



# SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the  
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Part 2 - Participants' reports in English

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这些会议文结合了会议的材料 – 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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## 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 71 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，  
教授，经济科学博士，中国科学院院士，会议组委会主席“上合组织国家科学研究：协同与融合”

在酒店业务中使用环境营销

## USE OF ENVIRONMENTAL MARKETING IN HOTEL BUSINESS

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抽象。 由于人类活动对环境造成的破坏性影响,对环境商品和服务的需求以及酒店业的需求正在增加。 本文讨论了在酒店业务中使用“绿色”营销以提高其服务竞争力和吸引客户的示例,为其发展和融入酒店公司的业务流程提供了有希望的方向。

关键词: 环境营销, 绿色技术, 酒店业务, 环境营养, 替代能源。

**Abstract.** *Due to the devastating impact of human activities on the environment, the demand for environmental goods and services, among others in the hotel business, is increasing. The article discusses examples of the use of "green" marketing in the hotel business in order to increase the competitiveness of its services and attract customers, offers promising directions for its development and integration into the business processes of hotel companies.*

**Keywords:** *environmental marketing, green technologies, hotel business, environmental nutrition, alternative energy sources.*

Over the past years, environmental issues have become even more important in society. The destructive impact of human activities on nature has prompted humanity to think about the respect and distribution of natural resources. On this basis, many different trends have appeared in society, for example, vegetarianism has now so firmly entered the way of people's life, that has already ceased to be fashionable. Garment production from garbage materials is gaining popularity. Ecotrend has become global in production: the well-known company Tesla produces cars exclusively on electric traction. The hotel industry has not stood aside.

By applying environmental marketing in management, hotels not only fulfill modern market requirements for their goods and services, but also convince people to opt for environmentally friendly hotels. However, the application of envi-

ronmental marketing is a much more complex process. The transition to "green" rails is quite costly and troublesome. Despite this, the policy of many hotels is aimed at greening their activities, the constant and steady introduction of systems of managerial, technological and other solutions to improve the efficiency of the use of natural labor resources while improving or maintaining the quality of the natural environment [1, 6].

Compliance of the hotel with the requirements is confirmed by certification and the assignment of certain marks. In 1991, the International Association for Standardization (ISO) created the ISO 14001 environmental management standard (EMS). In order to comply with it, the organization is obliged to confirm that it has a special environmental policy. The ISO 14001 standard is the minimum that every company must adhere to in order to minimize environmental damage.

For certification of eco-hotels there is also an authoritative system "Leadership in energy and environmental design". LEED certification can only be obtained by environmentally friendly facilities. The objective, well-known throughout the world LEED rating relies on energy and water savings, as well as environmentally friendly raw materials [4].

There is also an award in the application of environmental technologies. Green Key is an international quality mark awarded to hotels for their achievements in the field of environmental protection. In order to receive an eco-certificate, the hotel must meet fifty mandatory criteria and, preferably, a number of recommended ones. The criteria include several areas: environmental management, employee participation, information for guests, water consumption, cleaning and washing, waste management, energy consumption, food and drinks, office work, green areas and parking lots, environmental activities [3].

One of the main problems in the formation and development of hotel stability is the slow payback on the initial cost of installing equipment and technologies. The costs required for eco-hotels go beyond the income generated by many small and medium-sized companies. In addition, sustainable operation requires constant monitoring and measurement of the use of resources (electricity, water, chemicals, waste production, etc.), which additionally requires management training costs.

The main problem of environmental marketing is primarily in the search for alternative energy sources. Studies by the environmental organization "Green Seal" have shown that a hotel with 150 rooms consumes as much electricity per week as 100 private homes need. This is due to the heating of empty rooms, huge corridors, round-the-clock lighting and irrational use of electricity by guests [5].

One way to solve this problem, in our opinion, could be solar energy. In the hotel industry, the use of solar energy is actively used. Many hotels use solar energy both for direct heating of water and for generating electric energy. Studies have shown that through the use of new environmental working methods (for example,

solar water heating) and small investments in hotels and restaurants, it is possible to reduce electricity consumption by 10-25%, and water consumption - by 30%. However, this technology is effective if it is possible to collect solar energy for at least 7-8 months during a year. Given the fact that more than half of the globe cannot use solar energy even for 6 months, due to its geographical location, the effectiveness of this method of generating energy is reduced.

Considering the amount of energy consumed by the hotel, the issue of energy savings is becoming a hot issue. The next source of energy is wind energy. Of all the alternative energy sources, this method is perhaps the most problematic. One of the main reasons, as with solar energy, is the geography of use. The main source of energy here is strong gusts of wind that form in the highlands. This drastically narrows the scope of this technology. It's worth to mention that the wind is an unstable source of energy. The strength of the wind is very variable and often unpredictable, which requires the use of an additional buffer to accumulate excess electricity or duplicate the source for safety. Also, wind energy technology requires serious technical support. The use of such technology implies the presence of either a mountainous or vast open area. This makes it almost impossible to use wind energy if the hotel is located in a large city.

The growing importance of the latest technological trends in optimizing energy costs in the hotel industry can be noted in the transition to energy-saving equipment, the installation of various sensors, electronic access control and protection systems. For example, electronic access keys, which are responsible for managing the engineering of a room. The principle of operation of such a system is simple: as soon as the key card is inserted into the slot, the air conditioning, heating and ventilation system starts to work, the lighting turns on [2].

However, such a system has its drawbacks. As soon as the card is removed from the holder, the power supply to the room is cut off. In such circumstances, when a guest returns to the room after a certain period of absence, the temperature in the room often does not correspond to the desired values. As a result, those guests who have already faced this situation once or twice often bypass this "obstacle": leaving the room, they leave a second card inserted in the card holder slot. Sometimes such a solution is even offered by hotel employees who want to provide additional comfort to their customers. The result of this practice is significant energy losses and increased costs for the hotel operator.

High requirements in such hotels are presented to the organization of catering. Most eco-hotels try to use ecologically clean food of organic standards. In the simplest case, these are environmentally friendly products of local manufacturers, in the more advanced cases - products that have passed special strict control of European or American certification organizations. Equally important is the quality of the water. A real hotel in the ideology of "eco" should carefully monitor

the composition of the water that it uses. Influenced by vegetarianism, almost all modern hotels have a vegetarian menu.

The main problem here is limited access to environmentally friendly products. Ecological products are products grown with use of only natural fertilizers, without presence of genetically modified components, antibiotics, growth hormones, flavor enhancers, preservatives. The cultivation of such products is quite expensive financially, and therefore remains unpopular. In this regard, a careful selection of suppliers is necessary, because you will not only have to track the origin of the product, but also the method of growing it, only in this case the dishes served in your hotel can be called healthy and balanced. This increases the cost of such products, which cannot be ignored. However, there are indirect problems. The specifics of healthy nutrition also include special equipment for the processing and proper preparation of products. Such equipment is quite expensive to purchase and requires certain skills in use. This raises the problem of qualified personnel. An integral part of this kind of project is employee training. The training formats include the training of hotel chefs in the production and equipment of a healthy food company, as well as visits by company chefs to facilities for holding trainings and master classes for staff at various levels.

Moreover, the use of ecological food implies its integration into the overall concept of the hotel. This can cause problems if the hotel implements a market positioning strategy. In this case, it is necessary to make adjustments to the overall marketing strategy, which may affect other elements of this strategy.

However, in the presence of so many potential problems, it is fair to say that the format of a healthy diet can afford not only a premium class hotel. For a democratic menu, you can use cheaper varieties of fish, as well as find a domestic alternative to foreign varieties of meat. Creating a balanced menu, the chef also builds on the cost and sale price. There is an opinion that a healthy diet is not always tasty and not always beautiful. Effective tandems of chefs and nutritionists create culinary masterpieces that can surprise even the most demanding gourmets.

We summarize the above: when using environmental marketing, there is always a problem when the demand for the services of such hotels can be low, considering the higher costs of implementing such a marketing strategy and, as a result, the increase in the price of the services provided. Many of the methods necessary for managing an eco-hotel on a sustainable basis are not visible at first glance, so guests do not understand why these hotels are more expensive. The most important aspect, of course, is communication with tourists before, during and after the trip. An important element in communicating with potential visitors is the openness of the hotel company, which makes it possible to build a trusting relationship with the consumer. Honesty, a focus on public health, involvement in improving the environment, partnership with both public and private organiza-

tions, as well as with consumers ensure the positioning of the hotel as a socially responsible enterprise, improve the quality of services, and increase competitive advantages.

In addition, it is important to familiarize the guests themselves with their contribution to the preservation of the environment. For example, in 2012, a large French group Accor announced the launch of the environmental development program “PLANET 21”, the main purpose of which is to inform customers about the measures taken by the environmental group and invite guests to participate directly in this activity. The program includes lectures for employees and guests on the prevention of diseases, water and energy saving, innovations in the market of environmentally friendly products and services, and proper nutrition programs. The management of the English capital hotel “Cavendish” provides free parking for guests who come to the hotel by bicycle, and visitors using non-polluting modes of transport will receive a 50% discount on all hotel services. Such programs should be extended to the entire hotel business. And this should not be one-time promotion actions, but a necessary stage, built into the business process of each hotel. Only in this case can we talk about the effective integration of environmental marketing in the hotel business.

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后贝加尔地区影响中俄跨境合作发展的因素  
**FACTORS AFFECTING THE DEVELOPMENT  
OF SINO-RUSSIAN CROSS-BORDER COOPERATION  
IN THE TRANSBAIKAL TERRITORY**

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**摘要：**近年来，中俄两国关系得到了很大的改善。尽管，中俄贸易一体化不断深化，但跨境合作仍未达到预期效果。该研究的主要探讨中俄跨境合作的问题。本文致力于分析国家和地区因素对后贝加尔边疆区和中国边境地区之间经济合作发展的影响。文章重点研究该地区“增长点”的经济优势以及需要政府关注的问题。

**关键词：**后贝加尔地区，中俄跨境合作，经济潜力，影响因素。

**Abstract.** *Sino-Russian mutual relations have been seriously improved recently. Despite the constant deepening of Sino-Russian integration in trade, cross-border cooperation is not as effective as expected. The subject of the research is Sino-Russian cross-border cooperation in the Transbaikal Territory. The article is devoted to the analysis of the influence of state and regional factors on the development of economic cooperation between the Transbaikal Territory and Chinese adjustment border areas. The article highlights the economic advantages that can become the "growth points" of the region and the problems that require government attention.*

**Keywords:** *the Transbaikal Territory, Sino-Russian cross-border cooperation, economic potential, influence factors.*

Generally, cross-border cooperation aims to establish good-neighborly relations with adjacent states. But also it is a unique international tool which can help to promote the growth of the economic potential of border areas, increase the number of jobs there, improve living standards of the local population, attract foreign and national investment as well, develop tourism industry and provide other advantages.

As N. Hansen wrote, the economic and social life of the border regions in all countries directly and largely depends on proximity to the international border [1].

As world practice shows, when the border performs a barrier function to a

greater extent, the border peripheral regions lag behind the rest in socio-economic index, sometimes very significantly. When the border function changes from barrier to contact, in the context of the intensification of international relations, especially foreign trade, the border territories start to play the role of international development corridors of neighboring states, primarily transit corridors between central regions. The transit function is typical for border regions, and it is the transit potential that becomes primarily in demand when opening the economy.

With the intensification of foreign trade — the expansion of its channels, the growth of foreign trade operations with foreign counterparties — deeper integration of border peripheral regions and their economic and other interaction with the border regions of neighboring countries may also occur.

Globalization strengthens the interconnection and interdependence of national economies, accelerates the cross-border movement of goods, services, capital, information and expands labor market. Since border regions, in contrast to remote ones, are areas of close contact and interpenetration of economies, they can begin to develop more dynamically, both socially and economically.

However, this becomes possible only if certain regional factors are sufficient. These factors are as follows: structural features of the economy; the level of production development in the region; competitiveness of manufactured products; natural resources endowment; the amount of human capital; living standards in the region, etc.

According to Kozlov L., factors affecting the integration of peripheral regions also include the level of economic development of partner countries and the degree of attention the government pays to border areas. These are state-level factors. Kozlov L. considers the same economic level of neighboring border regions a necessary condition for their integration. If the difference is large, then a more developed peripheral region will establish relations with the central, more economically developed, regions of a neighboring country. [2]

Developed infrastructure and proper arrangement of border crossing-points should also be emphasized as an important factor of successful development of foreign trade relations.

Next, we consider the influence of the above factors on the development of cross-border cooperation between the Transbaikal Territory and the border territories of China - Autonomous Region of Inner Mongolia and Heilongjiang Province - and the prospects for such cooperation.

The Transbaikal Territory (Zabaykalsky krai) has a powerful transit potential: transport (railway and automobile) arteries connecting the eastern and the western parts of the country, the border with China and Mongolia, the presence of five border crossing-points on the Sino-Russian border and two border crossing-points on the Russian-Mongolian border .

Due to the favorable development of Sino-Russian trade and economic relations, the volume of foreign trade traffic only by rail and road at two checkpoints in Zabaykalsk annually amounts to more than 60 % of the total Sino-Russian trade turnover, and container transportation of goods from China to the EEC and Europe is also carried out. The region also has the potential to enter the markets of other countries in the Asia-Pacific region.

The second factor that has a positive impact on the development of cross-border cooperation is the resource endowment. In the region under discussion there are large unique reserves of copper ore, molybdenum, titanium, zirconium, iron ores, coal, gold, uranium and other minerals. In total, there are about 1,500 mineral deposits in the region. [3] Russia has focused on developing investment projects in this regional sector only in the past two or three years, but there are concerns that the region will become only a resource zone, and this prospect looks quite obvious – statistical data show that in terms of shipped products the region ranked 23<sup>rd</sup> and in terms of manufactured products volumes ranked only 75<sup>th</sup> in Russia. [4]

As for the level of economic development of the Transbaikal Territory, it is quite low. The region is subsidized and recognized as one of the most depressive. Zabaykalsky krai has a small number of industrial enterprises, there are not enough jobs for skilled workers, respectively, the living standard of the population is lower than in other Russian regions. This leads to a constant outflow of the working population. The steady decline in the region's population is alarming. Since 1990 the number of inhabitants in the region has decreased by one fifth; in 2017, the population decline amounted to 7.8 thousand people, in 2018 - 7.0 thousand people, in 2019 - 5.9 thousand people, in January – February, 2020 - 954 people, which exceeds the data for the same period in 2019. [5]

The Transbaikal Territory has good agricultural potential both in crop farming and in animal husbandry. There are 8,000 thousand hectares of unused agricultural land in the region, at the same time there is a demand for Russian agricultural products from China since they are competitive because of their high quality. The analysis shows that in the region there are no large agricultural producers, warehouses with modern technical equipment, supply logistics, big sales markets. These and other reasons hinder the development of the agricultural sector in the territory.

The next factor influencing the development of cross-border cooperation is the throughput capacity of border crossing-points. The largest rail (ZhDPP Zabaykalsk) and road (MAPP Zabaykalsk) border crossing-points between Russia and China are located in the Transbaikal Territory. Reconstruction of the transport hub and the modernization of the railway station in Zabaykalsk were carried out 20 years ago as part of the federal target program “Integrated Development of the Border Village of Zabaykalsk, Chita Region”. [6]

The insufficient capacity of the transport hub caused the reorientation of Chinese cargo flows to other directions, and Russia began to suffer losses. In 2014, the railway border post was reconstructed; currently coping with traffic. The automobile border crossing-point was also reconstructed, however, the new architecture of the checkpoint already during the reconstruction did not satisfy up-to-date requirements.

As a result, nowadays MAPP Zabaykalsk is one of the most problematic border crossing-points on the Sino-Russian border. Its limited throughput capability does not allow to cope with the increasing flow of goods and passengers. This negatively affects the development of inbound and outbound tourism, directly depending on the conditions and work regime at international border crossing-points.

China is ready and intends to increase the number of tourists to Russia through Manchuria, in addition, it plans to start high-speed rail. Taking into account that Russian tourism market is far from being leading in the world, this can be seen as an excellent opportunity for the development of tourism industry in Transbaikalia and in Russia as a whole, as well as for attracting national and foreign investment in this industry. Thus, it can be predicted that tasks of this scale will exceed the capabilities of the MAPP Zabaykalsk. It is worth noting that in 2019, MAPP Zabaykalsk was included in the new federal project, which was originally planned to be completed in 2023, but recently the deadlines have been shifted. [7]

Thus, the given research shows that the low level of economic development of the territory, insufficient human capital, underdeveloped infrastructure at border crossing points and weak state attention to the region are the factors hindering the development of cross-border cooperation in the Transbaikal Territory.

At the same time, the region has several potential advantages that need state attention and efforts to develop them. Such advantages include: the transit potential with respect to access to the Asia-Pacific countries, availability of unused agricultural land and the export opportunities of the agricultural sector taking into account the demand of China for its products, reserves of natural resources and Chinese investors' interest in the mining industry, the potential for the development of the tourism industry.

The benefits of the border region are obvious, but it is also obvious that the Transbaikal Territory, being a backward region, is not able to cope with a complex of problems; in order to realize the potential capabilities, the region needs state support, which includes not only financial assistance, but also the search for the most effective economic models and determining the most profitable specializations.

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上海合作组织保险业: 单一市场  
**INSURANCE SECTOR OF THE SHANGHAI COOPERATION  
ORGANIZATION:  
SINGLE MARKET**

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抽象。关于上海合作组织成员国保险业发展的广泛问题已得到研究。上合组织成员国中保险部门的地位是根据一项国际指标进行评估的,该指标确定了上合组织成员国保险市场的发展水平,即保险费在国内生产总值中的份额。文章提出了对上合组织成员国保险业的未来发展具有重要意义的建议。

关键词: 上合组织, 国内生产总值, 外贸营业额, 保险, 保险部门, 保险市场, 保险业务, 保险资金, 再保险, 保险费, 保险钱, 保险政策, 保险合同。

**Abstract.** *A wide range of issues on the development of the insurance sector of the member states of the Shanghai Cooperation Organization has been studied. The position of the insurance sector in the SCO member states is assessed on the basis of an international indicator that determines the level of development of the insurance market of the SCO member states, ie the share of insurance premiums in the GDP. The article puts forward proposals that are important for the future development of the insurance sector of the SCO member states.*

**Keywords:** *SCO, gross domestic product, foreign trade turnover, insurance, insurance sector, insurance market, insurance operations, insurance money, re-insurance, insurance premiums, insurance money, insurance policy, insurance contract.*

### **Introduction**

The Shanghai Cooperation Organization (SCO) is developing as an international and at the same time regional organization with the world's largest economic and political potential. This organization has already proved that it is one of the most influential participants in the modern system of international relations [1]. According to the data, the total territory of the SCO member states is 25.0% of the total land area, with a population of more than 3.2 billion people, or 43.0% of

the world's population [2]. According to Russian President Vladimir Putin, “the so-called “Seven” countries are richer in terms of GDP per capita, but the size of the economy (in terms of purchasing power parity) is higher in the SCO.”[3]. The SCO member states will become an important center of global development in the near future, and by 2030 its economy will account for 35-40% of world GDP. The annual foreign trade turnover of the member states of this organization today exceeds 6.0 trillion US dollars [4].

Within the framework of the SCO, the development of cooperation between its member states in trade and investment, banking and finance, transport and logistics, industry, agriculture and other areas is a priority. In particular, the construction and operation of railways and highways in the framework of the project “East and West”, creation of multimodal transport and logistics centers, implementation of promising joint projects in the field of high technology, digital technologies, In turn, it requires the integration of the insurance sector of the member countries, the creation of a single market for insurance services within the SCO.

#### **The main findings and results**

It should be noted that joint development of the insurance sector within the SCO member states, ongoing investment projects, foreign trade cargo, insurance protection of export-import operations are being carried out. On April 24-25, 2008, the 1st International Conference on “Insurance of Socio-Economic Cooperation of the SCO Member States” was held by the SCO Business Council in Moscow, Russia. In all member countries of the Shanghai Cooperation Organization, the insurance business is entering a new stage of development, integration processes in the socio-economic sphere, in many respects, support initiatives to develop cooperation in the field of insurance [5]. In the process of integration of the insurance market of the SCO member states, “Ingo-Uzbekistan” Insurance Company, the founder of one of the largest insurance operators of the Russian Federation – “Ingosstrax”, has been successfully operating in the Republic of Uzbekistan since 2008.

Despite the decisions taken at the conference on the creation of a single market for insurance services within the SCO, mutual coordination of insurance legislation and the implementation of joint insurance operations and reinsurance services, no concrete results have been achieved so far. The idea of creating a single insurance market within the SCO has not yet been realized [6]. N.Chelyukhina and E.Asyaeva in their research “many years ago, experts focused on the creation of a single insurance space for the SCO countries, and paid great attention to the possibility of developing their activities on the basis of international insurance money.” [7]. Although these ideas have not yet been realized, it has not lost its relevance.

The results of our research show that the cooperation between the SCO member states in the implementation of reinsurance operations within the SCO is unsatisfactory. For example, in 2019, insurance companies operating in the Republic of Kazakhstan transferred insurance premiums to foreign countries in the amount of 76,724 million tenge (US \$ 190 million, [8]), of which \$ 13.3 million or only 7 percent fell to China. However, in the analyzed year, the UK accounted for 49.4 million US dollars or 26% of insurance premiums transferred to foreign countries through reinsurance [9]. The work done by Uzbek insurance companies to carry out reinsurance operations within the SCO is also not good. According to the Ministry of Finance of the Republic of Uzbekistan, In 2018, reinsurance from the Republic of Uzbekistan amounted to 140 billion soums (information not disclosed by the Ministry, according to expert estimates, as of June 20, 2020 amounted to 10151.90 soums per 1 US dollar [10]), if insurance premiums were transferred to foreign countries, of which 9 per cent came from the Russian Federation and 3 per cent from China. However, this year Uzbek insurance companies have placed 58% of the total insurance premiums transferred to the UK through reinsurance to foreign countries through reinsurance contracts. [11].

It is known that to determine the level of development of the insurance sector, the indicator of the share of insurance premiums in GDP in the international insurance market is used. In this context, the role of the insurance sector in the economies of the SCO member states can be assessed by determining the share of insurance premiums accumulated in the insurance market of the SCO member states in GDP. We conducted an analysis to determine the share of insurance premiums in the GDP of the SCO member states.

The following conclusions can be drawn from the analysis of the data in the table below.

In 2018, the total amount of insurance premiums collected in the insurance market of the SCO member states amounted to 700,135.7 million US dollars. It turns out that among the member states of this organization, the country that has managed to collect the most insurance premiums is the People's Republic of China. The amount of insurance premiums collected by Chinese insurance companies in 2018 amounted to 575,000.0 million US dollars, or 82.1% of the total insurance premiums collected in the insurance markets of the SCO member states. According to the Swiss Re Institute research center, the amount of insurance premiums collected by Chinese insurance companies will increase from 575.0 billion US dollars in 2018 to 2.36 trillion US dollars by 2032.

**Table**  
*The main indicators of the development of the insurance sector of the member states of the Shanghai Cooperation Organization (2018)*

№	Countries	GDP, billion US dollars [22]	Insurance premiums, mln.US dollars	Share of insurance premiums in GDP,%
1.	China [15]	13 280,0	575 000,0	4,3
2.	India [16]	2597,0	99 840,0	3,8
3.	Russia	1576,5	21 725,4	1,4
4.	Pakistan [17]	305,0	2 331,9	0,8
5.	Kazakhstan [18]	170,5	1 001,7	0,6
6.	Uzbekistan [19]	48,6	196,1	0,4
7.	Kyrgyzstan [20]	8,0	15,7	0,2
8.	Tajikistan [21]	7,3	24,9	0,3

Strong economic growth in China, high government spending, consumer interest in insurance products and technological innovation will make it the world's largest insurance market in 2025 [12].

According to the data, the fact that in 2019, the top 10 insurance companies in the world include 2 insurance companies owned by the Chinese state, shows that there is every reason to further develop the insurance market in this country in the future. "China Life Insurance", one of the largest insurance companies in China, is ranked 6th among the strongest insurance companies in the world, and "Ping An of China" is ranked 8th. "China Life Insurance" has a market capitalization of \$ 123.9 billion and "Ping An of China" has a market capitalization of \$ 211.4 billion [13].

It should be noted that in recent years in international practice there are emerging digital ecosystems that combine a complex of citizens, organizations and products on a digital platform. This can be seen in the case of the Chinese insurance company "Ping An China". The company has such a digital ecosystem platform that currently provides medical consulting, car sales, banking and real estate services to more than 350.0 million online customers. "Zhong An" digital insurance company, which is part of this company, has issued 630.0 million insurance policies online to 150.0 million clients. [14].

However, the results of an in-depth analysis of the table data show that India, Russia and Central Asian countries have large untapped reserves for the development of the insurance market. Of course, it is not accurate to compare the economies of these countries with those of China. Nevertheless, the strengthening of trade and economic ties between China and other SCO member states will help Russia and Central Asia to have strong economies not only in the Asian region but also in the world.

In our view, in order to form a single insurance market within the Shanghai Cooperation Organization, first of all, it is necessary to harmonize legislation. It is advisable to use the experience of the European Union in the harmonization of legislation. It is necessary to study the possibility of mutual recognition of insurance policies, especially insurance policies on compulsory civil liability insurance of vehicle owners within the SCO. Of course, this is not all that is being done within the SCO to develop the insurance market of member countries. In future articles, we will continue our research on this topic and together we will serve to enhance the international prestige and prestige of the SCO.

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土地管理领域的国际科学融合：经验和前景

**INTERNATIONAL SCIENTIFIC INTEGRATION IN THE FIELD OF  
LAND MANAGEMENT: EXPERIENCE AND PROSPECTS**

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摘要。 我们的未来取决于许多客观和主观因素，但是科学的发展是所有过程的催化剂。 科学和教育都不了解国界，因此在现代条件下，国际科学融合不仅是科学界的需要，而且是任何国家发展的优先考虑。 俄罗斯在各种国际组织的框架内与其他国家一道，积极致力于加强对外科学关系，增加科学和学术人员的流动性，提供科学技术咨询等。上海合作组织被赋予特殊作用。 (SCO)，在土地管理领域具有发展科学合作的经验和潜力。

关键词：科学整合土地管理国际合作上海合作组织

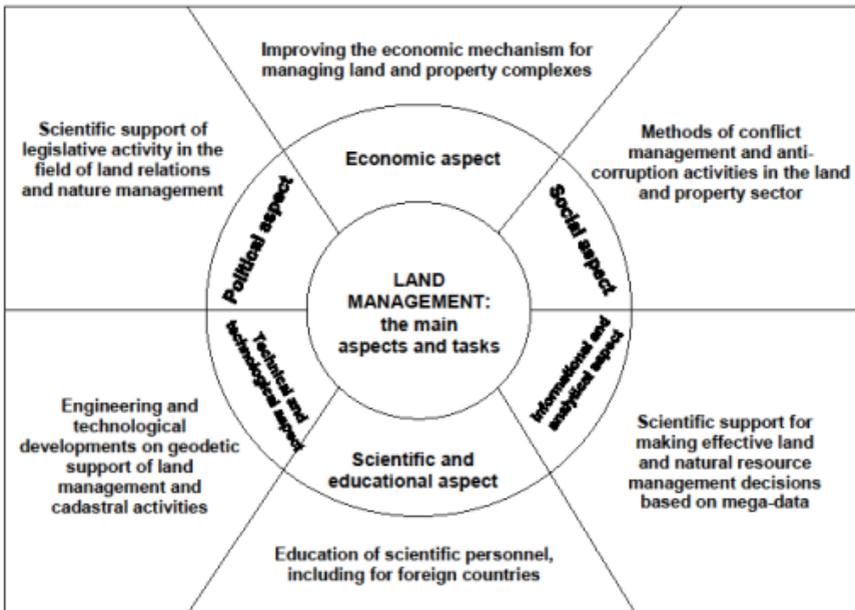
**Summary.** *Our future is determined by many objective and subjective factors, but the development of science is a catalyst for all processes. Science as well as education does not know state borders, so in modern conditions, international scientific integration is not only a need of the scientific community, but a priority for the development of any country. Russia, together with other countries within the framework of various international organizations, is actively working to intensify foreign scientific relations, increase the mobility of scientific and academic staff, provide scientific and technological advice, etc. A special role is assigned to the Shanghai Cooperation Organization (SCO), which has the experience and potential to develop scientific cooperation in the field of land management.*

**Keywords:** *scientific integration, land management, international cooperation, SCO*

### Introduction

International scientific integration as a complex phenomenon is, in our opinion, a process of uniting the interests of domestic and foreign partners in the framework of joint scientific projects and other forms of cooperation in order to solve urgent problems of scientific and technological progress. Integrators can be not only universities, but also other industrial and commercial organizations, as well as leading scientists and practitioners who are ready to take the initiative to determine the goals and objectives of scientific and technical coordination, the distribution of the necessary amount of work and available resources among all performers based on the role assigned to each of them.

Land management as a science is an integrated synthesis of various scientific fields – economic, social, technical, technological, environmental, etc. [1,2]. Today land management science has become increasingly active in integrating applied and fundamental research, especially in relation to land and natural resources.



