonyl bridges and the use of the latter in analytical chemistry.

All this confirms the conclusions of scientists that the main reason for the negative impact on the environment is not so much in the growth of production as in the absence of complex processing of minerals, as well as waste disposal in various industrial sectors containing macro-and microelements. The composition of minerals includes a sufficient number of macro-and microelements, the enrichment of which will allow you to grow any kind of environmentally friendly, high-yielding plants.

The nutrients contained in the slag and sludge are not used to a sufficient extent, and in the case of complex use, the element in one of them will replace those missing in the other.

Thus, we came to the conclusion that the application of this study is used for neutralization as biologically active substances.

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