*Fig.1. Main aspects and tasks of land management science*

The scientific community recognizes the leading role of universities in the development of mutually beneficial international cooperation in the scientific field, which is carried out through various forms of interaction, including the formation of stable scientific and technical ties, joint development of forecasts for the devel-

opment of science and technology, holding conferences and other international events, ensuring the dissemination of research results, awarding international scientific prizes, and much more.

The Shanghai Cooperation Organization, which currently unites 21 States with different status of participation in the work of the organization, provides wide opportunities for international scientific integration. It is well known that the total territory of the SCO member States is 34 million square kilometers, which is more than 60% of the territory of Eurasia, and the total population of the SCO countries exceeds half of the world's population. Within the framework of the SCO, norms of international law have been developed and are in force that allow for effective international scientific integration and activate integration processes for conducting joint research in the field of land management, which is especially important for our University as one of the leading specialized Russian universities. Our University develops cooperation with universities and organizations of all SCO countries, but the most productive results are available with such countries as Kazakhstan, China, Kyrgyzstan, Tajikistan, Uzbekistan, Belarus, Iran, Mongolia. Figure 1 shows the main aspects and tasks of land management science that can be solved within the framework of the SCO international scientific integration.

### **Results and discussion**

The increasing role of land management science is determined by the global challenges in the development of agriculture and the economy as a whole, as well as the real and possible risks of medium - and long-term character, which generally determines the subject of current and future research among universities and institutions of the SCO member States.

According to the UN, FAO and other international organizations, the world population growth rate is 1.13, and the average per capita food consumption is also increasing, so there is a long-term risk of exceeding the growth rate of demand over the growth rate of supply. The most acute problem will arise for such regions of the world as Africa and Asia, the population in each of which is projected at about 4-5 billion people by 2100.

The SCO countries, taking care of their own food security, can discover the great potential of the food market. In this direction, scientists of our University provide practical assistance through the development of projects "Land management support for the development of foreign economic relations of agricultural enterprises". In general, land management science, having important integration functions, solves many problems, including: scientific support of law-making activities in the field of land relations and nature management; engineering and technological developments on geodesic support of land management and cadastral activities; justification for making effective decisions on land and natural resources management based on mega-data; training of scientific personnel, etc. (table 1).

*Table 1. Global challenges and the role of land management science\**

<b>Type of global challenges</b>	<b>Real / possible risks</b>	<b>Role of land management science</b>
1. Economic	Global population growth and declining per capita food consumption	Scientific substantiation of territorial and spatial development of the agricultural and industrial complex
	Rapid growth of the urban population and the number of megacities	
	Development of technology of urban agriculture and the industrial synthesis of food	
2. Social	Increasing inequality of the population in terms of income and access to quality food	Integrated (system) design of rural territories and communities
	Reduction of rural employment, deterioration of the social situation in rural areas	
	The growth of social tension due to the use of technological innovations (GMs product, closed-loop industrial livestock production, etc.)	
	Conflict between large-scale production and small-scale farming	
3. Environmental	Global changes in natural and climatic conditions of agriculture	Land management support of safe technologies of adaptive landscape farming
	Degradation of agricultural land (reduction of natural land fertility, soil compaction, problems of irrigation and drainage-reclamation)	
4. Technological	Decrease in the growth rate of crop yield and agricultural productivity	Participation in the development of a program for the development of platform intersectoral technologies and modern information and communication technologies
	Significant losses of agricultural products at all stages from production to consumption	
	Constant growth of agricultural production for non-food purposes	

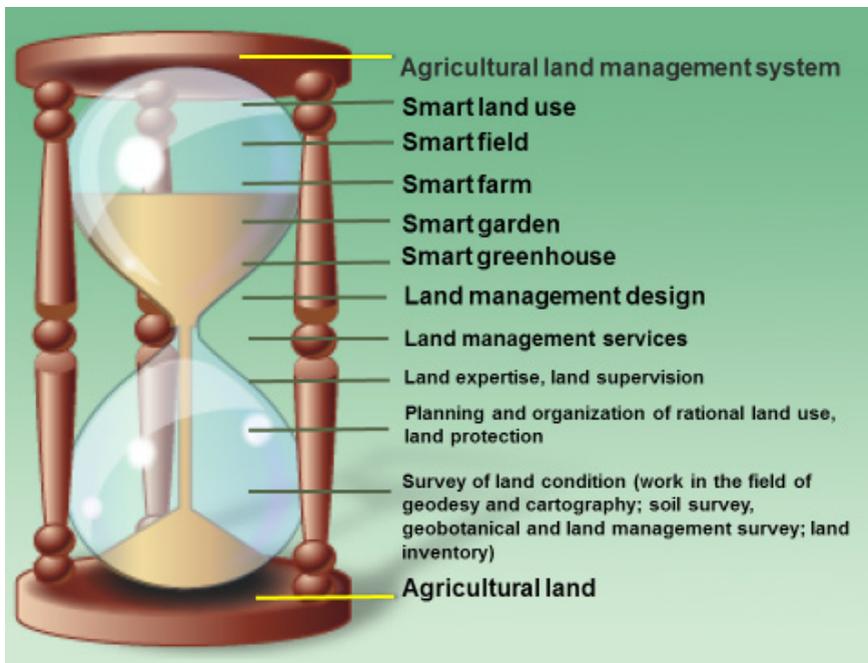
\*Developed by the authors based on open sources [3,4]

Among the economic and technological challenges of the modern world, the role of land management science in solving such problems as global changes in natural and climatic conditions of agriculture, degradation of agricultural land (reduction of natural fertility of land, soil compaction, problems of land reclamation), significant losses of agricultural products at all stages from production to consumption, etc.

Currently the State University of Land Use Planning (SULUP) has a share of publications in international databases Web of Science, Scopus, Chemical Abstracts, GeoRef exceeds 10 % of the total number of publications, and with Agris it reaches 25 %. Our inventors are working steadily. Ten patents were obtained for new technical solutions in the field of land management, ecology, construction and architecture in 2017-2018. Annual growth rate of research investment at the University amounted to 19.7 % in 2017, and 46.6 % in 2018, which allows us to hope for the successful achievement of the main indicators provided for by the "Science" project and the Federal scientific and technical program for agricultural development for 2017– 2025.

Formation of a modern scientific and technological base for rational planning, forecasting (economic and technological, informational), management and legal support of digital (smart) agricultural land use requires solving complex scientific problems of a fundamental and applied nature, including: improving and developing modern methods of managing agricultural land ownership and land use based on forecasts of socio-economic development of the country (land resource needs), taking into account market conditions and new mechanisms for evaluating management decisions; studying soil and agroecological characteristics of agricultural land using digital mapping technologies and innovative software for space and unmanned aerial vehicles, including identification of valuable and especially valuable agricultural land; creating a database of land conditions (geodesic and cartographic work, soil, geobotanical, land management surveys, land inventory) for making management decisions; forecasting, planning and organization of use of land resources by means of digital (smart) land management; development of the land cadastre based on systems with artificial intelligence, monitoring, accounting and control (supervision) of the use and protection of agricultural land, automated land management project, land use potential based on the assessment of risks of economic use to ensure the sustainability of agricultural land use; improvement of land legislation, development of land management regulations; improvement of methods for conducting and justifying land management (design and survey) works; development of intelligent technologies for the formation of land management documentation, automated geomarketing and business planning tools; formation and controlling of legal support for smart land use; online consulting systems, including land management expertise, the use of automated (formation of robotic technologies based on artificial intelligence systems) collection, storage and processing of information as the basis for decision-making operational management (design and expert) solutions; development of a technological platform for involving unused agricultural land in the turnover; the allocation of especially valuable agricultural lands and development regulations for their use; formation of an electronic Atlas for land administration system; modernization of the system

of training and additional professional education of personnel for the development of agricultural land use and management and attract young professionals, focused on rapid adaptation to the requirements of scientific and technical progress, creation of a network of centers improve qualifications and training for competence centers. Figure 2 shows some components of the smart land management system [5,6,7].



*Fig. 2. Some components of the smart land management system*

At present, the State University of Land Use Planning has accumulated considerable experience in scientific and industrial work in the field of land management, rational use of agricultural land, their cadastral security. Pilot projects are being implemented in a number of regions of the Russian Federation: Belgorod, Moscow, Tambov, Yaroslavl, Smolensk, Kirov regions, Krasnodar and Stavropol regions. The University has 2 research and production centers with an area of 95 hectares, where innovations in digital intelligent production technologies for zoning, regulating and organizing the rational use of rural land are practiced based on a set of methods for remote sensing of the Earth and ground-based geodesic measurements.

According to the indicators of the national project "Science", the rate of renewal of scientific equipment should be at least 50% by 2024. In 2017-2018, the University updated its hardware base by 16.6 %, which significantly increases the ability to conduct research on a global level [8].

The University has a set of the most modern geodetic equipment, unmanned vehicles, software for scientific research in the field of geo-information support of rational use optimization of management systems and forecast of the state and protection of land resources of the Russian Federation. We work with the most modern technical and software developed by leading companies in the world and Russia - robotic total station, satellite geodesic receiver, radio antenna, set of electronic theodolite and rangefinder laser scanner, geospatial data processing software and others.

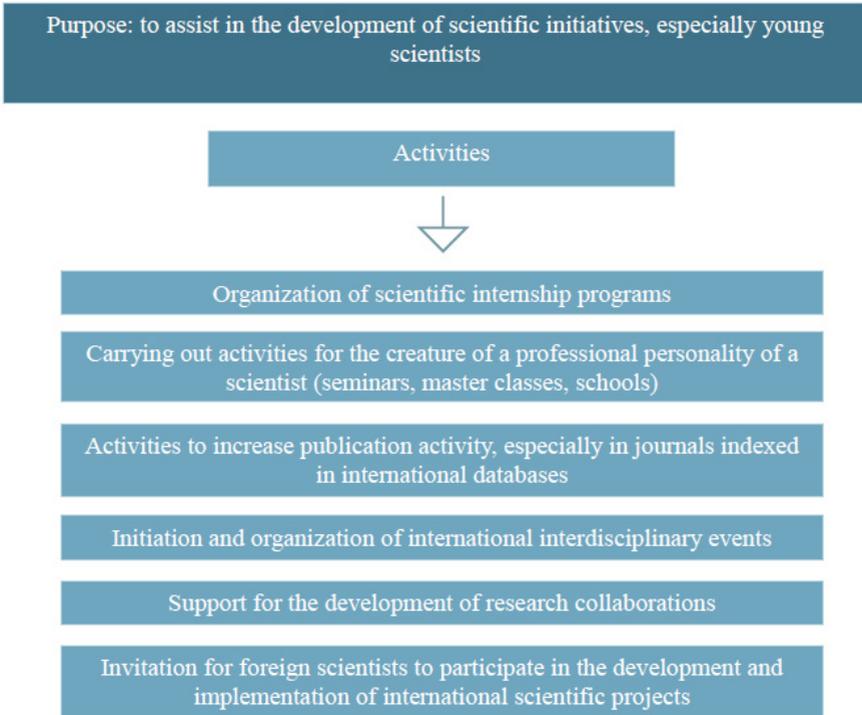
The University is actively working Youth Design Bureau "GEOKON", which hosts the development and modernization of unmanned aircraft technology to survey, land surveying tasks, condition monitoring of the agricultural land. The Bureau's arsenal includes: UAVs of aircraft and copter type: multi-purpose aircraft "Zemlemer-2" with a coverage area of up to 50 sq.km per flight; the quadrocopter; multispectral camera for agriculture; digital camera with built-in gps-lens; complex of GNSS equipment for UAVs, field charging station for batteries, imaging module, and more. The University has a large selection of special equipment for assessing the ecological situation of land, the degree of development of degradation processes: portable colorimeters; gas analyzer with high sensitivity of the FID detector; soil laboratory; laying-laboratory of field chemical control of water quality; dosimeter-radiometer, voltammetric analyzer, as well as a significant number of auxiliary analytical and forwarding equipment. The University has created and is constantly updating a database on the state of land in various regions of the Russian Federation, assessing the effectiveness of implemented land management systems projects both at the level of agricultural producers and at the level of municipalities. Accuracy of the created map database - from 1:500. Geospatial local binding is performed at level 5 – 10 cm.

### **Conclusion**

We can suggest the following main directions of international cooperation in the field of land management for interested universities and organizations of the SCO countries:

1. Signing and implementation of agreements on strategic partnership in the field of land management science between the leading agricultural universities of the SCO countries and interested industrial and commercial organizations.
2. Creation of unified joint programs for retraining of scientific personnel and advanced training in the field of land management and cadastre and joining efforts in organizing a system of distance learning for postgraduates and doctoral students in these areas.

3. Study of the establishment of an International Center for scientific integration in the field of land management on the basis of the State University of Land Use Planning and with the support of the SCO (Figure 3 shows the general scheme of functioning of such a center).



**Fig. 3.** *Activities of the International center for scientific integration in the field of land management*

As for the use of smart (digital) land management for agriculture and agro-industrial complex of the SCO countries, the following conclusions can be drawn:

1. Create an information computer system for assessing the quality and location of agricultural land plots based on their inventory and evaluation productive and territorial properties (similar to the American system "LESA" - Land Evaluation and Site Assessment System and the Soviet system of on-farm land assessment).

2. Complete the formation of land ownership in the in Russia and other SCO countries, implement these processes organizationally and technologically, ensuring the separation of all forms of ownership, setting all agricultural land plots on

state cadastral registration and their registration. This will allow attracting additional credit resources to the agro-industrial complex secured by land and increase the tax base.

3. Perform the function of planning the use of land in agriculture at the national, regional and municipal levels, as is done in the European Union, the United States and China [9], which will link the development of agriculture with the socio-economic and natural conditions of the country, individual regions, business interests and opportunities.

4. Develop as part of land management projects agricultural (land management) regulations, measures to protect land from degradation processes and to reproduce soil fertility, increase the efficiency of land use.

5. Develop for each agricultural commodity producer regional business-oriented projects of adaptive landscape land management, allowing to link the system of agriculture (technologies of cultivation of agricultural crops: the system of processing, fertilizers, soil reclamation, plant protection, seed production, machine system) to the land and thereby significantly increase its efficiency usage.

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俄罗斯移民歌词中的中国自然与文化。

## NATURE AND CULTURE OF CHINA IN THE LYRICS OF RUSSIAN EMIGRANTS

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抽象。俄罗斯移民的诗歌在塑造俄罗斯侨民关于中国文化的观念，塑造这个国家以及最终的“中国文字”形象方面发挥了巨大作用。诗歌成为俄罗斯东方国家文学中最重要的部分。

诗歌在俄罗斯东方移民的生活中起着特殊的作用：它是外国文化的“精神核心”。出于缘分的意愿而来到中国的俄罗斯人民，把他们留在中国是履行着旨在维护俄罗斯文化及其传统的特殊精神使命。他们认为自己的作品是俄罗斯银器时代尤其是诗歌流派的一个新阶段。

关键词：“中文文本”，俄罗斯移民的诗歌，俄罗斯文学中的中国，中国形象，“中文文本”发展的历史，二十至十九世纪的俄罗斯文学，二十世纪的移民诗歌

**Abstract.** *A huge role in shaping the ideas of the Russian diaspora about the culture of China and creating a detailed image of this country and - ultimately - the "Chinese text" - was played by the poetry of the Russian emigration. It was poetry that became the most prominent part of the literature of the Russian eastern countries.*

*Poetry played a special role in the life of Russian eastern emigration: it was a kind of "spiritual core" of foreign culture. Russian people who, by the will of fate, ended up in China, regarded their stay in it as fulfilling a special spiritual mission aimed at preserving Russian culture and its traditions. They perceived their work as a new stage in the Russian Silver Age and, above all, its poetic school.*

**Keywords:** *"Chinese text", poetry of the Russian emigration, China in Russian literature, the image of China, the history of the development of the "Chinese text", Russian literature of the XX – XIX centuries, emigrant poetry of the XX century*

The "Chinese text" [1], created by Russian writers of Harbin and Shanghai, became an important part of the Russian "Chinese text" of the XX century. In it, for the first time, Russian literature tried to artistically rethink the principles of Chinese art, and on the other, to portray the many-sided life of China in the 1920-1930s, to reveal the Chinese national character. The "Chinese text" of Russian

poetry and prose connected two time layers - the country's millennial past and its present [8].

The historical and cultural experience of Harbin and Shanghai turned out to be unique [6, 7]. Two cities that became “enclaves” of Russian culture sought not only to preserve the traditions of Russian classical culture and literature, but also the “new” culture of the Silver Age, but Russian writers living in them tried to “synthesize” two dissimilar cultures in their literary texts - Russian and Chinese, - to understand the historical processes and grandiose social upheavals that occurred in one country, through the prism of the history and culture of another country.

The image of China in the lyrics of Russian poets was often idealized and aestheticized. This was especially for the early works of poets and, first of all, in poems - landscape sketches in which events of the historical past were reproduced. Such, for example, is a poem by A. Nesmelov:

А небо очень зелёным  
Становиться от зари  
И светят в глаза драконам  
Бумажные фонари

[3: 235]

Often, portraying China, poets followed the principles of Chinese poetry (known to most poets from translations made by Harbinians), as well as Chinese calligraphy and painting. N. Panisheva, analyzing the lyrics of A. Nesmelov devoted to China, notes: “Nesmelov creates detailed images similar to stylized Chinese pictures. Static verses ... can be perceived as a symbol of the life of an ancient country. ... The lack of dynamics allows the poet to capture the Chinese landscape, filled with deep philosophical meaning”[4: 102].

Picturesque, associated with admiration and love for China, permeated poem by V. Pereleshin "China":

...Я люблю эти пёстрые стены,  
Эти дворики, сосны, цветы.  
Ах, не всем же, не всем же измены:  
Сердце, верным останься хоть ты!..

(1942) [2:: 521]

The poem “Xiantancheng” presents a bewitching description of the beautiful nature and all-consuming spiritual harmony that fills the author at the time of his stay in Xiantancheng:

...В Сянтаньчэн просятся улыбки,  
В Сянтаньчэн сходятся мечты.  
Про него всхлипывают скрипки,  
На него молятся цветы...

(1948) [2:: 534]

A beautiful and bewitching description of the nature of China was created in his works by A. Achair. In the poem “Song of Spring in the Courtyard”, which stylizes certain features of traditional Chinese poetry, spring is presented in the form of an elegant Chinese girl, and the surrounding nature is represented incredibly elegantly, subtly and sensually:

...Сквозь бамбуковые ставни сад пустынной и темней.  
На задумчивой поляне – блики света и теней.  
В этих тенях, тканях словно, в чуткой призрачности сна  
спит застенчивой и томной гибкой девушкой – весна.

(1929) [2:316]

In A. Achair’s poem “Hangzhou”, the poetic perception of traditional China (“the sacred ancient temples were reflected in the mirror of the waters”; the surrounding world is filled with the “languid smell of smoking from wisteria bent to the waters”) is interwoven with the image of everyday Chinese city life (“like bees and wasps, rang, buzzed both violins and lutes”):

и сон, и полет в беспредельность,  
и скрипки, и лютни, и цитры, и радостный крик окарины,  
и дрожь трепетавшего гонга, и млечность, и вечность, и цельность,  
и – облачный ладан, и звезды, и – путь в поднебесье орлиный.

(1939) [2: 322]

A fascinating description of Chinese nature (namely, twilight over the waters - in this image you can find the influence of traditional Chinese poetry) we find in the poem of the poetess M. Wizi "Chinese landscape":

...Там, где сгустилась  
предвечерняя мгла,  
остановилась  
звезда, взошла;

в объятую сном  
воду канала  
белым пятном  
упала...

(1937) [2: 343]

In her poem "On a Chinese Farm" a picture of a quiet, calm evening is presented:

Точно кружевом, одетый тиной,  
на закате тихо спит канал.  
Высоко над хаткой и плотиной  
жёлтый месяц острогогий встал...

(1937) [2: 343]

In the poem by T. Andreeva “In the Mi-Sin Temple”, the description of the life of rural residents and their traditional worldview is closely intertwined with Chinese symbols:

...В одеждах длинных старец и монах,  
Безмолвные, о чем-то грозно спорят;  
Потоки золота в округлых облаках  
Бросают свет на розовые горы...

(1931) [2: 304–305]

The best qualities of a Chinese person are the depth of soulful sincerity, inner dignity and kindness of a beggar who, giving in to a natural impulse, gives a wealthy foreign woman a delicate lotus flower and is offended when he is offered money in return, presented in the poem-sonnet by E. Rachinsky “Lotus”:

...Ладонью защитив, он нёс его так нежно.  
«Эй!» – и монет соблазна полный звон.  
Как удивлённо оглянулся он!

Жест отрицания был царственно небрежен!  
Раздумье... Узких глаз мгновенный блеск и жар,  
И лотос он, бедняк, мне протянул, как дар!

[2: 563]

For writers of Russian emigration, the theme of *memory* and *time* was important. It was especially significant for representatives of the eastern emigration, who had a poor idea of what they might expect in the future. Due to this, their perception of modern Chinese reality was often mythologized by them: they felt like “Russian wanderers” who had lost their way and found themselves on the border of worlds (Russia / China, past / future, life / death). The road back to Russia, as many of them understood, was closed to them; closed to most of them was the road to the West (to Europe or North America); they had no hope of adapting to life in a new country and completely “turning” into Chinese (besides, China itself was in a difficult historical situation of the civil war within the country and its external occupation by Japan in the 1920-1930s). Therefore, many representatives of the Russian emigration were in a state of thought about the future of their “cultural enclave” and about their personal fate, and in their works there were constantly motives for the uncertainty of the future ahead and the inalienable homesickness.

N. Svetlov in the poem “On the Street” draws an analogy between figures made of dough molded by a seller on the market and people's fates. “A Chinese sculpts figures from dough, he is surrounded by a crowd of onlookers,” whom he knows how to masterfully tune thanks to the sculptures he molded of “important officials”, the price of which is “nickel to live two days.” As a result, the poet makes a logical conclusion for the Russian emigrant:

...Фигурки из теста! Так странно схожа  
Судьба ваша – с чёрной судьбой людей;  
Но только за жизнь мы платим дороже,  
И мачеха-Жизнь к нам ещё лютей.

[2: 592]

In A. Achair's poem "In the Fruit Shop", the description of the traditional Chinese way of life is intertwined with memories of the past days of youth:

...Рыбацкая воля,  
купцовая леность,  
буддийская вечность  
и жёлтый закат.

...– Ты снова про годы,  
про время и бремя?  
За старую... юность?  
А я – за сейчас!

(1938) [2: 321]

National characteristics of Chinese culture in its traditional allegorical symbolic form are described in the poem "Narcissus" by L. Andersen:

...Словно стебли, ваши пальцы гибки...  
На халатике, как в пёстрой сказке,  
Бродят взбудораженные краски,  
Плавают серебряные рыбки  
Меж стеблей, как ваши пальцы, гибких...

[2: 296]

Poet B. Beta in the poem "Manchu Yamba" reflects on the traditional Chinese way of life, on a calm and peaceful worldview, which the lyrical hero so needs. In this world, the "Manchurian still heat" reigns; the sun is likened to a "fire nut". "Longing" comes to this world, which with its "easy hand" touches the hero, after which he has a desire to "swim, or else go on foot with a stray bag behind" to back to "where the towers have corners of clay walls", and "The incinerating dragon reveals the light," - to where "the flute cries lightly, and the musician on it - is blind" [2: 334]

The feeling of homesickness, mixed with the strange feeling of the author of "friend - foe" in China, is filled with the poem by E. Trachtenberg "Letter to Mother". "Again, the heart sank in sorrow," the poetess exclaims, "here are strangers, a stranger's sunrise, a stranger's sunset," but the confession immediately follows: "... But I have remained the same and call China my homeland! .." The lines of the poem are full of contradictions and reflect internal throwing:

...Здесь горы, словно тень Урала,  
Где детства светлая печать.  
Я там когда-то умирала  
И... умираю здесь опять.

[2: 625]

At the end of the poem, the poetess emphasizes that she has long lost the line between modern life in China and the "dark days" - the beginning of "our failures" in Russia. [2: 625–626]

In K. Baturin's poem "Нyo-N", China is likened to a bewitching young girl (comparing China with a girl was traditionally for Russian emigration poetry), the image of which is associated with a sophisticated, refined, gentle, airy and light feeling:

Ранней весной цветёт вишня,  
Голубой далью – неба край;  
В простые четверостишья  
Нежность собрал Китай.

Лепестки легли на лике,  
Чёрен в узком разрезе глаз.  
Разве скажешь – губы дики.  
Не целованные не раз.

Чарует изгибом тела,  
Точённостью линии рук –  
Чудеснейшая новелла,  
Изысканная, как бамбук...

(1930) [2: 327]

On the other hand, in the same poet, in the poem "On the Road", we find motives of hopelessness and irreversibility of time, the flow of which erases behind itself everything that was once valuable, important and unshakable - both in the space of nature and in cultural memory of people:

...По ступеням – камням щербатым –  
Время царственно протекло,  
И день угасает ровным закатом,  
Хотя ещё светло.

Из серого гранита тупорылый лев  
Ничком лежит в бурьяне.  
И никто не прочтёт нараспев  
Надписи на кургане...

...От старой кумирни остались обломки  
 В стёртых узорах знаков.  
 В заросли тополей бамбук тонкий  
 Растёт из могил монахов.

(1930) [2: 327–328]

The artistic prose and poetry of Russian emigrants living in China in the 1920-1930s, of course, had not only historical, but also great artistic value. Their works represented a “cultural bridge”, gradually built up in the process of interaction and mutual enrichment with cultural values between the two great countries and their peoples - Russia and China.

The main **results** of the development of the poetic version of the “Chinese text” of the literature of the Russian eastern countries include the following:

1. The "Chinese text" of literature of the Russian eastern countries remained an organic part of Russian culture and inherited the traditions of Russian classical literature of the Golden and Silver Ages. This feature was expressed, in particular, in the desire not only to show the nature of the exotic "East", but to understand and accept the "alien" culture and its traditions, to penetrate the depths of Chinese philosophy and religion.

2. Representing the nature and culture of China, Russian writers created a system of symbols that organically flowed from traditional Chinese culture. It was based on *motives* and special iconic (*key*) words – “dragon”, “phoenix”, “lotus”, “orchid”, “bamboo”, “chumiza”, “junka”, “fanza”, “kaolyan”, “rickshaw”, “fan”, “silk”, “tea ” and some others. "The hills of Manchuria, yellow Sungari, faces, views, street scenes, Chinese vignettes, music, holidays, spells, typhoons, dragons, temples, rickshaws and Taoist gods - all this was thickly, flowery, animated for the first time saturated the fabric of Russian verse," V.M. Crade, characterizing the Russian poetry of Harbin and Shanghai of the 1920-1930s. [5: 24]. Subsequently, all such words and motives began to be uniquely associated with Chinese culture and were widely used by Russian fiction and journalism (including Soviet and post-Soviet), as well as in literary translations of texts from Chinese into Russian.

3. In the poetry of the Russian “eastern” foreign countries, a pronounced *tragic outlook on life* was formed, an all-consuming homesickness was expressed. The lyrical hero of poetry was constantly in search of his "I", struggling with internal contradictions in search of answers to everyday and "being" questions. The writers perceived themselves as the last keepers of the traditions of Russian classical culture, located on its last frontiers, and at the same time as its "messengers" who were in the framework of a "foreign" culture, and "scouts" trying to comprehend everything new and unusual, which they became eyewitnesses in the country that gave them a temporary shelter.

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腔隙短语单位的中文和乌兹别克语翻译  
**TRANSLATION OF LACUNAR PHRASEOLOGICAL UNITS IN  
CHINESE AND UZBEK LANGUAGES**

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抽象。 本文专门介绍乌兹别克语用语单位的翻译方法，乌兹别克语用语单位被视为中文。 在研究过程中，确定了借助替代变体的腔隙性短语单位的翻译方法，轻度法的翻译，比喻法的翻译。

关键词：不足，词汇空缺，腔隙现象，腔隙词组，非宁静，翻译方法。

**Abstract.** *This article is devoted to the methods of translation of Uzbek phraseological units, which are considered lacunar in the Chinese language. In the course of the research, methods of translation of lacunar phraseological units with the help of alternative variants, translation by the method of calque, translation by the figurative method were identified.*

**Keywords:** *lacuna, lexical gap, phenomenon of lacunarity, lacunar phraseological unit, non-equilency, translation methods.*

### **Introduction**

Phraseological dictionaries (even bilingual dictionaries) help the translator to choose more successful functional alternatives to the phrase, proverb, or proverb actually used [1, p. 344].

Regarding the assignment of phraseology in Chinese dictionaries, A.L. Semenas states that if European dictionaries are understood mainly as descriptions of words, Chinese dictionaries as separate dictionary articles include not only words, fixed phrases, but also phraseologies. This approach is precisely suitable for Chinese, placing such units in dictionaries and reviewing them in separate dictionary articles along with the word is perfectly appropriate and very convenient for the dictionary user [2, 140].

### **The main findings and results**

In Chinese phraseology, there are often realities that are known and understood by the Chinese, but remain a mystery to foreigners. For example, there is no Uzbek analogue of the phrase “braids in the temple”. In ancient China, such braids were

specially cultivated by both men and women. Based on this, they would know the Chinese immediately.

There are “火眼金睛” *huo yan jin jing* phrases in modern Chinese that go back to “西游记” *xi you ji* “Journey to the West”. In the seventh chapter of the work, it is written that after the monkey king Sun Ukun was transferred to the "eight trigram furnace" (“саққиз триграмма печи”), he organized a riot in the palace of heaven. As a result of heating in this furnace, Sun Ukun's eyes turn red from the grass and smoke, and he is able to distinguish the tricks of those who can take on a different color with magic. The figurative meaning of this lacunar phraseology can be expressed as “хушёр кўзлар” (“vigilant eyes”) [3, p. 78].

Some expressions in a particular context in Chinese may lose their original expressive basis and may have another in general. For example, a newspaper headline reads: 发展小城镇莫唱“空城计” *Fazhan xiao cheng zhen mo chang "kongchengji"* – “кичик шаҳар ва қишлоқларни ривожлантиришда уларни бўшагиб қўйиб бўлмайди” (“in the development of small towns and villages they cannot be left out”). The content of the article is that no production infrastructure is currently being created in the construction of new housing for farmers in some parts of China, only the appearance of the city, i.e. squares, parks and streets, is being considered. “空城计” *kong cheng ji* is based on the phraseology of – “бўш шаҳар тактикаси” (“empty city tactics”) - a story in "Three Kingdoms". According to the story, during the conquest of a city, the famous general Juge Lyang was in no panic without having an army that could repel the enemy. He ordered the city gates to be fully opened, and he himself climbed the tower on the city wall and began to play the oud. The enemy soldiers retreated, thinking that an ambush awaited them in the city. Since then, the phrase 唱空城计 *chang kong cheng ji* has been used to mean “рақибни адаштириш мақсадидаги найранг” (“a trick to mislead an opponent”). In the article, the phrase is used in a completely different sense, "an empty city in terms of lack of production base." The new meaning of this phraseology, "empty, gap" is not mentioned in all dictionaries, but only in the "Normative Dictionary of Modern Chinese Phrases" edited by Li Singjen in 2002. With this example, it can be seen that Chinese bilingual dictionaries do not always provide an exact equivalent of phrases. Because of this, the translator should always be prepared to use comments from monolingual Chinese dictionaries and at the same time take into account the context [3, p. 107].

**Translation using alternative options.** In the absence of a phraseological equivalent to the phraseological unit originally used in the target language, adequacy is often achieved through the use of alternatives. Phraseological units of two languages, which are compatible in terms of meaning and methodological function, in some cases differ from each other either in lexical content or completely, or in elements other than the basic components. Such phraseological units are in a relationship of reciprocity [4, p. 195].

For example, 开夜车 *kai ye che* – тунни бедорликда ўтказмок (*сўзма-сўз*. тунги машина хайдамок) (to spend the night awake (literally. To drive a car at night)).

In the phraseological dictionary, the phrase 难兄难弟 *nan xiong nan di* is translated in Uzbek as “ўхшатмасдан учратмас” (“unparalleled”) and in Russian as “два сапога пара” (two shoes one pair) [6, p. 208]. If we translate it literally, a positive tone in the form of “brothers worthy of each other” will have a stronger meaning. The Uzbek version of the phrase has a neutral meaning.

Alternatives are easily interchangeable in translation. Because in the composition of these units there are no words of national character that hinder their mutual exchange [4, p. 196].

“欲速则不达 *yu su ze bu da*” [5, 267] (*сўзма-сўз*. тез бўлишини истаб етиша олмаслик) (literally, not wanting to be fast), “Шошган қиз эрга ёлчимас” (“A girl in a hurry does not go to the ground”) and “Поспешиш – людей насмешит” criticize the same feature - haste. Or another example, “有其父必有其子 *you qi fu bi you qi zi*” [5, 267] (*сўзма-сўз*. отаси қандай бўлса боласи шундай бўлади) (literally. The child is the same as the father), “Онасини кўриб қизини ол” (“See the mother and take the daughter”), “Яблоко от яблони далеко не падает” (“Apple drops under the apple tree”) although the lexical components of the phraseological units are different methodological function a. These tools can fully cover each other's semantic and methodological functions.

It is well known that phraseological units usually appear on the basis of vital observations. There is a similarity in the way people imagine the material world. But in no language can phraseological units cover all aspects of an objective being. For example, a phraseological unit of a language that expresses a particular concept figuratively or emotionally may not have its corresponding equivalent or alternative in the system of phraseology of another language. Although some of the phraseological units that sometimes exist in the original and translated languages are semantically and methodologically compatible, they have a distinct national color that does not allow them to replace each other in the translation [4, p. 240].

**Translation by the method of calque.** If the internal content and figurative basis of the phraseology in the original have a logical basis, and this basis is clearly visible, but also created on the basis of people's life experiences, such phraseology is sometimes translated in the calque method, in which case only the corresponding phraseological unit not only the semantic-methodological feature, but also the national identity, socio-cultural character is re-created. At such times, the unity of form and content of the original phraseology is fully restored, the reader's understanding of the original and its language is enriched, the concept of stable stylistic devices and artistic means used in the original vernacular, and sometimes the author's own creative style [4, p. 240].

Successfully implemented calque, in contrast to literal translation, which leads to literacy, along with the creative re-creation of the original form and content unity, also contributes to the process of enriching the vocabulary of the native language [4, pp. 207-208].

For example, 井底之蛙 *jing di zhi wa* is қудуқ тағидағи бақа (a frog at the bottom of a well). When the frog at the bottom of the well looks up, it sees only a part of the sky. Because of this, in Chinese, the phrase is used for narrow-minded people [6, p. 723].

It is well known that phraseological units usually appear on the basis of vital observations. There is a similarity in the way people imagine the material world. But in no language can phraseological units cover all aspects of an objective being. For example, a phraseological unit of a language that expresses a particular concept figuratively or emotionally may not have its corresponding equivalent or alternative in the system of phraseology of another language. If some of the phraseological units that sometimes exist in the original and translated languages are semantically and stylistically compatible with each other, they have a distinct national color that prevents them from substituting each other in the translation. In this case, more attention is paid to the calque, literal translation method of translation practice. The compound formed in this way in the language of translation takes the form of a phrase and, if it sounds natural, can reflect the intended meaning and methodological function. In this case, not only adequacy is ensured, but also the opportunity to enrich the vocabulary of the translated language [4, p. 199]. For example:

丢面子 *diu mianzi* – уялиб қолмоқ, шарманда бўлмоқ (to be ashamed, to be ashamed (literally. to lose one's face)).

说空话 *shuo konghua* – сафсата сўзламоқ (to talk nonsense).

没事找事 *mei shi zhao shi* – ўзига ўзи муаммо туғдирмоқ (to create a problem for oneself (literally. to look for a problem in a problem)) [7].

Phraseological confusions, the meaning of which is not directly derived from the meanings of its components, as well as other expressions that reflect the national character of the people to which it belongs, are not excluded. It contains the names of ethnographic concepts, lexical and semantic archaisms, as well as phraseological units that use words related to the history of the nation, the life of the people and its religion and beliefs [4, p. 200]. The lack of appropriate adequate tools in the language of translation makes it necessary to interpret such units in a figurative way. However, sometimes even when there are equivalent or alternative versions of the original units in the language of translation, translators resort to this method, as a result of which the necessary communicative effect and imagery of the original are blurred, and sometimes the content of the original is falsified [4, 247].

**Visual translation.** It is sometimes not possible to translate a certain phraseological unit with the help of equivalents, alternatives or calque. In such cases, artists inevitably resort to the descriptive method of translation practice, in which the meanings of units can be explained by means of a word or phrase in a free sense. In these cases, there can be no question of the re-creation of the methodological tasks embodied in the original phraseological units. In these cases, the impact of the stated idea decreases, clarity and density are lost. This in turn leads to a decrease in the artistic value of the original text. For example, the unit "To make a mountain out of a molehill" differs from its synonym "to exaggerate" and the unit "Si-lent as the grave" differs from the word "silent" in its imagery. Therefore, while the English word "to exaggerate" can be translated into Uzbek by the lexical equivalent of the words "exaggerate", "silent", the above phraseological units are translated into Uzbek by such methodically neutral words as "exaggerate", "silent", translation by means of which leads to the extinction of the imagery concentrated in English units. Only the translation of these phrases with the alternative version of "Нинадай нарсени туядай қилмоқ" ("To make something like needle like a camel") and "Қабрдай жим" ("Silence like a grave") creates functional adequacy [4, p. 205].

But sometimes it is possible to partially restore the additional information created in the original, even figuratively in translation. This is due, on the one hand, to the fact that almost all meaningful linguistic means in the structure of artistic speech acquire aesthetic-affectivity, and, on the other hand, due to overuse, some phraseological units lose some of their figurative-affective character.

Proverbs and sayings, like other genres of oral folklore, reflect everything that this or that nation has lived and faced for centuries. Here is a whole set of ethnographic realities, from labor tools to clothing, a comprehensive description of the geographical environment - landscape, climate, fauna and flora; these include memories of past events and celebrities, echoes of ancient religious beliefs, and a modern detailed description of the structure of society [8, p. 19].

### **Conclusion**

To conclude, the following can be cited.

Phrasebooks help the translator to choose more successful functional alternatives to the phrase, proverb, or proverb actually used. But bilingual dictionaries do not always give the exact equivalent of a phrase.

Lack of consistency is the complete absence of equivalents in the target language of the phraseological unit in the original language and the occurrence of realities belonging to the original language (non-equivalent lexical compounds) within these units.

There are the following methods of translating lacunar phraseological units: translation using alternative options, translation by the method of calque, and translation by the figurative method.

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文化转移与跨文化人格：多元文化小说的认知功能研究  
**CULTURAL TRANSFERS AND INTERCULTURAL PERSONHOOD:  
A COGNITIVE-FUNCTIONAL STUDY OF MULTICULTURAL  
FICTION**

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本文从认知功能的角度概述了如何在多元文化小说中构建跨文化人格（被视为文化身份的延伸）。在多元文化社会中，人类发展的研究往往侧重于个人家庭文化在其身份中的主要作用，或者着眼于跨文化交往形式的跨文化交流的广泛和长期经验的积极成果。但是，在本文中，作者提出了这样一个问题：一个人越受多样的文化传播，越容易超越传统文化认同的范围。使用后殖民文学的著名代表萨尔曼·拉什迪 (Salman Rushdie) 于2019年出版的小说《Quichotte》中的例子，作者证明了文化传播可能是障碍，而不是跨文化人格的催化剂。另一个结论是，向跨文化身份认同的转变可能产生与学者所设想的结果相去甚远的结果。

关键词：跨文化人格，文化转移，话语和文本中的身份建构，多元文化小说

**Abstract.** *The article presents an overview of how intercultural personhood (seen as an extension of cultural identity) is constructed in multicultural fiction, from a cognitive-functional perspective. Research on human development in multicultural societies has tended to focus either on the predominant role of an individual's home culture in their identity or on the positive outcome of extensive and prolonged experiences of communication across cultural boundaries, in the form of intercultural personhood. However, in this paper the author calls to question the idea that the more a person is subjected to diverse cultural transfers, the easier it is for them to transcend the perimeters of conventional cultural identity. Using the examples from "Quichotte", a 2019 novel by Salman Rushdie, a renowned representative of postcolonial literature, the author demonstrates that cultural transfers may act as hindrances rather than catalysts for intercultural personhood. Another conclusion is that the transformation toward intercultural identity may produce the results that are far different from what scholars envision.*

**Keywords:** *intercultural personhood, cultural transfer, identity construction in discourse and text, multicultural fiction.*

The debates that focus on the questions of unity and diversity in today's increasingly integrated world have been going on in many multicultural societies for at least four decades. It has become a standard practice for many social scientists to note that the criticism of multiculturalism is as old as multiculturalism itself (e.g. Kymlicka, 2010, Gozdecka et al., 2014). The fundamental dilemma that is now a topos in multicultural discourse is rooted in the very understanding of multiculturalism as an attempt to go beyond monoculturalism: it is a collision between the idea of fostering local cultures, emphasizing their essential individuality, and "the conventional and often unspoken advocacy for an integrative canon" (Caton, 2007, p. 103). Alongside "multicultural man" and "multicultural identity" there exists a whole range of terms for similar concepts, e.g. "international man" (Lutzker, 1960), "universal man" (Tagore, 1961), "species identity" (Boulding, 1990), "intercultural personhood" (Kim, 1999), etc. United through the idea of pluralistic thinking, accepting cultural diversity, being able to function effectively in a multicultural setting, these concepts differ, among other things, with regard to how great one's empathic capacity is and where one's loyalties lie: with one's home and host cultures, with the human race, or planetary community. In the present article the focus is on "intercultural personhood", which Young Yun Kim describes as "more generic, broader, more inclusive, and more flexible in meaning than other terms without implying any specific cultural attributes" (Kim, 2001, p. 196). The goal of the research is to examine the cognitive-functional construction of intercultural personhood in fiction, as exemplified by Salman Rushdie's novel "Quichotte" (2019), with special attention paid to the role of cultural transfer.

"Cultural transfer" is well-known for being "a highly integrative, polyvocal and elastic concept" (Mieke Bal, 2001, as cited in Rossini & Toggweiler, 2014, pp. 6-7). In this paper it is interpreted as a development of the original idea formulated by Michel Espagne and Michael Werner in the mid-1980s (Espagne & Werner, 1987): it is understood in the broad sense as "the global mobility of words, concepts, images, persons, animals, commodities, money, weapons, and other things" (Rossini & Toggweiler, 2014, p. 5). Jin-Ah Kim notes that cultural transfer research presupposes exploring "the transfer of values, ideas, norms, or material resources – both intended and unintended, one-directional and reciprocated." (Kim, 2015, p. 45).

Having firsthand experience of being immersed into (a) culture(s) other than the one they were born into, as well as of living "on the verge" between cultures, postcolonial writers provide valuable insights into multiculturalism and intercultural personhood. Salman Rushdie's work was chosen due to the themes addressed (including the problems of intra- and intercultural communication, and the search for happiness in multicultural societies of our time), which are nowadays more topical than ever, as well as the status of the author in the literary world in general,

and in postcolonial literature in particular. Last but not least, the impact of several cultures (Indian, Pakistani, British, American) on the writer's perception of the world was taken into account.

It should be pointed out that in "Quichotte" Salman Rushdie employs his trademark satire within the framework of magical realism, which allows the author to weave into the story as many culture-specific concepts and examples of cultural transfer as possible. Another important matter to bear in mind is that the novel represents a story within a story, both of which are connected to Rushdie's personal experience, since the writer and his characters share ethnic roots and certain episodes in their biography (they had to move from their home culture to (a) multicultural English-speaking state(s): we are talking about Great Britain and the US in Rushdie's case; the USA in the cases of Brother/Author, the protagonist of Brother's novel and his sister, Quichottes's Fair Lady Salma; and Britain in the case of Brother's Sister). It therefore comes as no surprise that the writer keeps interpreting and reinterpreting his personal ideas and feelings regarding the identity of a migrant in an alien society through the prism of his characters' experience and reflections.

In a 1983 interview Salman Rushdie argued that a migrant's search for identity and their identity crisis may be defined not by having been uprooted, but by having been imprinted upon by too many different cultures: "It's not the traditional identity crisis of not knowing where you come from. The problem is that you come from too many places. The problems are of excess rather than of absence." (as cited in Frank, 2011, p. 139). Let us find out whether or not this is the situation depicted in his 2019 novel, as well as take a look at how cultural transfers influence the construction of an immigrant's identity in a multicultural environment.

Cultural transfers undoubtedly play an integral part in the structure of Rushdie's multicultural discourse. To begin with, the novel abounds in onomastic concepts – including the "quantums of knowledge" which act as keys to the author's home culture, "inhabited linguo-cultural islands" (Robustova, 2015), as well as the "uninhabited lands" for the people who are not familiar with the history and cultures of the Indian subcontinent, e.g. *Rama searching for his kidnapped Sita; Mohenjo-daro; Shah Rukh Khan; Nissim Ezekiel; Lata Mangeshkar and Asha Bhosle, Husain, Binaca Geetmala, Behram Busybee Contractor, Filmfare, etc.* The list also includes onomastic keys to other cultures (the majority of which represent American culture – it is the host culture for most characters – and European cultures), e.g. *Elvis, Route 66, Technicolor, Bon Jovi, Incredible Hulk, Emmylou Harris, Bill Murray, Freddie Mercury, Ahab, Miss Daisy, Yosemite Sam, Whoopi, Heath Ledger, Lake Capote, Michael Corleone, the Emerald City, Katz's Delicatessen, Scully to my Mulder, Robin to my Batman, Spock to my Kirk, Don Quixote, Odyssey without an Ithaka, without a Penelope, Arachne, Elysian Fields, Rum-*

*pelstintskin, Boadicea, Prince Charles, Stephen Hawking, Narnia, Middle Earth, Madame Bovary, Mona Lisa, Innokenti Smoktunovsky, etc.* It is worth mentioning that the author mostly resorts to the onyms (referring to both real and fictional individuals and places) relevant for his home culture when his characters (i.e. Sam du Champ, Quichotte, Salma) reflect upon their childhood and become nostalgic or analyze the reasons for leaving their native country and culture behind; whereas the salient onomastic concepts of other cultures are typically introduced when Ismail Ismail aka Smile Smile aka Quichotte, the protagonist of the novel within the novel, gets immersed in the virtual worlds of literature and television in search for love and, ultimately, harmony with himself.

Another aspect of identity construction in the discourse space of the novel under scrutiny is the use of Hindi-Urdu and Bambaïyya dialect by Quichotte, when he is trying to bond with his newly manifested incorporeal son Sancho. Sancho, an ingenuine tabula rasa, not having any cultural roots whatsoever, for he is the product of Quichotte's loneliness and imagination, initiates the process of learning his father's native language after an unpleasant incident with racist Caucasian Americans: " "I want you to teach me your language," Sancho said. "The language you spoke back there. I want us to speak to each other in that language, especially in public, to defy the bastards who hate us for possessing another tongue. I want you to start teaching me now. <...> "I will teach you, my son. Your mother tongue, my child without a mother. It is a language of celebrated beauty. And I will also teach you Bambaïyya, the local variant which we spoke in my childhood streets, which is less beautiful but which you should know, because only when you know it will you truly be a citizen of that city which you have never seen." (Rushdie S. *Quichotte*, p. 150) The words and common phrases of Quichotte's mother tongue, and Bambaïyya (e.g. "*Khoobsoorat sé Khoobsoorat*", "*rawas*", "*raapchick*", "*That's one baap river; Dad.*", "*Chicago: totally majboot city, yaar!*", "*She's definitely chicken tikka, I'm sorry to inform you.*", etc.), are eventually used not for the sake of maintaining privacy or secrecy, but in order to foster one's positive identity: "*Quichotte took a wrong turn and cried out, "Vaata lag gayi!" "What did you say?" Sancho asked. "I said," Quichotte replied, abandoning his habitual dignity, "that we are totally screwed." To redescribe the country in their private language was also to take ownership of it. "I understand now why the racists want everyone to speak only English," Sancho told Quichotte. "They don't want these other words to have rights over the land." That launched Quichotte into a new elaboration of his "Indian country" trope. "Once there were other words with rights," he said. "Words belonging to those other Indians. Now sometimes those words are just sounds with lost meanings. Shenandoah, unknown Native origin. At other times the meaning remains but nobody knows it, which denies the word its influence. Ticonderoga is the junction of two waterways. Nobody knows that."*

(Rushdie S. *Quichotte*, p.152-153)

Furthermore, it is important to highlight that (regardless of their falling victim to several racist attacks) neither Quichotte nor Sancho manifests any inclination towards nationalism or ethnic fanaticism. Neither of them actually foregrounds the exploration of their identity status within American multicultural framework. They are both in limbo, in the sense that Quichotte feels more comfortable in the fantastic reality of TV and literature than in the real world, and Sancho is more preoccupied with his real-life experiences than his sense of belonging to a group.

This is when we get back to the concept of intercultural personhood proposed and developed by Young Yun Kim. The scholar argues that it suggests neither an individual's affiliation with all the groups of the world (unlike "universal person"), nor the fact that one possesses characteristics of several cultures (unlike "multicultural person"). "Instead the notion of intercultural personhood focuses on the expanded psychological orientation beyond national and ethnic boundaries, but it does not emphasize numerous subcultural groups within a society." (Kim, 2001, p. 196) I would therefore like to draw a connection between the concept in question and the last stage of Milton J. Bennett's Developmental Model of Intercultural Sensitivity (1986, 2013), "integration of cultural differences into communication". This stage includes contextual evaluation and constructive marginality which facilitate the "shift from in-context to between-context states, allowing for the meta-coordination of meaning and action that defines intercultural communication." (Bennett, 2017) Bennett postulates that this stage "is experienced as a kind of developmental liminality, where one's experience of self is expanded to include the movement in and out of different cultural worldviews. Cultural liminality can be used to construct cultural bridges and to conduct sophisticated cross-cultural mediation". (ibid.)

It might, at first glance, look like Quichotte and Sancho's case: Quichotte sets out on a journey towards happiness, and along the way, in order to achieve his goal, he is resolved to cast aside all dogma, belief/unbelief, reason, knowledge, and desires and attachments to the world; while Sancho's focus is on becoming human. However, taking into account the cultural anchors, be it Quichotte's home culture, or American culture, or any European culture, - they have all, throughout his life, imprinted on him in one way or another, it would be inappropriate to consider this a valid conclusion. Having too many ideas in stock, including reflections upon culture and humanity in general, he is incapable of living a real life, and, as a result, retreats to the world of fantasy, and eventually to the world of Sam du Champ, his creator. It is probable that this is one of the reasons why Quichotte got his name from Sam: "Quichotte (sounds like) key shot. *A key shot was a tiny bump of cocaine or heroin scooped up on a key. He didn't know how this fitted into Quichotte's story. Maybe there was no place for it. It would remain*

*just a note to be deleted later.*” (Rushdie S. *Quichotte*, p. 278-279) This note made by Sam on his phone reveals a nagging idea in his head, about his life in an alien multicultural environment, with all of its perturbations, resembling hallucinations caused by drugs.

As far as Sancho is concerned, it is noteworthy that he tends to acknowledge the interconnectedness among all peoples in the sense that is different from Young Yun Kim’s understanding of intercultural personhood, with a focus on all kinds of experience, i.e. feeling, tasting, orgasms, hallucinations, etc.

In the light of the above analysis it should be acknowledged that the potential impact of cultural transfer on intercultural personhood formation requires further research. Multicultural discourse in Salman Rushdie’s novel “*Quichotte*” demonstrates yet again that the gradual process of intercultural evolution, which individuals undergo through their intra- and, most importantly, intercultural communication experience in a multicultural environment, does not necessarily yield the desired result in the form of intercultural personhood. It turns out that various examples of cultural transfer, while bridging gaps between ethnic/national cultures and/or generations, may act as anchors that impede the formation of intercultural personhood, rather than trampolines that allow individuals to transcend the boundaries of cultural/multicultural identity. On the other hand, the desired state of intercultural identity might play a role just as diminishing in a person’s daily existence, as the ascription-based cultural identity that the advocates of intercultural personhood denounce.

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古代Bayhua的来源及其词典分析  
**SOURCES IN ANCIENT BAYHUA AND ANALYSIS OF THEIR  
LEXICON**

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抽象。该语言与社会同步发展，中文已有近4000年的历史，在此期间它自然发生了许多变化。汉语的语法，词汇和语音也时有发生变化和改进。考虑到上述因素，许多中文语言学家将中文分为三个主要时期（在这三个时期的基础上又分为几个次要时期）。这种方法处理的是拼花体裁来源中的词汇单位的词汇语义和语法特征，属于汉语Bayhua语言的出现时期。

关键字: Bayhua, 分期, 拼花, yuylu, byanven.

**Abstract.** *The language develops in tandem with society, the Chinese language has a history of almost 4,000 years, during which time it has naturally undergone many changes. The grammar, vocabulary and phonetics of the Chinese language have also changed and improved from time to time. A number of Chinese linguists, taking into account the factors listed above, divide the Chinese language into three major periods (and on the basis of these three periods into several more minor periods). This approach deals with the lexical-semantic and grammatical features of lexical units in the sources of the Pinhua genre, which belong to the period of the emergence of the Chinese Bayhua language.*

**Keywords:** *Bayhua, periodization, Pinhua, yuylu, byanven.*

### **Introduction**

徐时仪 Xu Shiyi divides the period of the emergence of the Bayhua language (露头), into three main periods, such as the period of development of the Bayhua language (发展) and the period of the development of the Bayhua language (成熟) and periodizes them in the following order:

1. The period of the emergence of the Bayhua language the period from the (露头) - 秦 *Qin* Qing and 汉 *han* Han periods to the 唐 *Tang* period, i.e., the period from 207 BC to 618 AD;

2. The period of development of the Bayhua language (发展) -唐 from the *Tang* period to the 明 period, i.e. from 618 to 1368;

3. The mature period of the Bayhua language (成熟) - 明 covers the period from the Ming period to the end of the 清 Qing period, i.e., from 1368 to 1911.

Ancient Bayhua sources include examples of folk art from the pre-Tang period [1, 2015]. What are the sources of Bayhua belonging to these periods?

First, oral works of art: for example, the Dunhuang Bianwen (敦煌变文) [2], the 宋元 Sun Yuan period (960-1368), the Xuaben (话本) [3] and Pinhua (平话) [4], 金元 the Jin Yuan (1115-1368) dynasty, Djugongdyao (诸宫调) [5] of the period, 元Yuan period (1271-1368), Zadzyuy (杂剧) [6], 明清 Min Qin (1368-1644) period Bayhua novels;

Second, the exact facts recorded from the oral speech for a specific need of the same period. For example: neo-Confucian washes (语录) [7], Buddhist washes, diplomatic records, court documents, interview statements;

Thirdly, among some Viennese works, we can find Bayhua materials, including historical biographical information that reflects the oral speech of that period in poems, songs and speeches, and texts belonging to the Bayhua language of oral communication in stone inscriptions [8, 2015].

### **The main findings and results**

Regarding Pinhua: interpretation of the term “Pinhua”; commentary on Pinhua texts; lexical units in Pinhua sources.

The interpretation of the term Pinhua is interpreted differently in studies on the history of Chinese linguistics. However, one can admit one thing from the various interpretations and interpretations that we can see that the Pinhua genre was primarily referred to by historical descriptions, i.e., 講史*jiǎngshǐ* names from the Suun period [9, 2004]. In this case, 講史*jiǎngshǐ* in 講*jiǎng* means "to say, to speak", 史*shǐ* means "history" and means to tell history.

I.S. Gurevich points out that research on the history of Chinese linguistics and other schools of Chinese studies in this genre is scarce or almost non-existent. However, if we look at the sources, we can see that there is little scientific work on this issue, and the research also addresses these issues, in particular, a number of scientific studies by Chinese linguists [10, 1994; 2020] and Russian Chinese scholars Riftin B.L., L.K. Pavlovskaya, as well as We can see that the scientific work of Hong Kong Chinese scholar Liu Tsun Yan and American Chinese scholar J. Cramp [11] reflected on the Pinhua genre [12], and in the context of our topic we relied on the results of these scientific studies.

L.K. Pavlovskaya describes Pinhuas: “Pinhuas are a synthesis of two aspects of language, a mixture of written (official historiography and classical prose) and oral (folklore). Pinhua are mainly the work of folk storytellers, they are the narrative of the plots of the history of the state, the art of narration, and at the heart of the Pinhua are historical facts.

There is currently a Pinhua work in Chinese source studies entitled the “新编五代史平话 *xīn biān wǔdài shǐ píng huà* - Five Restored Five Dynasty History Pinhua, which includes the following five Pinhua works.

1) 武王伐紂平话 *Wǔwáng fá zhòu píng huà* - A description of his king's struggle against Zhou. This source is based on a description of real events in the history of China. Statement of the struggle of the Zhou dynasty against King Zhou Xing of the in dynasty under King U;

2) 七國春秋平话 *Qī guó chūnqiū píng huà* - Description of the Spring and Autumn of the Seven Kingdoms - this historical source describes the struggles in China in the VII-III centuries BC and the consequent emergence of the Qing dynasty.

3) 秦拼六國平话 *Qín pīn liù guó píng huà* – Pinhua about the unification of the six kingdoms of the Chin dynasty. The historical events described in Pinhua took place in the 3rd century BC. After the title of Pinhua, the life path of the Chinese emperor is described.

4) 前漢書平话 *Qián hànshū píng huà* – Pinhua, which describes the rule of the first period of the Han dynasty in the III-II centuries BC.

5) 三國志平话 *Sānguó zhì píng huà* - Pinhua about the history of the three kingdoms. This source describes the crisis of the Han dynasty in the II-III centuries AD and its division into three kingdoms [13, 1985].

According to sources, the period from the 秦 *Qín* and 汉 *Hàn* to the 唐 *Tang* period, that is, from 207 BC to 618 AD, in the example of this source written in the Bayhua, is that 王力 *Wáng Li* had two written literary language systems in ancient Chinese. we can acknowledge his opinion [14, 1980]. L.K. Pavlovskaya also emphasizes this point: “武王伐紂平话 *Wǔwáng fá zhòu píng huà* - In the Pinhua text about the struggle of King U against Zhou, there is a clear boundary between the two layers: the statement of historical facts and the part of the preachers themselves (the preachers used mostly folklore materials), as well as the text. There are two layers in the language: one - if the literary language is Venyan in the part where the historical facts are stated, in the statement of the preachers the oral speech - Bayhua is observed. Bayhua mainly gives a description of the heroes whose names are mentioned in these Pinhua. There are also poetic inscriptions in Pinhua” [13, 1985].

Based on the topic of our research, we will begin to analyze the semantic and grammatical features of the lexicon of works belonging to the genre of Pinhua, as we begin the analysis of scientific work on written monuments in ancient Bayhua.

B.L. Rift's 武王伐紂平话 *Wǔwáng fá zhòu píng huà* - named pinholes are among the pinholes listed above - the Pinhua is full of less historical real events than other Pinhuas about the king's struggle against Zhou, a source who acknowledges his closeness to more folklore, a magical tale.

The Pinhua text consists of three parts (卷), in which the details of the Lyuchao [15, 1985] period take precedence over the text, in other words, the predominance of Venyan elements in the text, which consists of 武王伐紂平話 *Wǔwáng fá zhòu píng huà* 1900 characters (hieroglyphs) [16, 1994-2020], it should be noted that the features are almost non-existent [9, 2004]. In the text, instead of the demonstrative pronoun 这 in the Bayhua, 此 demonstrative pronouns are used in most cases, preferring the use of lexical units such as 的 in the vein, 卿 in the second person, and 之 in the third person. In addition, in the presence of 何 interrogative pronouns, 若何, 如何, 何如, 何人 suffixes, 内 suffixes instead of 里 suffixes were used in the text to express the meanings of "... to", "in", which shows that the elements of Bayhua are weaker than the Wenyan elements.

On the next five pages of the text, the situation changes, and the presence of Bayhua-related features is also observed. Among these Bayhua elements, the active use of the 了 morpheme is noticeable. I.S. Gurevich gives several examples of verbs connected with 了 morphemes in the text, and notes that the 了 morphemes are more common in parts 6-7-18-68 of the Pinhua text. For example:

紂王不阻, 留了宝剑, 将入后宫。 *Zhòu wáng bù zǔ, liúliào bǎojiàn, jiàng rù hòugōng* – King Djou did not resist, but laid down his sword and entered the harem.

Or:

父见了女, 大悦: 口中不语。 *Fù jiànliào nǚ, dà yuè: kǒuzhōng bù yǔ* – The father saw his daughter; he was very happy and could not speak.

In addition, the 着 morphemes representing the verb tense can serve as modifiers that indicate both the result and the state, for example:

太公一手拿着章, 一手拿着镜。 *Tàigōng yīshǒu nǎzhuāo zhāng, yīshǒu nǎzhuāo jìng* – Taygung was holding a seal in one hand and a mirror in the other.

The form of the verb, formed in the presence of the morpheme 着, mainly expressed the state that occurs as a result of the action. This morpheme is pronounced in *zhao* ways. In modern Chinese, however, this morpheme has two different pronunciations, and in addition to expressing the case, it also represents the resulting verb. If it is pronounced *zhe* times in the expression of the state, it is pronounced *zhao* times in the function of the resultant verb. Regarding the pronunciation of this morpheme, J. Prushek commented: "In ancient Chinese, the morphemes *zhe* and *zhao* were not distinguished, this morpheme was pronounced as *zhao*" [17, 1950-2020].

It is noteworthy that the frequency of use of **causative constructions** (使役结构) in Pinhua texts is high. Along with 交, which has the highest frequency, another 叫 morphemes have been used as a causative indicator. It can also be seen that in some cases the causative constructions of the verb are also made in the presence of 使, 令, 让 auxiliary words. At the same time, I.T. Zograf in his

monograph “Srednekitayskiy yazyk” (Central Chinese Language) [18] mentioned that during the Sun-Yuan dynasties 教 morphemes met in a causative construction, but in the analyzed works this idea was not confirmed. Examples include:

孙子交马升捉下乐毅来 *Sūn zǐ jiāo mǎ shēng zhuō xià yuè yì lái* – Sun Ji Ma ordered Shenga to arrest Yue Ini.

乐毅令石丙杀齐王 *Yuè Yì lìng Shí Bǐng shā Qí wáng* - Yue I ordered Shi Bing to kill King Chin.

In the analyzed Pinhua text, a phenomenon of **reduplication** is also observed, which can be seen mainly in the ambiguity of the kin-term terms [19, 2019], for example:

谁是卿之姐姐? *Shéi shì qīng zhī jiějiě?* - Who is your sister?

臣知一人有宝, 堪舆娘娘带玩。 *Chén zhī yī rén yǒu bǎo, kānyú niángniáng dài wán.* As far as I know a man has a treasure that is worth carrying in his mother.

The ambiguity (**reduplication**) of one-syllable words belonging to the same word family means "each one", "everyone". For example:

去斩太子 人人见着无不下泪, 个个观了, 咸皆伤情。 *Qù zhǎn tài zǐ rén rén jiàn zhe wú bù xià lèi, gè gè guān le, xián jiē shāng qíng.* Everyone saw the prince being executed, everyone cried, everyone suffered.

In Pinhua texts, the passive proportion is mainly represented by 被 *bèi*, rarely 蒙 *méng* precedent auxiliaries. For example:

被武吉杀之 *Bèi wǔjī shā zhī* – He was killed by Dzi.

It is also possible to encounter the use of forms such as 更, 又, 却 in front of 被 *bèi* front auxiliaries in Pinhua texts [9, 2004].

The following information can be given about some of the rhymes peculiar to written sources in the Bayhua language of this period:

**Pronouns:** 我 first **person pronouns** occur in these texts mainly in conjunction with kinship terms and in 俺 forms, for example:

俺爷爷 *ǎn yéyé* - my granddad; 俺父 *ǎn fū* - my father; 俺女婿 *ǎn nǚxù* - my son-in-law etc.; the second person singular pronoun 你 instead of 您 in the form of respect, 恁 *nèn* in Pinhua texts; as well as the personal pronoun 咱 *zá* - - the present 自己 words, a pronoun meaning “own, myself”: 咱每 *zá měi* “everyone”, 咱每生 *zá měi shēng* – used as “each of us”;

Interrogative pronouns for inanimate objects (represented by 什么?) 甚 *shén*, 甚底 *shèndǐ*, 甚的 *shèndì*, 甚麽 *shénma* in modern Chinese, for example:

李敬儒梦见甚底? *Lǐjìngrú mèng jiàn shén dǐ?* What did Li Jin see in his dream?

那讖上分明写出两句来。道个甚的? *Nà chèn shàng fēnmíng xiě chū liǎng jù lái. Dào gè shén de?* In that book of prophecy, two words are clearly distinguished. What is the essence?

The 甚麽 *shénma* interrogative pronouns are exactly 什么.

## CONCLUSION

Instead of drawing conclusions from the source analyzed, the following points can be acknowledged. During the emergence of the Chinese Bayhua language, that is, from 207 BC to 618 AD, sources written in the Pinhua genre can be regarded not as pure Bayhua, but as a combined product of Bayhua and Wenian. In the Pinhua texts, along with the description of historical facts, the speech of the preachers, who enriched these facts with elements of folklore and spoke among the people, belongs to the ancient Bayhua.

The grammatical features of the lexical units that corresponded to that period at the time of Bayhua's emergence and were used during this period were markedly different from those of Vienna. In particular, it is important to note that in the analyzed sentences, the presence of adjectives, personality and interrogative pronouns differ from their Venian analogues. We can also admit that the use of causative constructions, which are common in oral speech, is also characteristic of the stylistics of the Bayhua language.

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- [3]. 宋元话本 *Huaben of the Sun Yuan period* - stories in this genre were told orally, in addition to the huaben, the shadow theater and puppet theater also belonged to the huaben genre.
- [4]. 平话 *Pinhua is the art of verbally narrating a work of art or a historical event, which was very traditional in the Sun era.*
- [5]. 金元诸宫调 *The djugongdyao of the Jin Yuan dynasty is a traditional folk art of singing a story accompanied by pipa musical instruments.*
- [6]. 元杂剧 *Yuan-era zadzhuis are one of the most common genres in the Yuan-era, originated in the Sun-era. It was performed by singing the works of writers of that period. Also referred to as Yuan drama.*
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俄语语言文化中“麻”的概念表述研究  
LANGUAGE MEANS OF VERBALIZING THE CONCEPT MA IN  
THE RUSSIAN LINGUOCULTURE

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**摘要:** 麻味是中国饮食文化中最具代表性的味型之一,其广泛使用对汉语语言文化形成了深远的影响。然而,由于俄罗斯传统饮食中缺少麻味食材,“麻”这一概念在俄语语言文化中尚未形成,俄语词汇系统中也缺少汉语“麻”的对应词。本文在分析相关单语语料及双语语料的基础上,对麻味在俄语中的潜在表述方式进行总结,并从语义、情态、语体角度对其加以分析,以期推动翻译事业及跨文化交流事业的进一步发展。

**关键词:** 对比语言学, 认知语言学, 概念, 味道, 麻, 汉语, 俄语。

**Abstract.** *Ma is considered as one of the most representative flavours in the Chinese cuisine, the use and spread of which has a significant implication within the Chinese linguoculture. However, the concept of MA has not been yet clearly shaped and defined in the Russian linguoculture due to the lack of specific food with this particular flavour, and therefore the Chinese word "ma" does not have any equivalent in the Russian word-stock. Based on the study of monolingual and bilingual resources on the relevant topic, this paper summarizes all possible language means of verbalizing the concept of MA in the Russian linguoculture and introduces the analysis within the scope of lexical semantics and stylistics to promote translation practices and intercultural communication in further research.*

**Keywords:** *comparative linguistics, cognitive linguistics, concept, flavour, ma, Chinese, Russian.*

## 1. Introduction

Concept is considered to be one of the main research objects of modern cognitive linguistics, since it is a structurally meaningful unit of consciousness, which reflects human perception, ideas and opinions as for the surrounding world. N.D. Arutyunova interprets the concept as a notion of practical philosophy, arising as a result of the interaction of such factors as national tradition and folklore, religion and ideology, life experience and artistic images and value systems [1, p. 3].

Ye.S. Kubryakova defines it as an operational meaningful unit of memory, mental lexicon, conceptual system and brain language, the whole language worldview reflected in the human psyche [4, p. 90]; while Yu.S. Stepanov lays emphasis upon its cultural aspect and suggests that concept is a clot of culture in human consciousness in the form of which culture enters the mental world of human beings [7, p. 40]. Various definitions given above, however, prove the point that as a form of mental representation, concept plays a significant role in explaining how human mental processes execute a wide range of operations.

Among different kinds of concepts, the so called "non-equivalent concept" reveals linguocultural specifics of certain nation most clearly [8, p. 51]. This term is used to define concept that exists only in a certain linguoculture to reveal not a single equivalent in the other ones. Such phenomenon has a chance to appear most likely in linguocultures, which verbalize the resembling concepts, whereas the others tend to lack it in everyday practices.

In the category of taste, "ma" (commonly referred to as "numb" in English) is one of those that denote a limit in perception and description. It is a flavour or sense, which reminds of Sichuan pepper (spice that grows in the Sichuan Province of China). Sichuan pepper is rich in hydroxy-alpha-sanshool, which produces a strange, tingling, buzzing, numbing sense on human body [6]. It is pointed out by the scholars that ma is traced as a sense of touch rather than flavour, according to its action mechanics [3]. Undoubtedly, Sichuan pepper is traditionally used as a kind of seasoning, while it stimulates the receptors that are located in the mouth, ma is still frequently regarded as part of the category of flavours in the Chinese linguoculture.

Since the typical food product with this flavour is used only in China, the hypothesis is raised that MA is a non-equivalent concept in the Chinese and other linguocultures. This typically Chinese concept appears to be lacuna in the Russian linguoculture to lead to the absence of any verbalizer (a word or phrase which is regularly used to objectify the concept) in the Russian lexical system.

However, the process of globalization as well as the further development of Chinese-Russian strategic cooperative partnership accelerate the progress of intercultural communication in a wide range of spheres, including national cuisine and food industry. Therefore, the current paper aims at treating and summarizing all possible language means able to conceptualize MA in Russian based upon the information it contains in Chinese.

## **2. Methodology and materials**

The current research starts with analyzing the concept verbalizer in Chinese from the viewpoints of semantics, connotation and stylistics. Empirical materials used in the research include etymological dictionaries, contemporary dictionaries,

online linguistic corpora of the Chinese language and web as corpus.

The above analysis is followed with finding out language means used to objectify the concept of MA in the Russian linguoculture. The set of lexemes detected is grounded upon various empirical materials, such as explanatory dictionaries of the Russian language, Chinese-Russian bilingual dictionaries, Chinese-Russian parallel corpora, articles on the relevant topic in Russian and web as corpus.

On this basis, the language means in Russian are viewed in the framework of different discourse practices from the perspectives of their semantics, connotation and stylistics with the focus upon verifying their usage, environment, limit and feasibility.

### 3. Results and discussion

The flavour of *ma* is perceived and recognized by the Chinese nation since Ancient times. In the Chinese linguoculture, this flavour is described by the lexeme *ma*, which is interpreted as "ma mu, gan jue bu ling / feeling numb, insensitive" [2] or as "xiang tui, bi bei ya hou de na zhong bu shu fu de gan jue / an unpleasant sensation which is similar to that of legs or arms after being pressed" [10]. Such definitions prove that the main features of MA as the concept in the Chinese linguoculture are "sensation" and "numbness". The subjective assessment of this flavour is neutral.

In the Chinese linguoculture, the lexeme *ma* is able to verbalize the corresponding concept in all kinds of discourse regardless of connotations. For example<sup>1</sup>:

[1] *Jin tian, wo zhun bei wei ta shao yi wan ma la dou fu. Ma chang shuo, chi tang de shi wu, ke yi bang zhu hui fu yuan qi he jing shen.*

[2] *Wei zhe zhuo zi you xie chi ke jiao cai zai ban deng shang, tan huai qiao tui, jiang na xie qie cheng pian de niu za deng yi zhu zhu de jin ru huo guo zhong shuan lai chi, re teng teng chuan lai yi gu ma la xian xiang de qi wei.*

[3] *Ma xiang wei xing shi zhong shi tiao wei zhong guang fan shi yong de yi zhong wei xing, zai zhong guo nan bei fang di qu jie you ying yong. Qi guang fan yong yu leng re cai shi.*

[4] *Ju yan jiu, xian an lei wu zhi shi hua jiao zhong de zhu yao ma wei cheng fen, ji hua jiao ma wei su.*

However, in the Russian linguoculture, the borrowed concept of MA is verbalized irregularly by a set of different language means, the usage of which depends on both connotation and style. It can be summarized and distributed as follows:

1) *onemenie, onemevshii, pokalyvanie, pokalyvayushchii.*

Lexemes *onemenie* and *onemevshii* in Russian are formed from the verb *onemet'*, which is interpreted as "teryat' dar rechi, sposobnost' govorit'; teryat' chu-

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<sup>1</sup> All examples in Chinese and Russian are selected from the above-mentioned empirical materials.

vstvitel'nost', kostenet', tsepenet' / lose the ability to talk; lose sensitivity, become numb" [5] or as "stat' nemym, utratit' sposobnost' rechi; otsepenet', utratit' chuvstvitel'nost', gibkost' / become dumb, lose the ability to talk; become numb, lose sensitivity and flexibility" [9]. While lexemes *pokalyvanie* and *pokalyvayushchii* are formed from the verb *pokalyvat'*, which is defined as "izredka i slegka kolot' / occasionally and slightly prick" [5] or as "ukolot' v neskol'kikh mestakh ili neskol'ko raz ili zhe zanyat'sya ukolami nekotroie vremya / prick in several places or several times or have injections for a while" [9]. In the Russian linguoculture, these lexemes are not traditionally used to describe taste. However, they are able to reflect the main features of this concept.

In the Russian linguoculture, lexemes *onemenie*, *onemevshii*, *pokalyvanie* and *pokalyvayushchii* are mainly used to verbalize the concept of MA in the written language and in the formal style. However, these lexemes are not limited by connotation. For example:

[5] *Unikal'nyi vkus sychuan'skogo pertsy ne takoi zhguchii, kak u chernogo, belogo pertsy ili ostrogo pertsy chili. Perets imeet kislovatyi vkus i privodit k nekotromu onemeniyu rta.*

[6] *Izmel'chenie ustranyaet syroi onemevshii vkus i pridaet emu bolee priyatnyi aromat.*

[7] *On ne takoi zhguchii kak drugie pertsy, no ot nego ostaetsya svoeobraznoe poslevkusie, oshchushchenie pokalyvaniya (nemeet rot), napominayushchee legkuyu dozu obezbolivayushchego.*

[8] *Oni sozdayut stranno, pokalyvayushchee, zhuzhzhashchee, oshelomlyayushchee oshchushchenie, chto-to vrode deistviya gazirovki ili slabogo elektricheskogo toka.*

## 2) *elektricheskii*.

The lexeme *elektricheskii* in Russian is formed from the noun *elektrichestvo*, which is interpreted as "sovokupnost' yavlenii, v kotorykh obnaruzhivaetsya sushchestvovanie, dvizhenie, vzaimodeistvie zaryazhennykh chastits; energiya, poluchaemaya v rezul'tate ispol'zovaniya takikh yavlenii / the sum of phenomena which includes the existence, moving and interaction of charged particles; energy that derived from such phenomena" [5] or as "substantsiya, lezhashchaya v osnove stroeniya materii; eta energiya kak predmet bytovogo potrebleniya / a fundamental substance of the material structure; such energy as a commodity" [9]. It is worth noting that the flavour of ma has nothing related to electricity. However, this lexeme states that the flavour triggers an association of the electric shock.

In the Russian linguoculture, the lexeme *elektricheskii* is mainly used to verbalize the concept of MA in the written language and in the formal style, and it is not limited by connotation. For example:

[9] *Vmesto etogo, on imeet legkie ottenki limona i sozdaet pokalyvanie vo*

*rtu, kotoroe pochti mozjno nazvat' elektricheskim, chto sozdaet osnovu dlya ostrыkh spetsii.*

[10] *Zapakh pertsа op'yanyayushchii, limonnyi i aromatnyi, a vkus elektricheskii.*

3) *unikal'nyi.*

The lexeme *unikal'nyi* in Russian is defined as "edinstvennyi v svoem rode, nepovtorimyi / one of a kind, unique" [5] or as "yavlyayushchiysya unikumom / being unique" [9]. It is not a semantic equivalent of the Chinese verbalizer *ma*, since it does not describe a specific taste. However, it claims that such flavour is one of a kind and is not similar to any other one within this category.

In the Russian linguoculture, the lexeme *unikal'nyi* is mainly used to verbalize the concept of MA in the written language and in the formal style, and it is not limited by connotation. For example:

[11] *Sychuan'skii perets — eto spetsiya kitaiskoi kukhni, kotoraya proiskhodit iz kukhni Sychuan' v yugo-zapadnoi provintsii Kitaya Sychuan'. Imeet unikal'nyi aromat, vkus i ostrotu.*

[12] *Ego unikal'nyi aromat i vkus ne yavlyayutsya ostrymi ili ostrymi kak tipichnye chernye, belye ili chiliiskie pertsy.*

#### 4. Conclusion

All the statements above allow to draw the following conclusions:

1) MA is a lacunar concept in the Chinese linguoculture, since the typical food stuff with such flavour are spread throughout China and is commonly indicate only the traditional Chinese cuisine;

2) in the Chinese linguoculture, the concept of MA is verbalized by the lexeme *ma*, which can objectify the concept in all kinds of discourse without any limit of connotation;

3) in the Russian linguoculture, this borrowed into other linguocultures concept is not regularly verbalized. A set of different language means is observed, which include lexemes that describe the sense of touch (*onemenie, onemevshii, pokalyvanie, pokalyvayushchii*); the word that demonstrate the specificity of associations is *elektricheskii*; and the word which emphasizes the unique property of this flavor is *unikal'nyi*;

4) however, all these language means are basically used to objectify the concept of MA in the written language and in the formal style, since the lack of life experience in this sphere of the people native in Russian leads to using it in the spoken language and in the informal style.

In conclusion, it must be stated, that MA is a non-equivalent concept and is verbalized irregularly in the Russian linguoculture. Russian lexemes *onemenie* and *onemevshii* describe the phenomenon of taste precisely and they are most

likely fixed as regular verbalizers of MA. The results of the current research help to promote intercultural communication and translation practices between the Chinese and Russians.

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汉语和乌兹别克语中与死亡相关的委婉语的联想系列  
**ASSOCIATIVE SERIES OF DEATH-RELATED EUPHEMISMS IN  
CHINESE AND UZBEK**

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抽象。在本文中,根据中文和乌兹别克语语言文化的联想概念,单个事件或单个对象不是自发存在的,它们与其他现象和对象有关,所有事物都作为一个整体或结构存在。中国和乌兹别克语言文化中的委婉语也具有许多语义特征,并且已经发现关联群体形成一个单一的“网络”。在分析中国人和乌兹别克人与死亡相关的委婉语时,比较了“死亡休息”,“死亡旅程”,“死亡之家”和“死亡变形”等联想词。

关键词: 联想系列, 语言文化, 变态, 娱乐, 家庭, 旅行。

**Abstract.** *In this article, according to the concept of associations in Chinese and Uzbek linguoculture, a single event or a single object does not exist spontaneously, they are related to other phenomena and objects, all things exist as a whole or in a structure. Euphemisms in Chinese and Uzbek linguocultural culture also have a number of semantic features, and it has been found that associative groups form a single "network". In the analysis of death-related euphemisms in Chinese and Uzbek, associative lines such as "death-rest", "death-journey", "death-home" and "death-metamorphosis" were compared.*

**Keywords:** *associative series, linguoculture, metamorphosis, recreation, home, travel.*

### 1. Associative series "Death - rest"

It is known that after death, the movement of all beings ceases, rests, and it is as if it were asleep. Therefore, the words “rest” and “fatigue” often refer to the concept of death [1, 2010]. The expression "rest" forms a whole system based on the word "death": 休息 - "rest", 安息 ānxī - "eternal rest", 令其休息 línqíxiūxi - "relaxed", 安眠 ānyǎn - "to get tiredness", 在亚伯拉罕的怀里休息 zài yàbólahande huáilǐ xiūxi - “rest in the abode of Abraham” and so on.

In addition to the above, the words "peace", "sleep", "dream" also take an active part in the formation of this line: 得到安息dédàoānxī – "achieved peace", 被上帝招去永远安息bèi shàng dì zhāo qù yǒngyuǎn ānxī – "brought peace by God for life", 上帝令他灵魂安息shàngdì língtā línhún ānxī – "God gave him peace" 入睡rùshuì – "Sleep", 长眠chángmián – "Sleep forever", 闭眼了bìyǎnle – "Sleep internally forever", 长眼zhǎngyǎn – "Close eyes (meaning death)", 瞑目míngmù – "Close eyes forever (meaning death)", 永蛰yǒngzhé “蛰”zhé – "Sleep like an animal", 睡觉 – Euphemisms such as "dream" are among them.

Although the Chinese phrase "rest" is not directly involved in the formation of the associative line "death - rest" in Uzbek linguoculture, its meaning is understood through the expressions "sleep", "calm down", "turn a blind eye", "nod". For example: *Then, with a fiery sigh from his heart, his eyes fell asleep as he slept with her* (N., "Farhod and Shirin", p. 354); *His children continued the work he had begun after his father had fallen asleep* (from *The Nightmare*); *Mahin had fallen asleep on the bed forever* (M. Koz., "Terrible Tehran", p. 302); *Gulchehra's mother died at the age of 33* (S.S., "It Snowed in Cancer," p. 250); *In a foreign land, far from home, the child died with a wish* (S.Ahmad, "Silence", p. 8); *Sirojiddin also passed away and set his head on eternity* ("Mysterious World", 1997, №1, p. 26); *The minute the Unsin rode the monkey on his shoulder, the more frightened he was, the calmer he is now* (A.Kahhar, "horror", 8-B.); *His mother is also so blind, " said the old woman, trembling with her breath – "when I come in front of her, she says," when the wedding, let me see my daughter's wedding when my eyes are open "* (A.Kahhor, "Fairy tales from the past." Vol 3, p. 206).

In addition to the above, associations such as "resting place", which means "grave, grave", also serve to complement the system of "death - rest": Relaxation spot. *Every year, when the flowers open their eyes and the streams head to the shore, the tulips take an eternal rest* (Saodat, 1997, №6, p. 31); *Let the place where you lie be filled with light* (A.O., *Memoirs*, p. 43); *He now has his place in the world of the silent* (Saodat, 1998, №3, p. 21).

## 2. Associative series "Death - Journey"

In the associative group "Death - Journey" the words *travel* in Chinese and *journey* in Uzbek predominate: 单程旅行dān chéng lǚ xíng – "went on a trip alone"; 购买单程车票gòumǎi dān chéng chē piào – "bought a travel ticket alone"; 驾鹤西游 – "to sit on a crane and travel to the West"; 远行 – "long journey". *Aunt Risalat struggled with death for three months, and when it was not over, she traveled ...* (Saodat, 1996, №3, p. 8); *He knew why he had not obeyed all his life, and had given his last command before his last journey* (S.S., "It Snowed in Cancer," p. 248); *Yes, you went on a journey without end, my friend* (A.O., *Memoirs*, p. 215); *Momo was over eighty and went on a journey ...* ("Saodat", 1992, №6, p. 20).

In the formation of euphemisms in the associative series "Death - Journey", in particular, the verb "to go" is distinguished by its activity. Including 了- "to go", 去世 qùshì - "to leave life", 已经走了 yǐjīngzǒule - "already gone", 谢世 - "to go to a better world", 归天- "to go to their ancestors", 归山 道- "to go to the clouds". In Uzbek: *After my mother ... left, both our hearts and our kitchens were empty* (S.S., "It Snowed in Summer", p. 6); *His children thought that their father was tired of the worries of this world and had gone to the next world* (Gulistan, 1997, №2, p. 38).

At the same time, the verbs "to leave", "to return", "to observe", "to go" are also active in the euphemisms associated with the journey of death: 归天- "to return to heaven", 送别 sòngbié - "to observe". *We also observed my dear man on the day of the show* ("Saodat", 1997, №6, p. 18).

Euphemisms with the verb "to say goodbye" are also common in this group: 谢宾客 - "to say goodbye to this world"; 诀别 juébié - "Farewell to this world". 告别人世 gàobíerénshì - "Farewell to this world". *We said farewell to Salim Bobo two days ago* (from the conversation).

Horses, chariots, caravans and vehicles take an active part in the formation of euphemisms in the "death-journey" system: 跳上货运列车 tiào shàng huò yùn liè chē - "got in the car", 购买单程车票 gòu mǎi dān chéng chē piào - "got a car ticket", 最后的航程 zuì hòu de háng chéng - "last flight", 秦命航程 qín mìng háng chéng - "flight of a lifetime". *When Gulam Baba welcomed the spring of 98, he also sent a caravan of life* ("Gulistan", 1992, №6, p. 28); *On the day of the show, the caravan of his life had set out on a journey* (Tajhizil Amwat, p. 44); *Put the head handalak on the cart. The catastrophic farmer loaded his skulls into the wagon of destruction* (Temurnoma, p. 278); *Riding a four-legged wooden horse. A four-legged wooden horse, one day you get enough* (Yassavi).

### 3. Associative series "Death - Housing"

In Uzbek linguistics, the words cemetery, grave, tombs are used to create word associations with house, place, abode, and habitation and relaxation spot. The association "House" creates euphemisms such as *house, house without windows, house of the hereafter, going to the house of the hereafter, the last house, observing the true house: Now my friend in a quiet foreign house* (H.Olimjon, "Selected works", p. 413); *We will all go one day to that windowless house* (Saodat, 1998, №3, p. 21); *Sooner or later, when we all go to the abode of the Hereafter, ...* (Gulistan, 1997, №5, p. 18); *All will go to the abode of the Hereafter* (from Hidayat); *Many people gathered to follow him to the last house* (E. Turan, "These Mountains Are Great Mountains" p. 81); *Crowd followed him to his true home* (O., Navoi, p. 276).

Along with the noted, the "place" Association is also distinguished by its activity in the formation of euphemisms: the place of arrival, the place of lay /// bed, the place of truth, the place where all go, put in place.

*May your eternal light be your destination* (A.O. "Memoirs," p. 23); *If anyone lies, his bed is alone, nephew* (A. Kodiri); *He said that seven and a half leftists had come to you. ... I left to get seven and a half left-handed people* (A. Kodiri); *"Is he gone?" - Where?! ... - Wherever everyone goes ...* (From the conversation); *Three or four days later, we put my mother back in place.* (T. Sodikova "In a poem to a woman", p. 133).

In Chinese, 美好归宿 – "house of the hereafter" and 阴间 "dark rooms" euphemisms meaning "grave" can be found. For example, 阴间派来的人只收到一吊钱, 你为什么胡说? - "**A representative from another world informed me that they had taken only a handful of money. Why are you lying?**" - replied to Huang Sheng with ill-treatment (J. Ziyamuhamedov, "The Magic Monk", p. 149).

#### 4. "Death - metamorphosis" associative series

According to E.M. Meletinsky, metamorphoses reflect the peculiarities of early mythopoetic ideas in archaic forms: because of metamorphoses, gods are imagined with people, animals with inanimate objects, and sometimes they are transformed into each other. The clear boundary between "the world of the living" and "the world of the dead", "that world" and "this world", the transition from one dimension to another, is manifested through metamorphoses (Meletinsky, 1995: 225).

According to the beliefs of the ancient Chinese, if the source of eternal life is found, the creature can take on the form of a human being or, conversely, take on the form of a human being and develop a magical nature and live forever:

只见一个牙齿又尖又长的恶鬼, 正把一张人皮铺在床上, 拿着画笔在上面描画。花了一阵, 把画笔扔在一边, 拿起画好的人皮, 好像穿衣服一样披在身上, 马上就变成了那美丽的少女。 - *Then he saw a creature whose teeth were sharp and long. In bed, a man's skin was spread out. As the creature held the brush, he painted it with his whole body. When he had finished drawing, he threw the brush to one side. The beautifully drawn man took his skin in his hands and put it on as if he were wearing a robe. Immediately, the creature became the same young girl again* (J. Ziyamuhamedov, "Mask", p. 170).

It is also common in myths that a person turns into a butterfly or a bird after death. Consequently, in the legend of Lian Shanbo and Zhu Intai, during the Eastern Jin dynasty, Intai, the daughter of a rich man named Zhu Jiachjen, meets a teenager named Lian Shanbo on the way to school. The young men fall in love with each other, but the girl's family resists their marriage. As a result, young people perish and become inseparable butterflies (Yuan Ke, 1965).

Various euphemistic metamorphoses related to the transformation of the human soul into different birds can also be observed:

到了家里, 他又病了, 不吃不喝, 睡梦中还常喊阿宝的名字。恨不得自己的魂能再到阿宝家去。

一天孙子楚家的一只鹦鹉，忽然死了，小孩们拿着玩儿，孙子楚看见，心里想：要能变成一只鹦鹉，不一下子就飞到阿宝身边了吗？想着想着，他竟真的变成鹦鹉，不一会儿，就飞到阿宝屋里 – *When he returned home, he fell ill again and lay down to eat and drink. In his dream, he always mentioned A Bao's name. He dreamed that his spirit would go to A Bao's house again. One day, a parrot in Sun Zichu's house died suddenly. The children were playing with the dead bird. Sun Zichu sees this in:*

*"If I became a bird, I would immediately fly to A Bao," he thought. At that moment, he suddenly turned into a parrot and flew to A Bao's house (Ziyamuhamedov, 2016, pp. 189-190).*

In Uzbek, too, there are euphemistic metamorphoses, such as the *parrot of the soul ... flying, the parrot of the soul ... to fly, the bird of the spirit ... to fly. The narrator says that even though forty thousand mullahs recited verses for forty days ... the parrot of the spirit flew to the sugar cane of Paradise (Temurnoma, p. 106); ... after a while the spirit parrot prepared from the cage of the body to fly to the gardens (Temurnoma, p. 327); The spirit bird flew from the cage of the body to the branch of the tree of paradise (Temurnoma, p. 331) [2, 2006].*

In addition to the above, in Chinese linguistics, 华鹤 huá hè – "turn into a crane, go into the world", 跨鹤 kuà hè – "ride on a crane (eternal life)", 乘鸾 chéng luán "ride on a crane", 羽化 yǔ huà – "like a butterfly out of a cocoon", 升天 shēng tiān – "ascend to heaven, enter heaven" and so on. Euphemistic metamorphoses are also used.

### Conclusion

Because totemism was so prevalent in primitive culture, animals, birds, fish, insects, and even rocks, trees, and grasses were thought to have human-like souls, "all creatures in nature - the spirits of the dead." This led to the formation of specific metamorphoses.

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中华人民共和国在中国南方海域有争议领土上的作用  
**THE ROLE OF THE PEOPLE'S REPUBLIC OF CHINA IN THE  
DISPUTED TERRITORIES OF THE SOUTH CHINA SEA**

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抽象。 本文概述了当今南中国海的领土，该地区的地缘政治意义，以及中华人民共和国对南中国海的主张。

关键字。 南海，中美关系，世界贸易路线，南沙岛，西沙群岛，东京湾。

**Abstract.** *This article provides a general description of the territories in the South China Sea today, the geopolitical significance of the region, as well as the claims of the People's Republic of China over the South China Sea.*

**Keywords.** *South China Sea, China-US relations, world trade routes, Spratly Island, Paracel proles, Tonkin Bay.*

### **Introduction**

The South China Sea remains a region where the interests of Southeast and East Asian countries have clashed in recent years. The most interested country in these processes remains the People's Republic of China. Important world trade routes pass through the South China Sea. The marine basin is rich in energy resources, marine food resources. It is also of military-strategic importance in the fight against the U.S. blockade due to the geographical location of the islands and reefs in the South China Sea. For this reason, the South China Sea is a very important region for China to become a great power in the future.

In recent years, China's policy in the South China Sea has been interfering with the national security and sovereignty of the countries in the region. Free access of Chinese ships to the economic zones of ASEAN countries, the occupation of some islands by China, the construction of artificial islands and the deployment of Chinese military forces on them has caused sharp protests from states. However, many countries in Southeast Asia are economically closely linked to China and cannot openly fight China. In this regard, the situation in the South China Sea is significantly complicated.

The People's Republic of China, Taiwan, Vietnam, the Philippines, Malaysia and Brunei Darussalam are participating in the dispute. Of the above countries, the People's Republic of China claims 80% of the territory in the South China Sea, including the Paresel and Spratly Islands [1.49].

### **The main findings and results**

The South China Sea is part of the Pacific Ocean and is a border sea covering an area of about 3,500,000 square kilometers (1,400,000 square miles) from the Straits of Karimata and Malacca to the Strait of Taiwan. The sea is of great strategic importance, and one-third of the world's transport passes through it, with annual trade of \$ 3 trillion. The region has lucrative fishing, which is important for the food security of millions of people in Southeast Asia, however, there are significant oil and gas reserves in the South China Sea [2].

Today, international maritime communications pass through the South China Sea. 80% of oil imports from the People's Republic of China and Japan from the Middle East pass through this region. Another important aspect for the world economy is the passage of an average of 70,000 ships and 20,000 oil tankers per year through the Straits of Malacca [3.13].

The South China Sea is located in the Pacific Ocean. The South China Sea is located in southern China, eastern Vietnam, the western Philippines, the Malay Peninsula and eastern Sumatra. Around the sea are China, Vietnam, the Philippines, Cambodia, Thailand, Singapore, Malaysia, Indonesia and Brunei. That is why the sea plays an important role in the lives of more than 300 million people. The largest areas in the South China Sea are the Paracel Islands and the Spratly Islands.

Paracel Islands (Chinese 西沙群岛 Sisha) It has 15 islands and reefs. The total area of the islands is 3 km. sq.m, the distance from the archipelago to the Chinese island of Hainan is 290 km, The distance to the Vietnamese port of Danang is 320 km. Paracel Islands are divided into two groups: Amphitrite and Croissant Islands. The largest islands are Patl, Triton, and Lincon [4]. China and Vietnam are claiming the Paracel Islands.

The Spratly archipelago (Chinese 南沙群岛 Nansha) is located 500 km south of the Paracel Islands and has a total land area of 5 km<sup>2</sup>, sometimes 10 km<sup>2</sup>, compared to emerging islands. The archipelago consists of more than 200 small islands and reefs. Some lands are only visible when the water level drops. In this case, the number of islands and reefs reaches 400 [5]. Vietnam, China, Malaysia, the Philippines and Brunei have claimed the Spratly archipelago.

The Scarborough Reef (Chinese 黄岩 Xuanyan) is a landmass that exists over a body of water. The closest country to the Scarborough Reef is the Philippines, 220 km away. This reef is claimed by China and the Philippines.

The regime of the disputed territories in the South China Sea has not yet been resolved. The claims of states exist primarily because of economic interests. From the basin of the South China Sea, especially near the Spratly Islands, there are important sea trade routes, including an important sea route connecting the ports of the Far East and America with the countries of South Asia, Africa, the Middle East. In 2016, \$ 3.4 trillion worth of trade was done through this sea, accounting for 21 percent of world trade [2]. The main cargo transported through the South China Sea is petroleum products, industrial raw materials, machinery and equipment. In particular, Japan and the United States import large amounts of oil from the Persian Gulf. Japan also imports ores from Africa and India. The waterway in the South China Sea plays an important role in this.

The South China Sea is rich in energy resources. The United Nations Economic and Social Commission for Asia and the Pacific conducted research in the marine basin and in 1968 discovered vast reserves of natural gas and oil. This situation changed the situation in the South China Sea. Since then, territorial claims have intensified.

The South China Sea is rich in seafood and is one of the 5 largest fish zones in the world in terms of annual seafood production. Indeed, 12 percent of the world's fish catch is in the South China Sea. The South China Sea islands also have great potential for tourism development. Wind and solar energy are rich in marine energy resources.

A state that exercises control over the region will have natural resources in the region, gaining a military-strategic advantage in the fight against other states. The Paracel Islands and the Spratly archipelago are convenient points for controlling submarines, building bases to protect naval communications, and maintaining military forces. If war breaks out on the Asian continent, military forces in the Spratly Islands could easily block waterways in the South China Sea.

Tonkin Bay (Chinese Baybu Bay, Vietnamese Bakbo Bay) is located between the coasts of Vietnam and China, and there have been disagreements between the two countries since 1992 over the demarcation of the continental shelf. On December 25, 2000, the People's Republic of China and the Socialist Republic of Vietnam signed an agreement on "demarcation of the maritime area, economic zone and continental shelf in the Gulf of Tonkin."

Both sides agreed to complete the demarcation of Tonkin Bay and develop the region. During the official visit of the Prime Minister of the People's Republic of China Li Keqiang to Hanoi in October 2013, an agreement on the joint use of natural resources of the Tonkin Bay was also signed between China and Vietnam. It was agreed to solve simple problems, such as completing the delimitation of borders, improving transport links, expanding cooperation in the field of investment, and then the problems of the disputed territories.

### Conclusion

In short, China will never give up areas that fall within the “nine-point line” and, conversely, will continue to expand its territory by building artificial islands. Chinese President Xi Jinping has said that China's full sovereignty has been established in the South China Sea. For example, the “White Paper” on “Security Cooperation in the Asia-Pacific Region”, published in January 2017, states that China has full sovereignty over the Spratly Islands and adjacent territory. China’s “21st Century Maritime Silk Road” project is also very well designed and the South China Sea will never be allowed to be controlled by the United States. Today, the South China Sea is an important area where China and U.S. interests collide. U.S. intervention in territorial disputes in the South China Sea is further complicating the situation. The fate of the world in the near future will be decided by who will win the competition in the region.

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缺血性中风患者的催眠恢复  
**RECOVERY HYPNOSIS OF PATIENTS SUFFERING ISCHEMIC  
STROKE**

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**摘要。** 在这项研究中，我们试图确定催眠，催眠疗法在缺血性中风患者的康复治疗中的要点。尤其是，医学心理学家作为多学科团队的一员，以及在催眠恢复认知和运动障碍方面的协助。我们认为，将催眠药与药物治疗法结合使用可显著提高修复治疗的效果并缩短康复时间。

**关键词：**催眠，催眠疗法，医学心理学家，多学科团队，缺血性中风，大脑皮层。

**Summary.** *In this study, we attempted to identify the main points of hypnosis, hypnotherapy in the restorative treatment of patients who have undergone ischemic stroke. In particular, the role of a medical psychologist as part of a multidisciplinary team, as well as the assistance of hypnosis in the restoration of cognitive and motor disorders. In our opinion, the implementation of hypnosis in conjunction with pharmacological therapy allows to significantly increase the effectiveness of restorative treatment and reduce the period of rehabilitation.*

**Keywords:** *hypnosis, hypnotherapy, medical psychologist, multidisciplinary team, ischemic stroke, cerebral cortex.*

In modern medical research in the field of neurology, quite often you can find various approaches for non-drug treatment and recovery of patients who have undergone an ischemic stroke. To a large extent, the proof of the effectiveness of reflex therapy, mechanic therapy, ergo therapy in modern science is quite often found and logically understood, but hypnotherapy remains completely incomprehensible and unexplored [1; 5].

To date, the problem of post-stroke recovery is quite relevant, since there is a rather high percentage of disabled working-age population and insufficient socio-psychological adaptation [2; 3; 4]. Therefore, the psychologist of the neurological department at the first stage of restorative treatment should create the most positive motivational and emotional background. Therapeutic hypnosis is aimed at a certain focus of gene expression and neuro genesis, in general at certain time parameters in a healthy period of time, to create the synthesis of new synapses, neural connections, which in turn generate functioning neurons in the affected areas of the cerebral cortex.

In our clinical study, we look primarily at cognitive and motor impairment occurring after stroke. Quite often, cognitive impairment is accompanied by depressive and neurotic reactions to the disease, which greatly complicates the development of a positive attitude towards treatment in the patient. Patients' vision of the internal picture of the disease, a conscious positive perception of therapy, greatly facilitates both psychological care and pharmacological treatment. In this regard, psychological assistance in the rehabilitation of patients with the consequences of stroke is of great importance, which contributes to the creation of an active personal focus on overcoming the defect, correcting attitudes to the disease and to treatment, creating an optimistic therapeutic and life perspective, and developing a positive attitude to treatment and disease. The purpose of this work was to develop a positive perception of drug treatment, as well as to study the personality of patients in relation to treatment and disease depending on the severity of motor and cognitive disorders. We observed 150 patients with the consequences of stroke; between 30 and 75 years of age; 57 men, 93 women; in the process of restorative treatment (2019-2020), in inpatient treatment at the Regional State Health Budget Institution Bokhansky district hospital therapy unit.

We divided into two groups, according to the following criteria, patients of the first group made up with pronounced motor and cognitive impairment, attitudes associated with a significant overestimation of the severity of the condition, with an underestimation of their own capabilities, with negativity, and were accompanied by depressive, hypochondrias reactions to the disease. The second group included patients with moderate motor and cognitive impairment were observed mainly neurotic responses to the disease and manifested themselves in settings of post-improvement, distrust of specialist assistance, in reassessment of their own capabilities [7; 10; 11; 12].

We use the five main scales of MoCA, MMSE, FAB, Becka, Hamilton HDRS in our diagnostic work, which is quite wide range to consider various aspects of disorders and psychological abnormalities resulting from stroke. After that, we define the patient into a group by the severity of the disease and develop an individual route [9, p. 217].

In our study with regard to the second stage of rehabilitation of patients suffering from ischemic stroke, the need for integrated management of this category of patients [6; 8]. In general, the work of specialists of the multidisciplinary team quite significantly raises the rehabilitation potential of a patient who has suffered an ischemic stroke. But when the state has a medical psychologist who is engaged not only in diagnostic work, but also in psychotherapy, hypnotherapy, the development of positive motivation, he contributes to an increase in rehabilitation potential by 15% compared to the traditional approach of management of this category of patients.

When performing hypnosis in the restorative treatment of patients who have undergone ischemic stroke, we try to take into account all brain functions formed during evolutionary development. Therefore, very carefully together with doctors and neurologists, we design an individual restorative treatment route and strive to create a sparing therapeutic effect on:

- the oldest sections of the posterior brain, responsible for the instinctive basis of behavioral reactions;

- levels of "emotional brain," including the limbic system and pleasure centers;

- cerebral cortex, where the center of neural connections is concentrated, which is responsible for visualization of recoverable processes [4, p. 211].

A modern approach to the rehabilitation of patients suffering from ischemic stroke requires the organization of an assistance system with the formation of a multidisciplinary approach to physical, psychological, social and legal issues. Modern rehabilitation approaches include the active use of various computer technologies, including remote programs and techniques. Electronic information technologies can, on the one hand, be effectively integrated into existing integrated rehabilitation programmes [11; 12]. In our opinion, nothing will replace living human communication, psychotherapy sessions with the use of hypnosis, especially at the initial stage, imply rather long, frank conversations, to add and streamline visualization paintings that help in the restoration of cognitive and motor disorders. In a state of hypnotic sleep, we act on near affected areas of the cerebral cortex, while producing functional replacement of the affected area, on healthy areas or in the deep basics of the brain.

Thus, in the restorative treatment using hypnosis, we proceeded from the hypothetical capabilities of the brain to incorporate compensatory mechanisms, processes at different levels of functionality of the cerebral cortex. The use of the resource state of the organism in the restoration of destroyed neural connections and the activation of the neuro genesis process is, in principle, effectively achieved in the trance state, as well as functional relationships with the peripheral nervous system are formed in the restoration of motor activity.

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儿童严重外伤性脑损伤急性期全身炎症反应的特征  
**FEATURES OF A SYSTEMIC INFLAMMATORY REACTION IN  
THE ACUTE PHASE OF SEVERE TRAUMATIC BRAIN INJURY IN  
CHILDREN**

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抽象。在对100例重度颅脑外伤儿童的临床和生化参数进行的研究的基础上，作者表明，在最初的几个小时内形成的相关键与创伤后水肿的低氧发生一起在很短的时间内发生。机体全身炎症反应的STBI发生时间随年龄的变化而变化，其不同之处还在于，从创伤发生后的第一小时开始，仍未充分披露儿童对严重创伤的免疫反应的保护机制。研究发现，在STBI患儿的第一个小时内，格拉斯哥等级低于8分的意识障碍会抑制全身性炎症反应，并增加第二和第三亚组儿童的低凝倾向。

关键词：炎症，严重的颅脑外伤，儿童

**Abstract.** *Based on a study of the clinical and biochemical parameters of 100 children with severe traumatic brain injury, the authors showed that the correlation bonds formed in the first hours characterize, along with the hypoxic genesis of post-traumatic edema, the occurrence in a very short time after STBI of a systemic inflammatory response of the body, which varies depending on age, it differs by the feature of the still insufficiently disclosed protective mechanisms of the immune response to severe trauma in children from the first hour after the trauma. It was found that impaired consciousness on a Glasgow scale below 8 points inhibits a systemic inflammatory reaction and increases the disposition to hypocoagulation in children of the 2nd and 3rd subgroups in the first hours of STBI in children*

**Keywords:** *inflammation, severe traumatic brain injury, children*

### **Relevance**

Currently, the main concept - brain damage in STBI is determined not only by the primary impact at the time of the injury, but also by the action of various damaging factors over the next hours and days, the so-called secondary brain damage factors, which determines a high degree of relevance and the need to study deviations of indicators and assessment of the prognostic significance of early changes in vital functions in the “acute phase” after severe TBI. One of the leading factors in increasing intracranial pressure (ICP) is cerebral edema, caused not only by hypoxia, but also inflammatory edema that is natural for tissue damage. Of great interest is the feature of the systemic inflammatory response in the first hours after STBI in children [1,2].

### **Purpose of the work**

Study the features of a systemic inflammatory reaction in the acute phase of severe traumatic brain injury in children

### **Material and research methods**

Patients (100) are presented in three age groups: group 1 - from 9 months to 3 years (30), 2 - 3.1-7 years (31), older than 7.1 to 18 years (39). Depending on the severity of the condition, patients of each age group are divided into 3 subgroups: in 1 subgroup, the duration of treatment at the ICU was from 5 to 10 days - a total of 43 children (43%); the 2nd subgroup included 29 (29%) patients (duration of stay in the ICU - 11-20 days); subgroup 3 - 28 children (28%). Open traumatic brain injury (OSTBI) of moderate severity was diagnosed in 27% of children (of the total number of applicants), severe OTBI - 35%, closed traumatic brain injury (CSTBI) - 38%. Cerebral contusion (CC) was observed in 87% of children with a clear predominance in severe cases in schoolchildren in 51%, and moderate severity in 36%. While in children over 3 years of age, combined trauma with damage to internal organs was found in 13% of children. In the 3rd age group, OSTBI was detected in 29%, CSTBI in 18% of children, severe CC 18%, moderate 21%, Subarachnoid hemorrhage (SAH) - 10%, coma 2 23%, traumatic shock of 2nd degree - 21% of the total number of injured children.

The severity of acute cerebral insufficiency, the degree of brain damage was assessed on the basis of the Glasgow Coma Scale (GCS). Clinical assessment of the condition and damage according to the CRAMS, AIS scales was determined upon admission of patients by resuscitators, according to ISS, the results were recorded by surgeons, neurosurgeons with subsequent decision-making.

Upon admission to the clinic, we studied the data of a detailed analysis of peripheral blood, generally accepted in clinical practice biochemical blood parameters (glucose, total protein, bilirubins, urea, blood creatinine, potassium, plasma sodium, thrombotest (TT), prothrombin index (PI), blood fibrinogen 100 children with STBI in the first hours of admission, all patients were monitored for hemody-

namics, respiration, daily diuresis and estimated water balance taking into account the volume of enteral and parenteral water.

The obtained results were processed by the method of variation statistics on a personal computer using the Excel program by calculating arithmetic mean values (M) and average errors (m). To assess the significance of differences between the two values, Student's parametric criterion (t) was used. The critical level of significance was taken equal to 0.05. The method of correlation analysis is used.

### Results and discussion

Only in patients of 3 subgroup under the age of 3 years, significant deviations were revealed an hour after STBI: a decrease in blood hemoglobin level by 44% ( $p < 0.05$ ), a HMT index by 25% ( $p < 0.05$ ), an increase in glucose concentration in the blood by 19.3% ( $p < 0.05$ ), the highest AST  $329.5 \pm 29.5$  and ALT  $172.5 \pm 42.5$ , as well as a tendency to reduce the average daily plasma fibrinogen, PI. It should be noted that the greatest number of correlations was found in children with STBI up to 3 years. In the first hour after the injury in the 3rd subgroup up to 3 years, an increase in the value of aspartate aminotransferase (AST) with STBI was revealed. AST is one of the most important human enzymes responsible for the processes of glucose synthesis, and later on, energy for the whole organism. A change in its parameters in the biochemical blood test of govICU about the presence of damage in the organ most dependent on oxygen (liver, heart, muscles). The maximum amount of the enzyme is in the heart muscle, which serves as a diagnostic criterion for extensive damage to body tissues [Rusakov, VV 2006].

In the 1st subgroup, in children under the age of 3 years, a direct correlation was found (0.8061) in the number of leukocytes  $11.5 \pm 3.8 \times 10^9$  at a plasma fibrinogen concentration of  $2.6 \pm 0.6$  g/l, with an index of TT (0, 7443)  $4.8 \pm 0.6$  st., inverse correlation with PI (-0.7086)  $83 \pm 6\%$  and the number of eosinophils (-0.7686)  $1.7 \pm 0.1\%$ . An inverse relationship was found between stab and eosinophils (-0.9449), and a direct correlation was found between the number of stab and blood diastases (0.7150) at a diastase level of  $24 \pm 5$  mmol /l. The latter characterizes the situation when an increase in the inflammatory reaction leads to an increase in diastase in the blood, which leads not only to aggravation of general intoxication, impaired vascular permeability, but also to the fibrinolytic effect with hypocoagulation in the 3 phase of coagulation. The inverse correlation between segmented and lymphocytes (-0.9698) indicates an increase in the physiological feedback of segmented and lymphocytes in 1 subgroup in the first hours after STBI. Strengthening of the acute systemic inflammatory reaction - an increase in stab can cause hypercoagulation in phase 3 (the amount of fibrinogen) (0.9913).

An increase in the number of monocytes more than  $3.1 \pm 0.9\%$ , characteristic of an acute inflammatory reaction, would lead (-0.7637) to hypocoagulation (decrease in TT  $4.8 \pm 0.6$  st.). That is, it was found that the growth of stabs is fraught

with the appearance of a tendency to hypercoagulation in phase 3, and the increase in the number of monocytes to decrease TT - hypocoagulation in children of the 1st subgroup in the first hours after STBI.

In subgroup 2, the correlation relationships of the activity of the cellular response of the immune system differed from subgroup 1. So, an inverse correlation was found between the number of leukocytes  $14 \pm 3\%$  and monocytes  $9 \pm 6\%$  (-0.8806), segmented nuclear  $64 \pm 16\%$  and lymphocytes  $21 \pm 11\%$  (-0.9155). Direct correlation of changes in the number of segmented with TT  $4.5 \pm 1$  st. (0.8410) and PI  $74 \pm 4\%$  (0.806) characterized the likelihood of hypercoagulation, most likely associated with stress hypersympathotonia and in connection with the inflammatory response in the first hours after STBI. Thus, the factor contributing to the change in blood coagulation in the first hours of STBI in subgroup 2 was an increase in the activity of the cellular immune system of a protective nature in response to traumatic stress. However, at the same time, the negative effects of activation of the T-system of immunity were detected, so an increase in the number of leukocytes was accompanied by an increase in diastase ( $24 \pm 4$  mmol/l) (0.7135). The tendency to an increase in the number of lymphocytes ( $21 \pm 13\%$ ) was accompanied by a tendency to a decrease in blood coagulation factors, such as fibrinogen  $2.7 \pm 0.7$  g/l (-0.8682), TT  $4.5 \pm 1$  st. (-0.8358), PI  $74 \pm 4\%$  (-0.8673). An inverse correlation was also found between an increase in the number of monocytes of  $9 \pm 6\%$  and a decrease in blood diastase (-0.8572), which probably reflected the stimulating effect of monocytes on pancreatic function in subgroup 2. The revealed correlations reflect the complexity of the inflammatory response to acute excessive brain damage starting from the first hours after the injury.

In subgroup 3, only a direct relationship between the number of leukocytes and ESR (0.7888) and an inverse correlation between the number of leukocytes and the number of stab cells (-0.9869) were found. The increase in the inflammatory reaction in the first hours, leukocytosis was accompanied by a decrease in the number of stab-cells, which apparently reflected the peculiarity of the immediate systemic inflammatory reaction to excessive STBI in children under 3 years of age.

Of particular interest are compensatory mechanisms involving changes in the function of parenchymal organs. Significant deviations in the studied parameters in the first hours after STBI were not detected in any subgroup under the age of 3 years. The tendency to increase glucose levels of  $9.3 \pm 3$  mol/l contributed to hypercoagulation at TT  $4.8 \pm 0.6$  points (0.7291). The negative relationship between the concentration of total plasma protein  $51 \pm 8$  g/l and urea at a level of  $6.1 \pm 1.4$  mmol/l of blood can be explained by the activation of the detoxification function of the liver by an increase in protein formation function (-0.7295) in 1 subgroup in the first hours after injuries. An increase in urea concentration had a direct correla-

tion with blood creatinine (0.9208), and plasma diastase (0.8104), AST (0.7750), ALT (0.7439) and TT (0.8566), and growth plasma creatinine occurred with an increase in AST  $76 \pm 37$  mmol/l and ALT  $40 \pm 18$  mmol/l in 1 subgroup. In the first hours after the injury, in subgroup 1 in response to stress, a tendency to an increase in glucose indices, ALT AST was revealed, which indicated a restructuring of liver function in response to STBI.

The stress response to STBI in subgroup 2 of up to 3 years of age represented a more pronounced burst of functional activity than metabolism in subgroup 1, the metabolism of parenchymal organs, (mainly the liver), the immediate realization of the compensatory nature of protective reflexes. For a short period of time after an injury, compensatory reactions are realized mainly through activation of the functional activity of the nervous and humoral systems. An increase in the number of leukocytes in the blood to  $14 \pm 3 \times 10^9$  was accompanied by a tendency to a decrease in monocytes below  $9 \pm 6\%$  (-0.8807), as well as an increase in blood diastase more than  $24 \pm 4$  units/l (0.7136). The potential for an increase in the number of segmented white blood cells ( $64 \pm 16\%$ ) was accompanied by a tendency to a decrease in lymphocytes of  $21 \pm 13\%$  (-0.9155), as well as TT  $4.5 \pm 1$  st. (0.8410) and PI  $74 \pm 4\%$  (0.8069). A change in the ESR level of  $6.8 \pm 2.1$  mm/h corresponded to an increase in total  $13 \pm 3$  (0.8848) and direct (0.7920)  $2.4 \pm 1$  mmol/l blood bilirubins, an increase in AST ( $94 \pm 31$ ) (0.8766) and ALT ( $74 \pm 33$ ) mmol/l (0.9174) and an increase in TT (0.8277). Thus, in contrast to subgroup 1 in injured children, 2 subgroup with STBI up to 3 years of age increased the tendency to increase the number of leukocytes, AST, ALT, blood glucose in the first hours after the injury. In addition, an increase in blood glucose levels of more than  $6 \pm 1$  mmol/l in children of the 2 subgroup caused a high probability of diastase growth (0.7192) over  $24 \pm 4$ , a decrease in blood creatinine concentration (-0.7029) below  $0.05 \pm 0, 01$  mmol/l. A decrease in the concentration of urea was  $5.6 \pm 2$  mmol/l (-0.8190), creatinine  $0.05 \pm 0.01$  mmol/l (-0.7927) was inversely related to an increase in the concentration of total protein over  $51 \pm 7$  g/l in the blood. A direct relationship between the growth of diastase in the blood and the concentration of total protein in the blood (0.9975) with a still normal level of these indicators characterizes the emergence of a protective mechanism associated with an increase in the detoxification function of the protein environment of the blood. In parallel, the potential growth of blood urea and creatinine (0.9335), blood creatinine and PI (0.739), ALT and AST (0.9594), fibrinogen and PI (0.9667) suggest the occurrence of additional short-term connections of functional systems with compensatory significance in the first hour after a severe TB injury. It should be assumed that the functional failure of these systems at the time of injury leads to irreversible structural damage to the organs and systems involved in the protective reactions. That is, the next step was to increase the concentration of ALT, AST,

blood diastases, urea and plasma creatinine, etc., but already in the conditions of the disappearance of functional correlations revealed in subgroups 1 and 2 of children of up to 3 years old.

No significant correlation was found in subgroup 3; glucose parameters  $8.6 \pm 0.1$  mol/l, total protein  $45 \pm 1.8$  g/l, diastase  $31 \pm 8$ , urea  $4.8 \pm 0.9$ , creatinine  $0, 06 \pm 0.01$  mmol/l of blood as a whole did not differ from normative indicators, except for a decrease in total protein. Hypoproteinemia detected in subgroup 3 may have been the result of emergency mobilization of a protective liquid to preserve blood volume, respectively, stress sympathotonia, polycythemia, and other, implemented in a short time, protective mechanisms that are part of the centralization of blood circulation with STBI under the age of 3 years. The mechanism of blood sequestration in severe traumatic shock is suggested. It is difficult to exclude the possibility of a violation of the protein-forming function of the liver, usually realized by the rapid development of a deficiency of blood coagulation factors and the development of TGS in a very short period after an extremely severe injury, in the absence of visible blood loss.

The early (in the first hours) adaptation of the organism of children of the 1st subgroup aged 3.1-7 years with STBI occurred through the mobilization of predominantly reflex mechanisms, including through the activation of autonomic nervous regulation, which can be conditionally divided into 3 degrees in the absence of significant differences in hemodynamics, clinical and laboratory indicators. In subgroup 1 with GCS  $9.6 \pm 1.3$  points, a direct strong correlation was found with AST ( $76 \pm 27$  mmol/l) due to a significant array of damaged tissues, which led to the release of an intracellular enzyme into the blood. The direct correlation of the degree of impaired consciousness with creatinine ( $0.05 \pm 0.01$  mmol/l) and blood urea ( $6.1 \pm 1.4$  mmol/l) reflects the formation of compensatory mechanisms in conditions of damaged, but to a certain extent, preserved regulatory function of the head brain in the initial stages of acute cerebral insufficiency, apparently, are the result of disturbances in the water balance due to excessive stress in the first hours after the injury. In the 1st subgroup of 3.1-7 years, the compensatory value of the formation of the hyperdynamic type of hemodynamics was proved, when under conditions of traumatic stress, a decrease in SV could lead to renal, hepatic functional failure against the background of a tendency to hypercoagulation.

In subgroup 2, in case of impaired consciousness, respectively, GCS  $9 \pm 1.4$  points, a negative correlation was found between the indicator and the concentration of plasma potassium ( $3.3 \pm 0.1$  mmol/l), diastase ( $24 \pm 4$  mmol/l), and total protein ( $51 \pm 7$  g/l), glucose ( $6 \pm 1.3$  mmol/l) in the blood and a strong direct correlation with PI ( $74 \pm 4$ ), creatinine ( $0.05 \pm 0.01$  mmol/l) and urea ( $5, 6 \pm 2$  mmol/l) of blood.

Thus, the early (in the first hours) adaptation of the organism of children of the 1st subgroup at the age of 3.1-7 years with STBI occurred through the mobilization of predominantly reflex mechanisms, including through activation of VN regulation, which can be conditionally divided into 3 degrees in the absence of significant differences hemodynamics, other clinical and laboratory indicators. The first degree of activation of VN regulation in STBI was manifested by the mobilization of reflex correlations characteristic of the physiological level of increased load.

Grade 2 was distinguished by the enhancement of a compensatory reaction by involving new correlation links involving additional organs and systems in the process, which was also expressed in an increase in the number of correlation links at almost the same level of the studied parameters.

Grade 3 differed from the previous two by the disappearance of correlation relationships identified in the first two subgroups. The failure of adaptive reflex compensatory mechanisms can be explained by the depletion of resources in the 3rd subgroup of patients that previously provided adequate compensatory reactions in the first 2 subgroups due to the depletion of the energy reserves of the central and peripheral nervous systems, which was caused by an instantaneous extreme effect on the body, which required a very pronounced excessive (inappropriate to the energy and other resources of the CNS and other systems) mobilizing the functions of organs and systems, especially the CNS. Factors contributing to the aggravation of the condition in the first hours after injury in children of 3 subgroup with STBI at the age of 3.1-7 years were, in addition to the degree of damaging effects on the brain, damage to other organs, bleeding, individual, functional features of CNS, including ANS, characterized by not only more pronounced reactivity, but also faster exhaustion, foreshadowing a longer course, the development of various complications, primarily associated with secondary immune deficiency caused by STBI even with the same strength and damage to STBI, as in subgroups 1 and 2 children of under 7 years old.

When stress exposure was aggravated in subgroup 3, the increase in leukocytosis in the first hours after an injury in children of 3.1-7 years old was accompanied by a decrease in the number of stabs, which apparently reflects the peculiarity of the immediate systemic inflammatory reaction to excessive STBI.

At 1st day older than 7 years, an inverse correlation was found between the amount of injected fluid and the level of blood urea (-0.7630), less pronounced with the concentration of blood creatinine (-0.5820), total bilirubin (-0.6458), direct bilirubin (-0.6024), which characterizes not only the substitutional nature, but also the hemodilutionary focus of infusion therapy on the 1st day. Already in the first hour after STBI, changes appeared due to stress polycythemia, most likely due to the destructuring of a large array of tissues, which in the absence of immediate correction increased the likelihood of developing acute renal failure

(ARF) on the first day after a severe injury. The more pronounced the traumatic disturbance of consciousness, the worse the effect on the systemic inflammatory response and the protein-forming function of the liver in the 2nd subgroup of children. It was found that impaired consciousness on a Glasgow scale below 8 points caused inhibition of a systemic inflammatory reaction and increased the disposition to hypocoagulation in children of the 2 and 3 subgroups older than 7 years. In the 3rd subgroup of children over 7 years old, a tendency to hypocoagulation was found depending on the severity of STBI from the first hour after the injury. In children of 3 subgroup older than 7 years, the influence of the general severity of the condition on the blood coagulation system was revealed with a TT index ( $5.8 \pm 1.2$ ), a direct relationship between the general severity of the condition according to CRAMS ( $3.3 \pm 1.3$ ) and the indicator (TT  $5.2 \pm 0.6$ ), that is, the more severe the patient's condition, the greater the risk of coagulopathy (0.9111). An analysis of correlations of the general severity of the condition of children in the 2nd subgroup according to CRAMS revealed a direct effect of the general severity of the condition on the severity of impaired consciousness (GCS  $9.7 \pm 1.4$ ), on the number of leukocytes (0.8455) in peripheral blood ( $13.1 \pm 4.1$  %) and the inverse relationship (-0.8466) with an ESR index ( $6.3 \pm 3$  mm per hour). The latter characterized an increase in systemic inflammatory reaction with a worsening of the general severity of the condition in subgroup 2, that is, the more severe the general condition of patients according to CRAMS, the more pronounced the signs of an inflammatory reaction in the first few hours after the injury.

**Conclusion.** The revealed correlation links characterize, along with the hypoxic genesis of post-traumatic edema, the occurrence in a very short time after STBI of the mobilization of the systemic inflammatory response of the body, which varies depending on age, a feature of the yet insufficiently disclosed protective mechanisms of the immune response to severe trauma in children from the first hour after the injury.

It was found that impaired consciousness on a Glasgow scale below 8 points inhibits a systemic inflammatory reaction and increases the disposition to hypocoagulation in children of the 2nd and 3rd subgroups in the first hours of STBI in children.

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都格尔扎布治疗胃包如病临床优势定性评价研究报告  
**RESEARCH REPORT OF QUALITATIVE EVALUATION ON  
THE CLINICAL ADVANTAGES OF DUGARJAB IN TREATING  
STOMACH-BAORU**

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**摘要：**目的：评价名老蒙医都格尔扎布运用蒙医药治疗胃包如病的临床优势。方法：采用定性评价方式从相同病种、相同技术、本民族、本地区四个方面对该专家的临床优势进行评述。结论：都老师擅于治疗消化系统疾病，尤其对胃包如病，形成了自己独特的学术思想，临床优势非常明显。

**关键词：**都格尔扎布；蒙医；胃包如病；优势评价；定性评价

**Abstract.** *Objective: To evaluate the clinical advantages of Dugarjab in treating Stomach-Bor. Methods: Comment on the clinical advantages of Dugarjab in treating Stomach-Bor by used the qualitative evaluation from four aspects that the same disease, the same technique, the own nationality and the local area. Conclusion: Dugarjab is good at treating the disease of digestive system. In particularly, he had formed many his own particular thoughts about Stomach-Bor and had the obvious clinical advantages.*

**Key Words:** *Dugarjab; the Mongolian medicine; Stomach-Bor; advantageous evaluation; qualitative evaluation.*

### **Introduction**

Chief Physician Dugarjab, the late famous old Mongolian medical expert, was one of the first batch of famous old Mongolian medical experts selected by the Ministry of Science and Technology around China, and was also one of the inheritors of traditional Mongolian medical skills. He had been practicing medicine for more than 60 years, studying medical skills and caring for patients, and had

accumulated rich experience. At the same time, he had also been recognized by patients and peers in the region and even all over the country. In order to reflect the clinical advantages of Chief Physician Dugarjab in the treatment of stomach Baoru disease or Weibaoru (a disease name of traditional Mongolian medicine), we have made qualitative evaluation and research on the clinical advantages of Dr. Dugarjab from four aspects: the same disease, the same technology, the same nationality and the same region. The report is as follows:

### **1. Advantages of the same disease**

#### **1.1 Theoretical Innovation of Weibaoru**

Dr. Dugarjab expanded the etiology of Weibaoru from Khii, Shar, Badgan, Chusu (blood), Sharvsv (yellow water)" <sup>[1]</sup> to "Khii, Shar, Badgan, Chusu (blood), Sharvsv (yellow water), Nianhorhai (armyworm)" <sup>[2]</sup>. During the treatment, attention was paid to the treatment of causes, and the treatment principles of removing Badgan, protecting liver and clearing Chusu heat, and killing armyworm were put forward <sup>[3]</sup>.

#### **1.2 Being good at combining Mongolian medicine theory with modern medical theory**

According to Mongolian medicine theory, Dr. Dugarjab believes that *Helicobacter pylori* belongs to the category of armyworm in Mongolian medicine. According to the theory that armyworm falls on viscera organs, he believes that after armyworm falls on stomach organs, it conflicts with Badgan, Khii, Shar and Chusu to aggravate the pathological changes or make them chronic, which is the main pathogenesis of adhesion and Weibaoru (sticky Weibaoru). This view was put forward for the first time in the field of Mongolian medicine. Dr. Dugarjab supposed that *Helicobacter pylori*-related chronic gastritis, gastric ulcer, duodenal ulcer and gastric cancer can be classified into the category of Mongolian medicine adhesion and Weibaoru <sup>[4]</sup>, so drugs with adhesion-killing effects should be used in treatment.

### **2. Advantages of the same technology**

As an independent medical system, Mongolian medicine's technical system includes diagnostic technology and therapeutic technology. Diagnostic technology includes diagnostic methods and analysis methods. The former is to collect patient information data, while the latter is the thinking process of sorting out data, i.e. evaluation data, analysis, reasoning and judgment, and making final diagnosis. Treatment technology includes formulating treatment principles, determining treatment methods and specific technical operation methods.

#### **2.1 Advantages of Diagnostic Techniques**

Diagnostic techniques include diagnosis and analysis. During diagnosis, Dr. Dugarjab always take observation diagnosis as the first step, with special emphasis on pulse diagnosis, and the combination of three diagnosis and Mongolian

medicine special diagnosis. When making comprehensive analysis of diseases and diagnosis, great attention is paid to the application of “Ten Elements of Mongolian Medical Diagnosis”.

**2.1.1** Many old Mongolian doctors and Mongolian medicine workers arrange the order of Mongolian medicine’s three diagnoses as interrogation, inspection and palpation and pulse taking. The sequence of Mongolian medicine’s three diagnoses in Mongolian medicine’s higher education textbooks is also written in this way. According to Dr. Dugarjab, as a diagnostic method for doctors to infer disease conditions by visually observing patients' external mental state, color, shape, posture and abnormal changes of local conditions, inspection is a diagnostic method for obtaining first-hand information related to patients’ diseases. Therefore, inspection should be ranked first among the three diagnoses of Mongolian medicine. In Mongolian medicine, pulse diagnosis is an important diagnostic method to determine the location of lesions. Doctors estimate the location and nature of the disease according to the pulse conditions of internal organs in different parts of the patient’s left and right hands. Each finger of cun, guan and chi (three places at the wrist where the pulse is usually taken) is divided into an upper part and a lower part. The upper part is the outer side of the anatomical finger pulp and can be used to examine the five internal organs (heart, liver, spleen, lungs and kidneys). The lower part is the medial side of the anatomical finger pulp and can be used to examine the six hollow organs (gallbladder, stomach, large intestine, small intestine, bladder and sanjiao). Because the stomach belongs to one of the six hollow organs, Dr. Dugarjab attach great importance to pulse diagnosis in the diagnosis of Weibaoru.

**2.1.2** The special diagnosis of Mongolian medicine is a method of pressing specific acupoints to diagnose diseases. The viscera to which the disease belongs can be verified by the tenderness response to the acupoint, and the pain at a certain acupoint or when pressing indicates that the viscera corresponding to this acupoint is suffering from disease. If there is tenderness in the 12th segment of the spine of a patient, it indicates that the lesion site of the patient is in the stomach, which is one of the auxiliary diagnostic methods for the diagnosis of Weibaoru.

**2.1.3** Dr. Dugarjab obtained the overall situation related to the disease by means of interrogation, inspection and palpation and pulse taking and special diagnosis of Mongolian medicine, and then used the "Ten elements of diagnosis and treatment of Mongolian Medicine" to identify the nature of the disease, and combined with the six basic syndrome theory and cold and heat theory to summarize in order to make a correct judgment. Ten elements are the important basis that must be followed in diagnosing the nature of all diseases. Its contents include the external causes of the disease, the main symptoms, the location of the lesion,

the morbidity season, the physical signs of the patient, the nature of the patient, the age of the patient, the habit of living, the physique of the patient, the degree of the disease, etc. [5].

## **2.2 Advantages of treatment techniques**

Treatment techniques include the formulation of treatment principles and the determination of treatment methods.

### **2.2.1 Advantage of treatment principle**

Dr. Dugarjab mainly follows the following principles in the treatment of Weibaoru: First, treatment should be carried out according to the etiology, i.e. The main etiology leading to Weibaoru among the six causes of the disease (Khii, Shar, Badgan, Chusu, Sharvsv, armyworm) should be treated first. Secondly, attention should be paid to the combination of the treatment of removing Badgan and protecting the liver to clear the Chusu heat. If the disease is caused by armyworm falling into the stomach, we should emphasize the treatment of killing adhesion. The ultimate principle of treating Weibaoru is to regulate physical elements to restore the balance function of the three roots (Khii, Shar and Badgan) and seven elements (water cereal essence (transparent liquid), blood, meat, fat, bone, marrow, and semen).

### **2.2.2 Advantages of Treatment Methods**

Since ancient times, Mongolian people have used diet, daily life, medicine and external treatment to prevent and treat diseases in order to achieve the goal of strengthening the body and prolonging life. In the 18th century, the outstanding Mongolian medical scientist Ishibalazur elaborated on the four therapies of Mongolian diet, daily life, medicine and external treatment in his *Sibu Ganlu*. The Mongolian people gradually learned in their daily practice that there is a complementary and inseparable relationship between diet, daily life, medicine and external treatment. For thousands of years, it has made indelible contributions to the reproduction and living of the nomadic peoples in the north represented by the Mongolians. In the process, it has gradually improved itself and developed into the four major therapies of Mongolian medicine<sup>[6]</sup>. Dr. Dugarjab is good at using Mongolian medicine's four major therapies when treating various diseases.

#### **2.2.2.1 Drug therapy**

(1) Administer medicine according to the law of human life: The fundamental secret of Mongolian medicine's long-term prosperity for thousands of years lies in its own characteristics and its inherent scientific nature. Since ancient times, Mongolian doctors have attached great importance to sending prescriptions and medicines by following the laws of human body clock. Dr. Dugarjab is also one of them. The internal activities of Khii, Shar and Badgan in the human body show periodic laws of prosperity and decline with the change of people's age, season and hour. The scientific nature of Mongolian medicine lies in respecting the life law of

the human body itself and administering drugs according to different stages, hours and seasons of the human body. Influenced by internal and external factors, the three roots of the human body have certain laws of prosperity and decline at different times of the day. The temperature is cool in the morning, which is Khii hour; hot at noon, Shar hour; cold in the evening, Badgan hour. Therefore, Dr. Dugarjab often prescribe warm and hot drugs for the morning, cold drugs for the afternoon and warm or neutral drugs for the night in order to balance cold and heat, thus care for one without losing another.

(2) Drugs for invigorating stomach and regulating stomach fire are often given before breakfast: Dyspepsia is the factor causing various diseases in internal medicine. Dr. Dugarjab believes that “the stomach is the life foundation after birth and is the biochemical source of Khii blood”. In the diagnosis and treatment of various diseases, the balance of gastrointestinal function is emphasized, with improving digestive function and regulating stomach fire as the first priority.

(3) Make good use of the drug introduction: Dr. Dugarjab often dispenses the drug introduction while giving the main drug to help the main drug to give full play to the best curative effect. Commonly used herbs include butter, milk, milk wine and decoction for various diseases<sup>[7]</sup>.

(4) Special prescription for treating special diseases: Gaoyou-11 Powder is Dr. Dugarjab’s special prescription for treating gastric bag diseases. Gaoyou-11 Powder has strong specificity and obvious curative effect among Mongolian medicines commonly used by Dr. Dugarjab in the treatment of Weibaoru<sup>[8]</sup>. Through “Clinical Study on Mongolian Medicine Gaoyou-11 Powder in Treating Helicobacter Pylori Positive Chronic Superficial Gastritis”, it is concluded that Gaoyou-11 Powder can effectively improve the clinical symptoms of HP positive chronic superficial gastritis, and the long-term efficacy of clinical symptom improvement and HP eradication is better than that of western medicine “Standard Three Drugs”<sup>[9]</sup>.

(5) It has distinct national characteristics: Dr. Dugarjab’s medication method has distinct Mongolian national characteristics. For example, butter, milk and milk wine are commonly used as drug introduction, which not only conforms to the Mongolian national eating habits, but also enhances the drug effect.

(6) Low dosage: Dr. Dugarjab only prescribe 3g of drugs for each time, not more than 18g or less a day at most, thus saving drug resources<sup>[10]</sup>.

#### 2.2.2.2 External therapy

According to the different causes and types of Weibaoru, Dr. Dugarjab often use drugs to treat them, supplemented by other treatments. For example, Mongolian moxibustion and butter rub massage therapy are applied to Khii Weibaoru; Hot compress therapy is used to treat Badgan Weibaoru, and diarrhea therapy is used to treat Shar Weibaoru, etc.

### **2.2.2.3 Diet therapy**

Mongolian medicine diet therapy is a subject based on Mongolian medicine theory and guided by Mongolian medical theory of “six flavors, eight natures and seventeen effects”. It is an effective auxiliary method to treat diseases. In clinical practice, Dr. Dugarjab mainly instructed the patient to adjust diet reasonably according to the patient’s age, digestion ability, physique, physiological characteristics, etiology, diseases, seasons, etc. Generally speaking, patients with Weibaoru should eat some moderate food. Patients with Shar type Weibaoru should avoid eating hot, greasy, indigestible and irritating foods, and can eat a small amount of soft, nutritious and easily digestible foods, such as fresh beef, mutton, pork, fish, fresh vegetables and fruits, milk, rice, white flour, etc.

### **2.2.2.4 Daily living therapy**

The daily life therapy of Mongolian medicine mainly refers to the rational regulation of the body, language and mind, and it is an auxiliary therapy of other treatment methods. “Body” refers to all physical activities such as walking, lying, standing, sitting, stretching, bending, releasing and holding. “Language” refers to language activities such as speaking, singing, shouting and screaming. “Mind” refers to the psychological activities such as happiness, anger, sorrow, happiness, sadness, thinking and surprise. The daily life therapy of Mongolian medicine includes residence and environment in addition to body, language and mind <sup>[11]</sup>. Mongolian doctors believe that body, language, mind, as well as residence and environment are essential for people, but all their activities should be appropriate. Too much or too little of them will cause internal strife among the three roots of the body and cause diseases. The residence of patients with Weibaoru should be kept dry and quiet. Patients can take a proper outdoor walk, but they should not be excessively tired. Badgan Weibaoru patients are not allowed to eat cold and heavy food that is not easy to digest. They should not sleep during the day and suffer from cold. They can do some physical activities properly in dry and warm places, but do not sweat.

## **3. Advantages of the nation and the region**

Mongolian medicine is deeply rooted in the native Mongolian culture, sucking the nutrients of the national culture and benefiting the people of all ethnic groups. Mongolian medicine is not only a traditional medical science, but also a unique thinking and method for Mongolian people to observe human life phenomena. In a sense, Mongolian medicine has the function of national identity beyond the medical field itself. The survival and development of Mongolian medicine in Inner Mongolia Autonomous Region has superior natural and geographical conditions and a broad mass base, which meets the needs of all ethnic groups with Mongolian as the main body for Mongolian medicine services. The unique theoretical system, natural pharmaceutical preparations and magical clinical effects possessed by Mongolian medicine are trusted and recognized by the local people.

#### 4. Conclusions

Inner Mongolia is located in a plateau with a cold climate. People mostly eat beef, mutton and dairy products. As a result, gastrointestinal diseases such as indigestion and Weibaoru are common. Dr. Dugarjab's view that "the stomach is the life foundation after birth and the source of Khii, Shar and Badgan" is adapted to the natural characteristics and people's living customs of the region. In the process of treating various diseases, the balance of gastrointestinal function is emphasized, with improving digestive function, regulating stomach fire and "killing adhesion" as the first priority, thus obtaining the reputation of magical curative effect and good treatment of digestive system diseases, and providing new ideas for the extension of our future research<sup>[12][13]</sup>.

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蒙医胃包如病的诊断与治疗

**DIAGNOSIS AND TREATMENT OF STOMACH BAORU DISEASE  
IN TRADITIONAL MONGOLIAN MEDICINE**

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**摘要:** 目的: 展示蒙医胃包如病的最佳诊断与治疗。方法: 查阅蒙医经典著作中有关蒙医胃包如病文献资料, 整理、归纳著名老专家的经验。总结出15种分类病症及治疗所常用32种蒙成药。结论: 蒙医胃包如病的诊断与治疗, 要遵循蒙医学理论, 通过蒙医辨证对症治疗, 常可收到标本兼治, 能获得最佳治疗效果。

**关键词:** 蒙医 胃包如病 诊断 治疗

**Abstract.** *Objective: Show the best diagnosis and treatment of Stomach-Bor disease in Traditional Mongolian Medicine. Methods: Refer to the Traditional Mongolian Medicine classics about the Stomach- Bao-ru disease: sum up the experience of the famous Mongolian medicine expert. Summarize 15 kinds of classification of diseases and 32 kinds of commonly used Mongolian medicine for Treatment. Conclusion: Diagnosis and treatment of Stomach- Bao-ru should follow the Traditional Mongolian Medicine theory. Through the Mongolian medicine syndrome differentiation and treatment, we often can receive the best treatment effect.*

**Key words:** *Diagnoses; Treatment; Stomach Baoru disease; Traditional Mongolian Medicine*

Stomach Baoru disease is a common disease of the digestive system in Mongolian medicine. It is caused by the retention of Baoru heat pathogen in the stomach or the stagnation of cold food to hurt the stomach. It is a polymeric chronic disease of gastric organs with the most complicated etiology and pathogenesis, and various treatment principles and methods [1]. Peptic ulcer in western medicine

belongs to the category of this disease<sup>[2]</sup>. We consulted the literature of Stomach Baoru disease in the classic works of Mongolian medicine<sup>[3]</sup>, sort out and summarize the experience of famous old experts<sup>[4]</sup>, explore the academic thoughts of famous and old experts<sup>[5]</sup>, refer to the consensus of Helicobacter pylori infection abroad<sup>[6]</sup>, and domestic<sup>[7][8]</sup>, the diagnosis and treatment suggestions of peptic ulcer in China<sup>[9][10]</sup> and the clinical treatment guidelines of traditional Chinese medicine<sup>[11]</sup>, actively respond to the recommendations of the clinical treatment guidelines of traditional medicine<sup>[11]</sup>, the consensus guidelines of Mongolian medicine special diseases<sup>[12]</sup> and Stomach Baoru disease<sup>[13]</sup> are proposed, and the concept, classification, pathogenesis, diagnosis and treatment of Stomach Baoru disease in Mongolian medicine are summarized as follows for the first time.

**1. Concept, classification and pathogenesis of Stomach Baoru disease in Mongolian medicine**

**1.1 Concept of Stomach Baoru disease in Mongolian medicine**

Stomach Baoru disease in Mongolian medicine is mainly caused by epigastric pain, which includes distending pain, stabbing pain, flashing pain, dull pain, severe pain, and differences between preferring to press and refusing to press. It can be accompanied by symptoms such as abdominal distension, acid swallowing, acid regurgitation, nausea and vomiting, loose stool, mental fatigue, etc.

**1.2 Stomach Baoru disease classification of Mongolian medicine**

**1.2. 1 Classification of etiology (internal cause):**

It can be divided into 6 types: Stomach Baoru disease of Khii type, that of Shar type, of Badgan type, of Chusu type, of Sharvsv type and of Nianhorhai type. See the table for literature records.

*Table-1. Etiological Classification of Mongolian Medicine Stomach Baoru Diseases in Literature*

Literature	Etiological classification (quantity)
The Four Medical Tantras	Khii, Shar, Badgan, Chusu (4 types)
Clinical Notes	Khii, Shar, Badgan, Chusu, Sharvsv (5 types)
Encyclopedia of Mongolian studies	Khii, Shar, Badgan, Chusu, Sharvsv (5 types)
Modern Research <sup>[14]</sup>	Khii, Shar, Badgan, Chusu, Sharvsv, Nianhorhai (6 types)

**1.2. 2 Classification of inducements (external factors)**

It can be divided into two categories: cold and heat, which are rarely used in contemporary Mongolian medicine.

**1.2. 3 Symptom classification**

According to symptoms, it can be divided into four types: retention, diffusion, persistence and siltation, which are the same as the classification in classic works and modern classification.

#### **1.2. 4 Classification of disease course**

It can be divided into three phases: fever in the early stage, cold and heat in the middle stage, and cold in the late stage [15].

#### **1.3 Pathogenesis**

The etiology of the disease can be summarized as follows: Six basic symptoms (Khii, Shar, Badgan, Chusu, Sharvsv, and Nianhorhai) of the human body are over-abundant, over-deficient or disordered due to environmental external factors such as diet, behavior, seasonal hours and unexpected factors, resulting in abnormal digestive functions of the three kinds, pain caused by the blockage of Chusu and Sharvsv, and loss of function of Nianhorhai, which eventually leads to the disease.

### **2. Diagnosis**

#### **2.1 Clinical Manifestations**

Recurrent, periodic and rhythmic pain occurs in the middle and upper abdomen. A few patients have no symptoms or mild symptoms. Complications such as hemorrhage and perforation are taken as the first symptoms. Pain site: Gastric ulcer is on the left side of the upper abdomen and occurs irregularly. Duodenal ulcer is on the right side of the upper abdomen. Nature and time of pain: mostly empty abdominal pain, dull pain, burning pain and distending pain. The pain at the gastric ulcer half an hour after the meal gradually, relieved after 1-2 hours, and the above-mentioned pattern occurred again after the next meal. Duodenal ulcer has empty abdominal pain and midnight pain, which can be relieved by eating. Pain is often accompanied by dyspepsia symptoms such as heartburn and belching. Some patients, especially those who ate before going to bed, may suffer from midnight pain, with obvious periodicity, especially in colder seasons from late autumn to early spring.

#### **2.2 Relevant Inspection**

Endoscopy, <sup>13</sup>C or <sup>14</sup>C labeled urea breath test and X-ray barium series are used as references for the diagnosis of Stomach Baoru disease in Mongolian medicine.

#### **2.3 Classification criteria**

##### **2.3. 1 Classification of Etiology and Source (Internal Causes)**

###### **2.3. 1.1 Stomach Baoru disease of Khii type**

Main symptoms: epigastric distension and pain, worsening mood; thin and white tongue coating. Secondary symptoms: noisy; frequent belching; reddish tongue and floating pulse.

###### **2.3. 1.2 Stomach Baoru disease of Shar type**

Main symptoms: epigastric burning pain; dry mouth, bitter mouth; yellow, thick and greasy moss. Secondary symptoms: heavy body drowsiness; nausea and vomiting; acid regurgitation; less food and less appetite; pulse slippery number.

### **2.3. 1.3 Stomach Baoru disease of Badgan type**

Main symptoms: epigastric dull pain, preference for warmth and preference for pressing; The pain is severe on an empty stomach and decreases after eating. The tongue coating is thick and white. Secondary symptoms: aversion to cold and cold limbs; fatigue; frequent saliva spitting; less appetite; diarrhea in loose stool; heavy, thin or late pulse.

### **2.3. 1.4 Stomach Baoru disease of Chusu type**

Main symptoms: epigastric burning pain; The tongue is purple and dark or has petechia and ecchymosis. Secondary symptoms: hunger and lack of appetite; anorexia retching; dry mouth; Hematemesis can be seen; black and dry stool; fast pulse.

### **2.3. 1.5 Stomach Baoru disease of Sharvsv type**

Main symptoms: epigastric dull pain; uncertain sore spot; yellow, white and thick tongue coating. Secondary symptoms: poor appetite; dry mouth; yellow brown stool; floating pulse.

### **2.3. 1.6 Stomach Baoru disease of Nianhorhai type**

Main symptoms: epigastric pain or burning pain or stabbing pain, and unmovable pain spot; red tongue with little coating. Secondary symptoms: severe pain at night; dry mouth without desire to drink, and tight pulse.

## **2.3. 2 Symptom classification**

### **2.3. 2.1 Retention type**

Main symptoms: loss of appetite; dyspepsia; deficiency and inverse belching; acid regurgitation or vomiting a small amount of bitter water and food. Secondary symptoms: gastric distension and bowel sounds; upper abdominal distending pain; dry and black stool; fast pulse; red tongue; light and green urine.

### **2.3. 2.2 Diffusion type**

Main symptoms: liver and stomach pain and pain through chest and back; weakness; the eyelid; black and gray vomitus; diarrhea. Secondary symptoms: reddish brown tongue; gray lips and tongue, and completely tarnished gums and nails; pulse deficiency and promotion; yellow or brown urine; white and yellow tongue coating.

### **2.3. 2.3 Blood seepage type**

Main symptoms: feeling heavy; chest tightness; heat and dryness; flash pain of diaphragm waist and back. Secondary symptoms: edema; skin pruritus; exposure of veins standing out; pulse deficiency; red and foaming urine.

### **2.3. 2.4 Siltation type**

Main symptoms: abdominal palpable mass, and fever at the mass; stabbing pain, and when it hurts, it feels like rolling. Secondary symptoms: fatigue; abdominal distension; red urine; the pulse becomes narrower, thinner and faster.

## **2.3. 3 Classification of disease course**

### **2.3. 3.1 Initial heat syndrome**

Main symptoms: intermittent fever in abdomen and wrist; bitter and sour

mouth; nausea; dry stool. Secondary symptoms: greasy face; heavy limbs; fatigue and sleeplessness; Stabbing pain in diaphragm and back; thick and full pulse; red urine with thick steam and strong taste.

### **2.3. 3.2 Mid-term cold-heat interaction**

Main symptoms: liver and stomach pain and pain through chest and back; gastrointestinal colic. Secondary symptoms: physical weakness; dry purple stool or bloody stool; thick and full pulse; urine with uncertain colors.

### **2.3. 3.3 Cold syndrome in late stage**

Main symptoms: drowsiness and weakness; indigestion; nausea and vomiting; stomachache after eating. Secondary symptoms: abdominal distension and bowel sounds; occasional constipation; chill aversion; thick or late and slight pulse; white urine.

The above syndrome classification is determined: The diagnosis can be made if there are main syndromes and more than secondary syndromes.

## **3. Treatment**

### **3.1 Syndrome Differentiation Treatment in Mongolian Medicine**

Mongolian medicine mainly adopts syndrome differentiation and individualized treatment when treating diseases, and Stomach Baoru disease treatment is nothing more than using this method.

### **3.2 The combination of Mongolian and Western medicine**

It can also be used to treat stomach envelopment.

### **3.3 Other treatments**

According to the condition of the patient, the patient can be treated with soaking bath, bloodletting, fire moxibustion, acupuncture and diarrhea, etc.

## **4. Conclusion**

Stomach Baoru disease in Mongolian medicine is the most common and changeable disease in the gastroenterology department of Mongolian medicine. Under the guidance of Mongolian medicine theory, treatment based on syndrome differentiation according to the 13 categories mentioned above is carried out in Mongolian medicine. For 32 diseases that can only be treated with Mongolian patent medicines, individualized treatment and syndrome differentiation are often adopted to treat both the symptoms and the root causes, thus obtaining the best therapeutic effect.

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浅谈蒙医“六基症”论应用于“胃溃疡”分型的可行性  
**DISCUSSION ON THE FEASIBILITY OF APPLYING THE  
THEORY OF TRADITIONAL MONGOLIAN MEDICINE SIX BASIC  
DISEASES TO GASTRIC ULCER**

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**摘要:**目的: 研究蒙医胃溃疡致病“六基症”, 常用不同性味的规律与特点, 为胃溃疡的蒙医药诊疗提供借鉴。方法: 采用文献研究法, 搜集、鉴别、整理中国知网、百度学术公开发表文献及蒙医教材、经典著作相关内容, 近代脏腑论, 对60例胃溃疡进行蒙医分型。结果: 本文以蒙医学经典著作《四部甘露》中论述的“六基症”理论为基本依据, 结合现代蒙医临床消化性溃疡胃包如病诊疗现状, 对胃包如病的病因、分类、临床症状及治疗进行了概要讨论。同时, 作者以“六基症理论”为疾病分类的基本原则, 概括总结了消化性溃疡蒙医胃包如病六种亚型症候的临床表现。

**关键词:** 六基症 赫依 希拉 巴达干 楚素 希拉乌素 粘浩日海 胃溃疡

**Abstract. Objective:** To study the “six basic disorders” caused by gastric ulcer in Mongolian medicine and the laws and characteristics of commonly used medicinal materials with different natures, so as to provide reference for Mongolian medicine diagnosis and treatment of gastric ulcer. **Methods:** 60 cases of gastric ulcer were classified into Mongolian medicine by literature research method, collecting, identifying and sorting out the published literature of CNKI(Chinese National Knowledge Infrastructure) and Baidu, Mongolian medicine teaching materials, classic works and modern viscera theory. **Results:** Based on the theory of “six basic disorders” discussed in the classic Mongolian medical work *Sibu Ganlu (The Four Tantras of Nectar)* and combined with the current situation of clinical diagnosis and treatment of stomach Baoru disease in modern Mongolian

*medicine, the etiology, classification, clinical symptoms and treatment of stomach Baoru disease were briefly discussed in this paper. At the same time, the author summarized the clinical manifestations of six subtypes of stomach Baoru disease in Mongolian medicine of peptic ulcer based on the “six-basic-disorder theory” as the basic principle of disease classification.*

**Key words:** *six basic disorders; Khii; Shar; Badgan; Chusu; Sharvsv; Nianhorhai gastric ulcer*

## Introduction

The theory, also known as “six causes”, was put forward by Mongolian medical scientist Yeshes Palbyor<sup>[1]</sup> at the end of the 17th century, referring to “Khii” (meaning Qi), “Shar” (bile), and “Badgan” (mucus, tissue fluid, etc.) as “three roots”<sup>[2][3]</sup> and “Chusu” (blood), “Sharvsv” (yellow water), and “Nianhorhai” (insect, pathogenic microorganisms, also including beneficial flora of human body) as “three elements” under normal health and pathological conditions. The relative balance between the “three roots” and “three elements” of the human body is health, and their imbalance will increase, consume and disorder under the influence of internal and external factors. As a result, the core theories of Mongolian medicine related to physiology, pathology, syndrome differentiation and treatment of systemic diseases such as “Khii disease”, “Shar disease”, “Badgan disease”, “Chusu disease”, “Sharvsv disease” and “Nianhorhai disease” continue to develop nowadays<sup>[4][5][6][7]</sup>. The first four kinds are combined into “aggregation disease”, i.e. stomach Baoru disease in Mongolian medicine, which belongs to the category of peptic ulcer and is a common and multiple digestive system disease in Mongolian medicine. The human body suffers from human life activities including the “three karma” of body, language and mind, that is, the relative balance of the “three karma” of body, language and psychological activities<sup>[8][9]</sup> and the “four external factors” of diet, living and transportation, climate and special factors is destroyed, The epigastric pain, anorexia, acid regurgitation and belching are the main manifestations caused by the excessive Badgan and its interaction with Chusu, Shar, Khii and Nianhorhai and the evil blood and Sharvsv falling into the stomach together<sup>[10][11]</sup>.

### 1.1 Khii disease

Health “Khii” is affected by the “three karma” of body, speech and psychology, resulting in irregular life, pessimistic mood, massive hemorrhage, vomiting and diarrhea, prolonged wind exposure, lack of sleep, loss of appetite, lust and excessive thinking. Four external causes include frequent consumption of bitter, cold and low-nutrition foods, resulting in lack of nutrition, etc. ; living in a cold environment, and wearing thin clothes, etc. ; seasonal and time factors such as summer, dawn, and night, etc. as well as other special factors. Under the adverse

influence of the “four external factors”, when the body’s “Khii” function loses its relative balance, such as excessiveness, weakness and disorder, it leads to pathological changes, which is called “Khii disease”. The elderly are prone to “Khii disease” accompanied by yawning, trembling, under-stretching, chills, retching, blurred sensory perception, dysphoria, emotional instability, uneasiness, unprovoked fuss, dizziness and tinnitus, palpitations, insomnia, systemic wandering pain, eyelid edema, emaciation, rough skin, warmth, transient eye skew or convulsion, fasting pain; Khii acupoint has tenderness; After eating spicy, sweet, warm and nutritious foods and drugs such as scallion, sheep meat and brown sugar, and living in a quiet, elegant and comfortable environment, the symptoms are relieved to cure. Pulse condition is empty and occasionally there is cardiac arrest. The tongue coating is dry and red. Urine is light and foam is large and abundant.

### **1.2 Gastric ulcer of Khii type**

In addition to the symptoms of “Heyi disease”, patients will suffer from epigastric distension and pain, chest tightness, anorexia and acid regurgitation, which will worsen in case of depression, and improve when belching or exhaust; being irritable; preference for sighs.

### **2.1 Functions of healthy Shar**

As one of the “three roots” of the human body, Shar exists in the middle of the body. Under normal, healthy and balanced state, it can transform the heat energy of human body and participate in the function of material metabolism. It is one of the essential vital energy elements in human body. Under normal state, Shar performs the function of “feeling hungry and thirsty, feeding and digestion, providing heat and energy to maintain physical and mental activities” [12].

### **2.2 Clinical manifestations of Shar disease**

Healthy Shar is damaged by the faults in conduct karma, speech karma and thinking karma, and frequent diet of garlic, wine and other spicy, acid, and warm food, long-term consumption of high calorie food and other dietary factors; living in a hot and warm environment, sunburn, fatigue and other living factors; in case of autumn, noon, midnight and other seasonal timing factors, plus trauma and so on. Due to the adverse effects of the “four external causes”, the function of Shar appears to be overactive, declining and disordered, thus making the “three roots” function lose relative balance and lead to Shar disease. The main symptoms are pain in the mouth, fever, headache, chest and back pain, preferring sour and spicy food, and pain aggravation after eating, etc. The constitution of the middle-aged and young people are Shar-dominated, and they are susceptible to Shar disease. In addition to signs and symptoms such as pressing pain at the acupoint of Shar, the pulse is tense, full, stringy, or rapid; the tongue coating is yellow, thick and greasy, and the urine is yellow with strong odor.

### 2.3 Gastric ulcer of Shar type

In addition to the symptoms of “Shar disease”, the patient has urgent epigastric pain, burning sensation, obvious relief of pain after eating, or pain during eating. Dry and bitter mouth; preference for cold drinks, vomiting acid, indescribable discomfort in stomach, emotional irritability, and constipation.

#### 3.1 Functions of healthy Badgan

As one of the “three roots” of the human body, Badgan belongs to the brain. Under normal, healthy and balanced conditions, Badgan plays a vital role in human digestion, regulating humoral functions and secreting substances. It is one of the essential vital energy elements of human body. Under normal state, Badgan performs the function of “being physically and mentally strong, sound sleeping, tough joints and flexible body”<sup>[12]</sup>.

#### 3.2 Clinical manifestations of Badgan disease

Healthy Badgan is damaged by the faults in conduct karma, speech karma and thinking karma, and the frequent diet of lettuce, immature fruit, pork and other sweet, cold food, continual eating before full digestion and other dietary factors, living in windy and damp cold environment and other living factors; in the case of spring, early morning, dusk and other seasonal factors. Under the bad influence of the “four external causes”, the function of Badgan is overactive, declining and disordered, thus making the “three roots” function lose relative balance and leading to Badgan disease. The main symptoms include loss of appetite, vomiting, abdominal distension, hiccup, fatigue, body coldness and aggravation after meals and so on. The constitution of children is Badgan-dominated, and they are susceptible to Badgan disease. Besides signs and symptoms such as pressing pain at the acupoint of Badgan, the pulse is dull, late and weak, and the tongue coating is white, wet and slippery, and the urine is white with weak smell.

#### 3.3 Gastric ulcer of Badgan type

In addition to the symptoms of Badgan disease, patients will also suffer from dull stomachache, preference for warmth and pressing, frequent attacks or aggravation of illness every time they encounter cold or overwork, abdominal distension after eating, tiredness and fatigue, mental fatigue and laziness, aversion to cold, cold limbs and thin stool. The tongue is light and tender, with tooth marks on the edge, thin and white coating, and weak or slow pulse.

#### 4.1 Function of normal and healthy “Chusu”

Chusu (blood), as one of the “three elements” of human disease, is also one of the “seven substances” that make up human diet, blood, muscle, fat, bone, bone marrow, semen, etc.. Under normal, healthy and balanced conditions, Chusu spreads all over the body through blood vessels, maintaining the foundation of human life, forming an important link in metabolism, and becoming an important material basis for transforming and nurturing muscles.

#### **4.2 The clinical manifestation of Chusu disease**

In the process of subtle transformation of diet into blood, healthy Chusu often induces or accompanies Shar fever, disorders in the “three karma” of body, language and psychological activities, and dietary factors such as eating leeks and hot food. due to the adverse effects of “four external factors” such as living in a warm environment, the function of Chusu appears in prosperity, decline and disorder, which leads to the relative balance between “three roots” and “three elements”, leading to Chusu disease. Chusu disease is one of the most characteristic and dominant diseases in Mongolian medicine<sup>[16-19]</sup>. Diseased Chusu (blood) can also form endotoxin or splenic disease, Chusu-Shar disease and other diseases in the body. The main symptoms and signs are chest and rib tingling, facial redness, corneal red filaments, high fever, irritability, headache, sore throat, dry mouth, avoiding light, epistaxis, gingival blood, skin purple spots, mouth and tongue blood blisters and so on. The diagnosis of Chusu disease is mainly based on the above-mentioned clinical manifestations, moreover, some special manifestations of pulse, red tongue, yellow, fissure, black, and yellow-red urine should be observed.

#### **4.3 Gastric ulcer of Chusu type**

In addition to the “Chusu disease” symptoms, the patient’s symptoms include high fever, dysphoria, headache, red pharynx, dry mouth, epistaxis, gingival blood, purple skin spots, and blood bubbles in the mouth and tongue.

#### **5.1 Function of normal and healthy “Sharvsv”**

Sharvsv is one of the “three elements” of disease and the “essence of bile” produced in the derivation process of the “seven substances”. Under normal, healthy and balanced conditions, Sharvsv exists in all parts of the human body, especially in skin and joints, which lubricates the joints of the whole body and makes them move with ease.

#### **5.2 The clinical manifestation of Sharvsv disease**

Sharvsv disease refers to the pathological changes caused by abnormal states such as excessive, weak and dysfunction caused by inducement and external interference of healthy Sharvsv. Sharvsv disease is divided into cold and heat. Heat Sharvsv disease is accompanied by disordered Khii and Shar. Cold Sharvsv disease is accompanied by disordered Khii and Badgan. Therefore, Sharvsv disease has both pathological manifestations of cold and heat. According to the degree of influence of “three roots” and “four external factors” on healthy Sharvsv, its function may be excessive, weak and disordered, resulting in heat or cold Sharvsv disease. However, the pathological changes of Sharvsv can cause various diseases such as rheumatoid arthritis, various rashes, and edema, etc. by combining and accumulating.

#### **5.3 Gastric ulcer of Sharvsv type**

Skin damage, pruritus, rash, bone and joint swelling and pain, and pathological changes.

### 6.1 Normal and healthy Nianhorhai

Nianhorhai or Myxovirus (pathogenic microorganisms, viruses, bacteria, mold, mycoplasma, chlamydia, gastrointestinal parasites, trichomonas, tooth decay, etc.) is one of the "three elements" of disease. Under normal, healthy and balanced conditions (healthy immune system function), Nianhorhai or myxovirus does not invade skin, head, digestive tract, reproductive tract, blood and other body parts.

### 6.2 The clinical manifestation of Nianhaorihai disease

Nianhaorihai or myxovirus is adversely affected by the "four external factors". When it is excessive, weak and dysfunctional (imbalance of normal flora in the body, acid-base imbalance in the internal environment, etc.), it will attack skin, mucosa, head, digestive tract, reproductive organs, blood, etc. to lead to Nianhaorihai disease. There is no difference between cold and heat in Nianhaorihai disease, but it is infectious. Nianhaorihai of pathological changes can cause various myxovirus diseases (bacterial infectious diseases, viral epidemic diseases, influenza, virulent infectious diseases, etc.) by combining and accumulating. Therefore, Nianhaorihai disease also belongs to "six basic diseases" in disease classification.

### 6.3 Gastric ulcer of Nianhorhai type

Symptoms include abdominal pain, abdominal distension, nausea in the morning, acid regurgitation, belching and hunger. In severe cases, nausea, vomiting, chills, cold sweat on the back, erect hairs, joint pain, dyspnea, occasional high fever, irregular heart rate, irritability, reddish brown body surface, accompanied by cramps, vomiting and diarrhea.

**7. Conclusion:** The Mongolian medical theory founded by the famous modern Mongolian medical scientist Ishbalazur is a theoretical hypothesis that organically integrates the traditional "three roots" theory of Indian, Tibetan and Mongolian medicine with the "three elements" pathological theory of Mongolian medicine and systematizes it. The "six basic disorders" deduced and explained by this theoretical hypothesis is the basic principle of clinical disease classification and diagnosis in Mongolian medicine, and this principle is also applicable to guiding clinical etiology classification, diagnosis and treatment of gastric ulcer disease in Mongolian medicine stomach Baoru disease. The clinical manifestations and treatment of six etiological subtypes of stomach Baoru disease are the experience summary of Mongolian medicine's long-term clinical observation and practice, and have more clinical guiding significance.

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稀土纳米颗粒和银纳米颗粒的组成对慢性实验性前列腺炎后果的纠正  
**CORRECTION OF THE CONSEQUENCES OF CHRONIC  
EXPERIMENTAL PROSTATITIS BY THE COMPOSITION OF  
RARE-EARTH NANOPARTICLES AND SILVER NANOPARTICLES**

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这项工作的目的是确定由chronic和银NP激活的原钒酸镧NP组成对慢性慢性前列腺炎引起的病理状况的纠正作用。

材料和方法。成年雄性大鼠的慢性前列腺炎 (CP) 的建模是使用冷冻装置 Wartner (比利时欧米茄医药国际公司) 通过冷冻装置对前列腺腹侧进行冷冻伤而进行的。手术动物是一群CP; 对照组由假手术大鼠组成。

CP的校正通过尺寸为6-8×50-56 nm的europium (NPs Ag) (CP + NPs组) 活化的 activated (NPs LaV04: Eu3<sup>+</sup>) 激活的原钒酸镧的NP组成。剂量为0.3mg / kg体重。选择每只动物0.5 ml的前列腺素 (0.5%) 作为参考药物 (CP + Pr组)。从手术后第15天开始, 用特殊的非创伤性半刚性导管从手术后第15天开始, 以0.5 ml的体积注射, 直径为3 mm, 从直肠上端直达直肠上端, 距离直肠上端20至25 mm的深度肛门。实验结束时, 确定白细胞的数量, 检查前列腺和精囊的状况和重量, 计算其重量系数, 确定精子发生的功能状态。

结果。发现用NP组合物治疗CP两周后, 大鼠白细胞减少了30%, 前列腺和精囊腹侧部分的大小和重量减少了 (由于分泌物的重量), 因此与来自CP的动物的数据 (p<0.05) 相比, 它们的重量系数和增加的精子图参数。用前列腺素治疗CP男性后获得相似的数据。

结论: 使用NPs LaV04: Eu3<sup>+</sup>和NPsAg组合物具有明显的抑制系统性炎症过程的能力, 对冷冻伤致前列腺损害, 恢复其功能和改善大鼠精子图具有积极作用。

关键字: 慢性前列腺炎; 稀土纳米粒子; 银纳米颗粒; 精子图雄性大鼠。

*The aim of the work is to determine the effect of the corrective action of the composition of NPs of lanthanum orthovanadate activated by europium and silver NPs to the pathological condition due to chronic experimental prostatitis.*

**Materials and methods.** Modeling of chronic prostatitis (CP) in adult male rats was performed by cryotrauma of the ventral part of the prostate using a cryo device for removing warts Wartner (Omega Pharma International, Belgium). The operated animals are a group of CP; the control group consisted of sham-operated rats.

Correction of CP was performed by the composition of NPs of lanthanum orthovanadate activated by europium (NPs  $\text{LaVO}_4\text{:Eu}^{3+}$ ) of size  $6-8 \times 50-56$  nm to which silver NPs were attached (NPs Ag) (CP +NPs group). The dose was 0,3 mg/kg body weight. Prostatilen (0,5 %) in a volume of 0.5 ml per animal was selected as the reference drug (CP+Pr group). Test compounds were administered from the 15th day after surgery for 2 weeks in a volume of 0.5 ml using a special non-traumatic semi-rigid catheter with a diameter of 3 mm rectally into the upper rectum to a depth of 20-25 mm from the anus. At the end of the experiment, amount of leukocytes was determined, the condition and the weight of the prostate and seminal vesicles were examined, their weight coefficient was calculated, the functional state of spermatogenesis was determined.

**Results.** It was found that after two weeks of treatment of CP with a composition of NPs, the amount of leukocytes of rats decreased by 30 %, decreased the size and weight of the ventral part of the prostate and seminal vesicles (due to a decrease in the weight of the secretum), and as a result, their weight coefficients and increased parameters of the spermogram compared with data from animals with CP ( $p < 0,05$ ). Similar data were obtained after treatment of CP males with prostatilen.

**Conclusion.** The use of the NPs  $\text{LaVO}_4\text{:Eu}^{3+}$  and NPsAg composition has a distinct ability to inhibit the development of the systemic inflammatory process, has a positive effect on the prostate gland damaged by cryotrauma, restoring its functions and improving the spermogram of rats.

**Key words:** chronic prostatitis; rare earth nanoparticles; silver nanoparticles; spermogram; male rats.

According to epidemiological studies, up to 45% of men in Ukraine suffer from chronic prostatitis (CP) and in 40 % of cases, CP can cause male infertility [1]. However, the treatment of patients with prostatitis is still a difficult medical problem, which makes the search and creation of new prostatoprotectors urgent.

Today, the search for fundamentally new drugs created in nanoform is a promising area in the biomedical and pharmaceutical industries [2, 3]. It is generally recognized that a change in the physical properties of a substance in the form of nanoparticles (NPs) is accompanied by changes in their biological effects, since they have a large surface area per unit mass, which makes them more reactive than

macroforms [4, 5]. Small sizes facilitate binding to nucleic acids and proteins, integration into cell membranes, and change in the function of biostructures [6]. An important property of NPs is their high ability for accumulation, because they may not be recognized by the body's defense systems due to their small size and they may not be biotransformed.

Rare earth NPs such as  $\text{CeO}_2$  or  $\text{GdVO}_4$  have a positive effect to fertility and spermatogenesis during reproductive disorders due to neonatally induced interventions or during age-related involution and have antioxidant properties [7-9]. The results of a study of the toxicity of NPs of another rare-earth element – lanthanum oxide ( $\text{La}_2\text{O}_3$ ) – indicate improved spermatogenesis defects of mice [10].

In addition, worldwide interest in development and use of drugs that contain silver has increased. The specific properties of silver are significantly enhanced due the transition to the nanoform, as a result of which it penetrates more easily through the protective barriers of living organisms and enters directly into organs and tissues [5, 11].

Therefore, the aim of the study was to determine the effect of the corrective action of the composition of NPs of lanthanum orthovanadate activated by europium and silver NPs to the pathological condition due to chronic experimental prostatitis.

### Materials and methods

Modeling of CP in adult male rats (250-350 g) was performed by cryotrauma of the ventral part of the prostate using a cryo device for removing warts Wartner (Omega Pharma International, Belgium) [12]. This model is accompanied by hemodynamic disorders, the development of the inflammatory process and allows to reproduce the pathological process in the prostate of rats, which corresponds to the course of chronic abacterial prostatitis in men. The operated animals were alone in cages (CP group). The control group consisted of sham-operated rats (Control group). Correction of CP was performed by the composition of NPs of lanthanum orthovanadate activated by europium (NPs  $\text{LaVO}_4:\text{Eu}^{3+}$ ) of size 6-8 × 50-56 nm to which silver NPs were attached (NPs Ag) (CP+NPs group). The administered dose was 0.3 mg/kg body weight. Prostatilen (0,5 %) in a volume of 0.5 ml per animal was selected as the reference drug (CP+Pr group), which has a prostate-protective effect, reduces edema and leukocyte infiltration of the prostate, improves microcirculation and platelet-vascular hemostasis, positively affects the functional activity of spermatozoa, and is widely used for the treatment of chronic abacterial prostatitis and male infertility [13]. Test compounds were administered from the 15th day after surgery for 2 weeks in a volume of 0.5 ml using a special non-traumatic semi-rigid catheter with a diameter of 3 mm rectally into the upper rectum to a depth of 20-25 mm from the anus.

Blood was taken from the tail vein of rats for determine of amount of leukocytes at the end of the experiment. After decapitation the animals, the condition and the weight of the prostate and seminal vesicles were examined, their weight coefficient was calculated as the ratio of organ weight in milligrams to animal weight in grams. The functional state of spermatogenesis was determined, the concentration of morphologically normal cells (CN) was calculated [14]. Experimental work with animals was performed in accordance with the national «General Ethical Principles of Animal Experiments», consistent with the provisions of the «European convention for the protection of vertebrate animals used for experimental and other scientific purposes» [15]. Experimental animals were kept under standard vivarium conditions under natural light, diet and drinking regimen [16]. The obtained digital material was analyzed using the Shapiro-Wilk test, Student's t-test [17].

**Results and discussion**

It was found that after two weeks of treatment of CP with a composition of NPs, the amount of leukocytes of rats decreased by 30 % compared with the CP group ( $p<0,05$ ), which may indicate a decrease in the inflammatory process (Table 1). Similar data were obtained after treatment of CP males with prostatilen.

*Table 1. – The concentration of leukocytes and weight coefficient of the genitals of rats with chronic prostatitis after correction with nanoparticles,  $\bar{x} \pm S_{\bar{x}}$*

Index	Group			
	Control (n=13)	CP (n=17)	CP+NPs (n=9)	CP+Pr (n=13)
Amount of leukocytes, $10^9/l$	10,6±0,2	15,0±0,3*	11,5±0,6**	11,8±0,6**
weight coefficient of seminal vesicles	3,4±0,2	4,3±0,2*	2,8±0,3**	4,4±0,3*
weight coefficient of ventral part of prostate	1,3±0,1	1,7±0,1*	1,0±0,1*/**	1,6±0,1*
Weight of the secretion of seminal vesicles, mg	610,5±35,0	830,5±51,6*	443,0±81,6**	748,5±63,0

Notes: \*  $P<0,05$  compared with the data of the Control group; \*\*  $P<0,05$  compared with the data of the CP group.

It is known that hemodynamic disorders due to cryotrauma of the prostate, leads to the development of its inflammation and causes similar changes in the seminal vesicles of rats, which is explained by the common trophism and functional unity of the prostate and seminal vesicles [18]. Due to a disturbance of

the drainage function of the seminal vesicles during inflammation, the secretum accumulates in their lumen and pressure increases. This, in turn, contributes to increased ischemia of the wall and activation of inflammation [19]. Thus, the increase of the volume of the secretum of seminal vesicles, which was discovered of males of the CP group, can be an indirect sign of inflammation of the prostate and seminal vesicles. Correction of CP by the composition of NPs led to a change in the size and weight of the ventral part of the prostate and seminal vesicles (due to a decrease in the weight of the secretum), the weight coefficients of which were reduced statistically significantly compared with the data of males of the CP group. The use of reference drug prostatilen was not affect to the studied parameters (Table 1).

It is known that oxides of rare earths in the form of NPs have an anti-inflammatory effect by minimizing the production of reactive oxygen species in the foci of inflammation, and the addition of silver, which has an anti-inflammatory antibacterial effect, together led to a decrease in the inflammatory process [20-22].

In the study of the spermogram, it was found that all parameters increased in rats treated with NP composition, compared with data from animals with CP. Similar data were obtained after treated rats with CP by prostatylen (Table 2).

**Table 2.** – *Parameters of spermograms of rats with chronic prostatitis after correction with nanoparticles,  $\bar{x} \pm S_{\bar{x}}$*

Index	Group			
	Control (n=7)	CP (n=16)	CP+NPs (n=7)	CP+Pr (n=12)
Total concentration, mln/ml	68,4±5,2	40,3±3,9*	63,0±6,7**	52,3±3,4*/**
CN, mln/ml	65,4±4,5	36,1±3,8*	60,0±6,9**	49,1±3,3*/**
Mobility, %	74,6±4,4	45,9±3,5*	63,1±6,6**	66,6±4,6
Pathological forms, %	4,1±0,7	11,2±1,0*	5,4±1,1**	6,4±0,9**

Notes: \* P<0,05 compared with the data of the Control group; \*\* P<0,05 compared with the data of the CP group; CN concentration of morphologically normal cells.

Pathological changes in the composition of seminal plasma, which consists of 40-60 % of prostate secretion, lead to a deterioration in the fertilizing ability of ejaculate. In this case, the violation of prostate function, which occurs during its inflammation, inevitably leads to changes in sperm parameters, and hence to a decrease in reproductive function [23].

## Conclusion

The use of the NPs  $\text{LaVO}_4:\text{Eu}^{3+}$  and NPsAg composition has a distinct ability to inhibit the development of the systemic inflammatory process, has a positive effect on the prostate gland damaged by cryotrauma, restoring its functions and improving the spermogram of rats.

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水性介质水力空化作用下环烷烃的化学转化  
**CHEMICAL TRANSFORMATIONS OF CYCLOALKANES UNDER  
HYDRODYNAMIC CAVITATION ACTION OF AQUEOUS MEDIA**

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抽象。以环己烷为例，研究了水力空化作用下水和水-酸性环境中脂环烃的化学转化。根据气相色谱法和带质谱检测的气相色谱法的结果，发现环己烷反应的主要产物是分子量比正癸烷，苯及其烷基衍生物，萘和萘高和低的正烷烃。缩合多核芳香化合物。已经发现向反应混合物中添加质子酸抑制了正构烷烃的形成。无论其引发机理（自由基还是离子）的性质如何，反应的主要产物都是缩合多核芳香族化合物。酸催化增强了它们的形成过程。

关键词：机械化学，声波分解，空化，环烷烃，烷烃，气液色谱法，质谱

**Abstract.** *On the example of cyclohexane, the chemical transformations of alicyclic hydrocarbons in an aqueous and water-acidic environment under hydrodynamic cavitation are studied. Based on the results of gas chromatography and gas chromatography with mass spectral detection, it was found that the main products of cyclohexane reactions are n-alkanes with a higher and lower molecular weight compared to n-decane, benzene and its alkyl derivatives, naphthalene and condensed polynuclear aromatic compounds. It has been found that the addition of protonic acid to the reaction mixture suppresses the formation of n-alkanes. The main products of the reaction, regardless of the nature of the mechanism (radical*

*or ionic) of their initiation, are condensed polynuclear aromatic compounds. Acid catalysis enhances the processes of their formation.*

**Keywords:** *mechanochemistry, sonolysis, cavitation, cycloalkanes, alkanes, gas-liquid chromatography, mass spectroscopy*

### **Introduction**

The high capital costs of technological design of thermocatalytic processes in petrochemistry make work aimed at the development of alternative oil processing technologies relevant. A promising area of research is the use of methods of mechanochemical destruction of petroleum raw materials [1-6].

It is known that during the mechanochemical management of the process, condensation and destructive processes compete [4-6]. The greatest practical interest is the conduct of mechanochemical activation in water environments under hydrodynamic cavitation action.

Objective: to study the general regularities of chemical transformation of oil cycloalkanes under hydrodynamic cavitation treatment of hydrocarbon in an aqueous emulsion using gas-liquid chromatography with mass detection.

### **Experimental part**

To reduce the proportion of condensation processes and increase the dissociation constant, water was introduced into the reaction system as a dilution medium.

Under the influence of ultrasonic cavitation, the O-H bond in the water molecule was subjected to homolysis with the formation of peroxide compounds, whose free radical state initiates the process of dissociation of alkanes. In order to shift the equilibrium towards the reaction products, cracking was performed under conditions of continuous distillation, similar to distillation with water vapor.

To understand the chemistry of transformations of the main components of oil, the first studies were conducted on model compound - cyclohexane.

To carry out the experiment, a water emulsion of 1800 ml of water and 200 ml of cyclohexane was placed in an A.D. Petrakov's design cavitator and sonicated for 10 minutes.

To suppress the formation of free radical states and stimulate the heterolytic flow of mechanochemical transformations of cycloalkane in a separate experiment, glacial acetic acid was additionally introduced into the reaction mixture, taken in a volume of 1.14 ml.

Qualitative and quantitative composition of n-alkanes in the obtained samples was carried out using the following analytical equipment: PerkinElmer gas chromatograph Clarus 500 with a flame ionization detector. This chromatograph has a capillary analytical column with a length of 30 m, an internal diameter of 0.32 mm and a fixed Elite - 1 phase (film thickness of 0.25 microns).

Conditions of gas chromatography with a flame ionization detector analysis: programming the temperature of the thermostat of the columns from 40 ° C, thermostating for 5 minutes, then heating at a rate of 5 ° C/min to 310 ° C and holding the final temperature - 10 minutes. Carrier gas - nitrogen. The temperature of the injector (sample injection unit) is 220 ° C, the detector is 300 ° C. Data collection and processing program - TotalChrom.

Identification of n-alkanes peaks was carried out according to the relative retention times and yield sequence of homologues on the chromatogram relative to the standard of n-dodecane and isoprenoids - pristan and phytane. The percent hydrocarbon content of the total weight of paraffins was determined using an external standard method based on calibration schedules. The peak area was calculated with respect to the sum of the areas of all peaks on a total ion current chromatogram.

Other reaction products were determined using a gas chromatograph Clarus 500/Turbomass-Gold with mass detection on a chromato-mass spectrometer, equipped with a capillary column of 30 m × 0.25 mm × 0.25 μm with methylphenylsilicone elastomer MS-5.

For effective separation of organic substances on the analytical column used, the following conditions were selected: programming the temperature of the column thermostat from 40°C, thermostating for 5 minutes, heating up to 310°C with a speed of 5 deg / min, holding the final temperature – 20 min. The carrier gas is helium. The temperature of the injector is 220°C, the electron source is 190°C, and the transfer line is 300°C. Registration of mass spectra at an electron energy of 70 eV, mass scanning range 41-450 m/z, spectrum scanning time 0.2 s, delay between scanning - 0.05 s. The internal calibration standard acenaften-D10 in chloroform in the amount of 0.912 micrograms was introduced into each analyzed sample.

Identification of organic compounds was performed by processing the spectra by relative retention times and by reconstructing the chromatogram of the total ion current by characteristic ions.

After detecting the peak of the identified component, the original chromatogram was reconstructed by determining its mass spectrum and all its characteristic fragment ions. The mass spectra of the components were compared with the NIST 98 mass spectrum catalog (Table 1). If the mass spectra matched by more than 90%, the substance was considered identified. If the match was less than 90%, the most likely group of organic compounds was determined, which included the substance under study.

**Table 1 - Main characteristic ions used for hydrocarbon identification**

Characteristic ions, m/z	The name of the hydrocarbon	Characteristic ions, m/z	The name of the hydrocarbon
55, 69, 83	cycloalkane	155, 156	dimethylnaphthalene
91, 92	n-alkylbenzenes	178	phenanthrene
105, 106	methylalkylbenzene	191, 192	methylphenanthrene
128	naphthalene	202	pyrene, fluoranthene
141, 142	methylnaphthalene	228	chrysene,benzanthracene

### Results and discussion

The resulting exposure products were studied by the method of gas-liquid chromatography and gas chromatography – mass spectrometry (Tables 2, 3).

**Table 2 - Content of n-alkanes in cyclohexane subjected to mechanochemical action, according to gas-liquid chromatography**

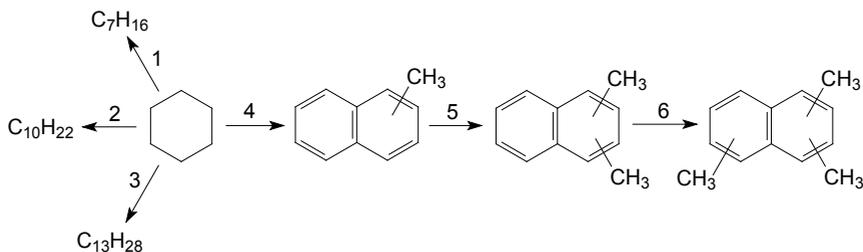
N-alkanes	Content, % mass.		N-alkanes	Content, % mass.	
	without CH <sub>3</sub> COOH	with CH <sub>3</sub> COOH		without CH <sub>3</sub> COOH	with CH <sub>3</sub> COOH
C5	-	0.0003	C20	0.0013	0.0002
C6	0.0010	-	C21	0.0011	0.0002
C7	0.3253	0.1508	C22	0.0013	0.0003
C8	0.0090	0.0356	C23	0.0008	0.0002
C9	0.0165	-	C24	0.0007	0.0002
C10	8.1226	0.1775	C25	0.0071	0.0002
C11	0.0101	0.0003	C26	0.0006	0.0002
C12	0.0042	0.0003	C27	0.0005	0.0001
C13	0.0644	0.0074	C28	0,0010	0,0002
C14	0.0337	0.0033	C29	0,0005	0,0001
C15	0.0112	0.0005	C30	0,0006	0,0001
C16	0.0071	0.0004	C31	0,0002	-
C17	0.0036	0.0003	C32	0,0003	-
Pristan	0.0028	0.0002	C33	0,0001	-
C18	0.0027	0.0003	C34	-	-
Phytan	0.0017	0.0001	Total	8,6349	0,3796
C19	0.0024	0.0003			

**Table 3** - Content of main hydrocarbon classes in cyclohexane after ultrasonic exposure of aqueous media, according to gas-liquid chromatography with mass detector

Main classes of hydrocarbons	Mass content, %	
	without CH <sub>3</sub> COOH	with CH <sub>3</sub> COOH
Monocyclic hydrocarbons	0.03295	0.11065
Aromatic hydrocarbon	0.40846	1.89199
Dicyclic hydrocarbons	0.02430	0.10087
Polycyclic hydrocarbons	88.78490	98.59140
Cycloalkane	0.03295	0.11065

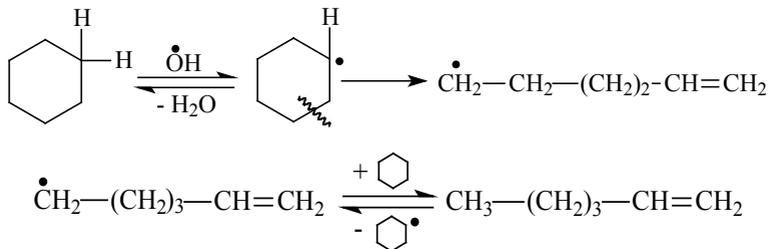
### Chemical transformations of hydrocarbon under conditions of bond homolysis (without acid)

The composition of the product mixture is shown in Tables 2, 3. The main regularities of chemical transformations of cyclohexane are summarized in the form of a reaction scheme (Figure 1).



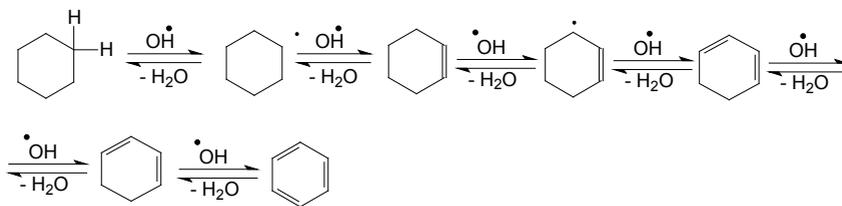
**Figure 1** - Diagram of basic cyclohexane transformations

According to the scheme presented, cyclohexane conversions can be divided into two groups of interconnected reactions: cycle destruction and dehydrocyclization. The destruction of naphthene occurs by breaking the C-C bond of the cycle (Figure 2) described for thermal cracking processes in [7].



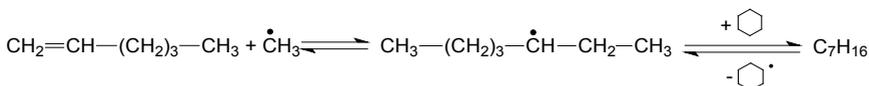
**Figure 2** - Scheme of homolysis of the carbon-carbon bond of cycloalkane

The second group of reactions is associated with the dehydrogenation of cyclohexane to the benzene molecule. Since the ultrasonic treatment process is carried out in an aqueous medium, the presence of hydroxyl radicals [8], transferring free radical states to arenes molecules formed during the dehydrogenation of cyclohexane, is not excluded (Figure 3).



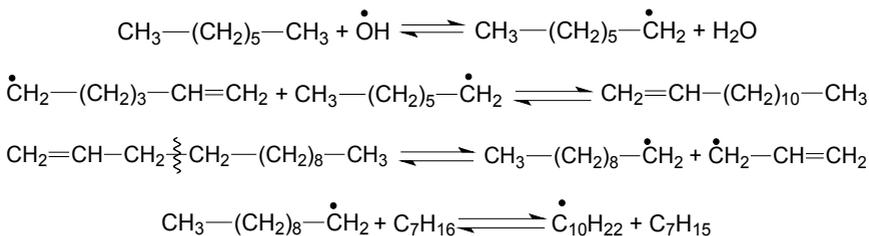
**Figure 3** - Scheme of cycloalkane dehydrogenation

The accumulation of alkenes is accompanied by their further transformation to form hydrocarbons with both higher and lower molecular weight. Thus, hexene-1, formed as a result of radical chain decay, is capable of joining lower radicals by a double bond. Reactions of addition of alkanes with a longer hydrocarbon chain are not excluded, which leads to the growth of the main chain (Figure 4).



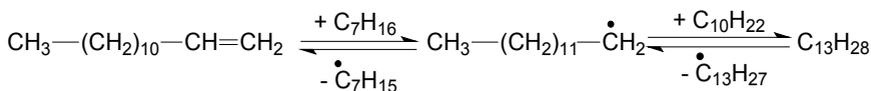
**Figure 4** - Free radical alkylation scheme of alkenes

The increased content of n-decane in the reaction products can be explained by the following elementary reactions (Figure 5).



**Figure 5** - Scheme of higher molecular weight alkanes formation at mechanochemical impact

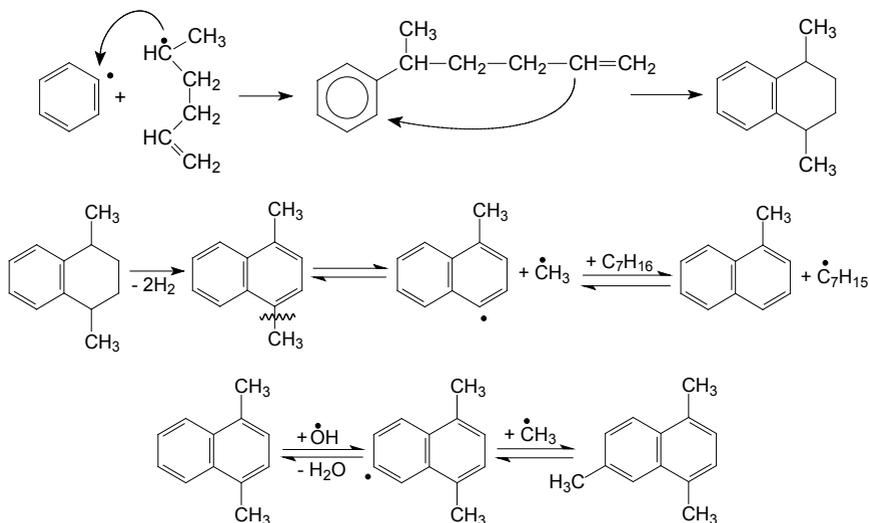
Similarly, tridecan is formed (Figure 6):



**Figure 6** - Scheme of tridecane formation by alkylation of alkenes at mechanochemical impact

The increased concentration of tridecane is due to the fact that the substances obtained in the above two reaction schemes are used as a raw material for its conversion (Figures 4, 5).

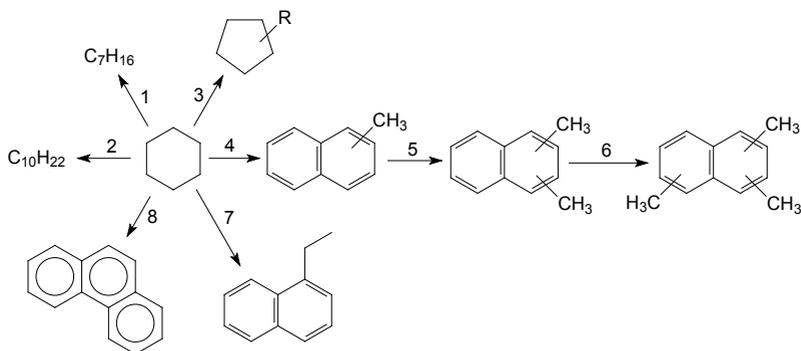
Along with benzene (Figure 1), polynuclear arenes and their alkyl derivatives are formed from cyclohexane (direction 5-7, Figure 1). Their formation can be explained by the following sequence of transformations (Figure 7):



**Figure 7** - Scheme of formation of poly-nuclear arenes under mechanochemical impact

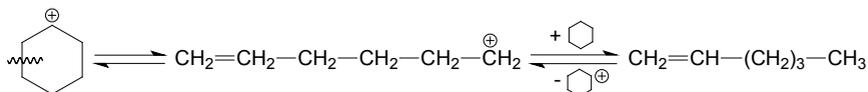
### Chemical transformations of oil cyclohexane under conditions of ultrasonic action of aqueous-acidic media

The main conversions of cyclohexane under conditions of ultrasonic treatment of the system in the presence of acetic acid proceed in the direction of dehydrogenation of the cyclic structure to form aromatic hydrocarbons of the polynuclear structure (Table 2, 3). Such transformations will adversely affect the yield of light hydrocarbon fractions from oil. The analysis of experimental data allows us to graphically describe the process of mechanochemical transformations in an acidic medium in a generalized reaction scheme (Figure 8).



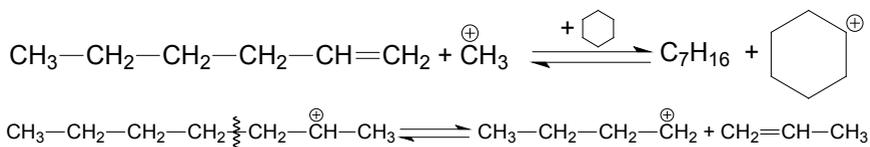
**Figure 8** - Scheme of the main transformations of cyclohexane in an aqueous-acidic medium under mechanochemical action

The authors suggest that the mechanoinitiation process involves heterolytic break of the C-H bond and the formation of carbocation. Further transformations are associated with splitting along the  $\beta$ -C-C bond relative to the position of the charge in the cyclic structure (Figure 9):



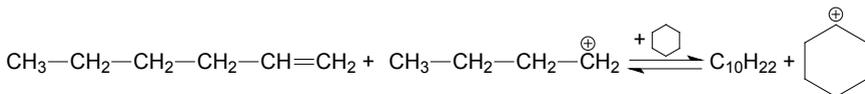
**Figure 9** - Scheme of alicyclic alkene formation under mechanochemical action

The resulting olefin, being unsaturated, binds the lower carbocation by double bond (Figure 10) to form normal structure alkanes (see Figure 8, direction 1):



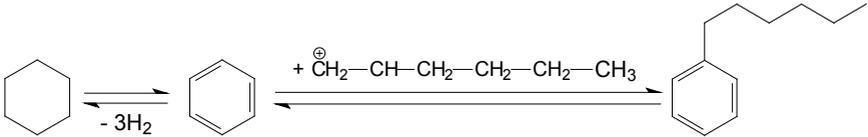
**Figure 10** - Scheme of formation of alkanes of normal structure of lower molecular weight under mechanochemical impact

The implementation of the transformation in direction 2 (see Figure 8) is related to chain elongation and dimer formation (Figure 11):



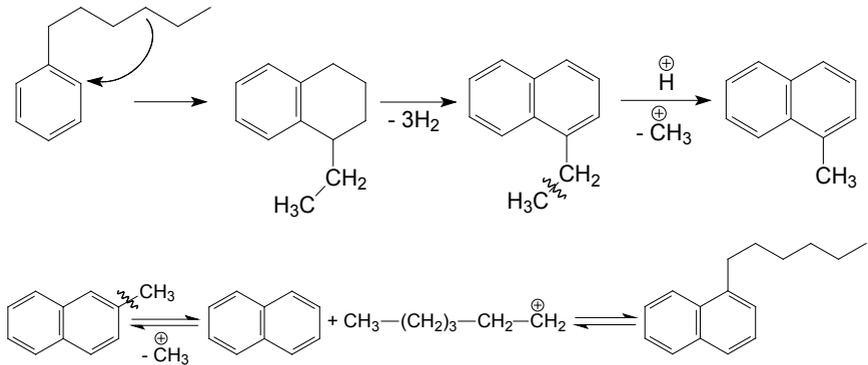
**Figure 11** - Scheme of formation of alkanes of normal structure with higher molecular weight at mechanochemical impact

In addition to the decomposition reactions, there are dehydrogenation reactions of cyclohexane to the benzene molecule. Subsequent alkylation of the aromatic structure allows conversion in direction 4 (see Figure 8) of alkyl substituted arenes (Figure 12):



**Figure 12 - Scheme of formation of alkyl substituted arenes**

The mechanism of dehydrocyclization of alkylbenzene having an alkyl group with a number of carbon atoms of four or more into alkyl derivatives of naphthalene is explained by conversions in direction 4-7 (see Figure 8). Dehydrocyclization of the long chain alkyl fragment results in the formation of naphthalene and its alkyl derivatives (Figure 13):



**Figure 13 - Scheme of formation of polynuclear arenes**

Further dehydrocyclization leads to ring build-up, and subsequently to the formation of resinous substances.

### CONCLUSION

1) Hydrodynamic cavitation effect on water-hydrocarbon emulsions contributes to the intensive flow of cycloalkanes dehydrogenation processes, with the collection of mono- and polynuclear arenes and their derivatives.

2) The acidic reaction of the medium suppresses the formation of alicyclic alkanes of a normal structure.

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铵盐在低度各种中央磷酸基磷酸酯生产偶氮过磷酸酯中的作用  
**EFFECT OF AMMONIUM SALTS IN THE PRODUCTION OF  
AZOSUPERPHOSPHATE FROM LOW VARIOUS, CENTRAL  
KYZYLKUM PHOSPHARITS**

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摘要。 本报告介绍了用硫酸铵浓溶液活化低品位亚磷酸盐矿石的结果。 结果表明, 用硫酸铵溶液处理矿化质量导致磷酸盐原料中可同化形式 $P_2O_5$ 的含量急剧增加。

关键词:低品位磷酸盐,硫酸铵溶液,脱碳,分解

**Abstract.** *This report sets out the results of the activation of low-grade phosphorite ore with concentrated solutions of ammonium sulfate. It was shown that treatment of the mineralized mass with a solution of ammonium sulfate leads to a sharp increase in the content of the assimilable form of  $P_2O_5$  in phosphate raw materials.*

**Keywords:** *low-grade phosphorites, ammonium sulfate solution, decarbonization, decomposition.*

### **Introduction**

Decree of the President of the Republic of Uzbekistan dated February 7, 2017 № PF 4947 "On the strategy of further development of the Republic of Uzbekistan" and the Decree of the President of the Republic of Uzbekistan dated April 3, 2019 "On measures to further reform the chemical industry and increase its investment attractiveness" -4265; In order to fully provide the republic's agriculture with nitrogen, phosphorus and potassium fertilizers in the agro-technical terms of their use, in 2019-2020, the enterprises of JSC "Uzkimyosanoat" have developed measures to increase production of nitrogen and phosphorus mineral fertilizers [1,2].

Phosphorus fertilizers based on phosphates in the Central Kyzylkum basin are produced in the country. Currently, the amount of phosphorus fertilizers produced is too low to provide phosphorus fertilizers to agricultural lands.

Lack of phosphorus nutrients in the cultivation of agricultural crops reduces the drought tolerance, growth and productivity of plants. Therefore, the production of phosphorus fertilizers with satisfactory brand properties is one of the main problems of today in order to increase the amount of phosphorus reserves in the soil.

It is known that the main constituents of phosphorites are water-insoluble secondary

salts. Therefore, the plant can hardly absorb phosphorus from them, only in acidic soil conditions. The production, transportation and application of softened (or mechanically activated) phosphorite flour in agriculture is not cost-effective, and given that the commercial properties of phosphoric fertilizers processed with sulfuric acid are not resistant to environmental influences, its marketable properties creates the need to create a competitive technology for obtaining phosphorus fertilizers.

One of the rational ways to obtain high-quality azosuperphosphate by processing phosphate rock raw material with sulfuric acid is to implement it in the presence of ammonium sulfate [3]. The presence of carbonate mineral-calcite in Central Kyzylkum phosphorites in three forms, ie "ecdocalcite", "enzocalcite" and phosphate minerals in the structural rings of carbonate ions ( $\text{CO}_2$ ) in isoamorphic binding allows this raw material to decompose easily and quickly under the influence of mineral acids and salts [4.5].

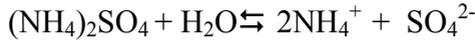
Therefore, taking into account the above problems, the processes of processing various enriched phosphates, in the presence of ammonium sulfate, with sulfuric acid to create a technology for obtaining nitrogen-phosphorus fertilizers that meet agricultural requirements were studied.

### **Review methodology**

The experimental processes were mainly enriched, unenriched, phosphate flour with  $\text{P}_2\text{O}_5$ -16.53%, CaO-44.93% and  $\text{SO}_2$ -15.20%, in the presence of ammonium sulfate with nitrogen content of N-20.58%, 92.5 % concentration is based on the decomposition of sulfuric acid at different rates (100, 80 and 60).

The improvement of the decomposition coefficient of phosphates and granularity in the composition of fertilizers in the processing of phosphorites with sulfuric acid in the presence of ammonium sulfate can be explained on the basis of a complex decomposition mechanism of phosphorite minerals. Ammonium sulfate in sulfuric acid neutralizes free phosphoric acid formed in the system, along with the decomposition of phosphate minerals. This eliminates the neutralization phase in the acid treatment of phosphorites.

Also, ammonium sulfate dissociates in water to form an acidic environment in solution.



The resulting acid ions react primarily with the calcite (exocalcite) mineral. In the next stage, the diffusion process is accelerated by the penetration of sulfate ions into the minerals fluorocarbonatapatite and endocalcite [6].

The resulting reaction mass is moistened to the required volume, granulated in a plate granulator under laboratory conditions and then dried to a constant mass. Finished sample products are analyzed according to the normative documents [7,8,9].

**Analyses and results**

We used basically 3 experiments to carry out the experimental processes; In the first (Experiment 1) experimental sample, phosphorite flour was decomposed with sulfuric acid and the resulting mass was added in the granulation process  $(\text{NH}_4)_2\text{SO}_4$ -ammonium sulfate in the specified amounts, in the subsequent (Experiment 2) decomposition process the raw materials were phosphate and  $(\text{NH}_4)_2\text{SO}_4$ -The pulp was prepared by adding ammonium sulfate and then decomposed using sulfuric acid. Also in the experiments, to determine the optimal conditions for the action of ammonium sulfate in the process of obtaining azosuperphosphate, its determined amounts were dissolved in  $\text{H}_2\text{SO}_4$ -sulfuric acid and the resulting solutions were used in the decomposition process, product samples were taken (Experiment 3). The raw materials initially selected for Experiment 1, ie phosphorite flour, were decomposed at different rates of sulfuric acid (100, 80, 60) and in the process of granulation of the resulting masses, according to the amount of phosphate flour (5%,10%,15%,20%) ammonium sulfate was added (Table 1).

The resulting finished product samples were analyzed on the basis of normative documents, (State Standards) GOST: 20851,2-75, the content of plant-soluble and water-soluble parts of  $\text{P}_2\text{O}_5$ , 2% citric acid [7,8,9] and the data in Table 1 below.

**Table-1.** The content of samples with the addition of ammonium sulfate in the process of granulation of unenriched phosphate rock with sulfuric acid %

№	The number of content	Amount $(\text{NH}_4)_2\text{SO}_4$	$\text{P}_2\text{O}_5$ , (in %-)		$\frac{\text{P}_2\text{O}_{5\text{ass}}}{\text{P}_2\text{O}_{5\text{gen}}}$
			$\text{P}_2\text{O}_{5\text{gen}}$	$\text{P}_2\text{O}_{5\text{ass}}$	
$\text{H}_2\text{SO}_4$ - standard=100					
1	1- content	5	10,74	9,13	85,02
2	2- content	10	10,31	8,97	86,98
3	3- content	15	9,96	8,75	87,88
4	4- content	20	8,62	7,06	88,80

H <sub>2</sub> SO <sub>4</sub> - standard=80					
5	1- content	5	11,46	7,57	66,09
6	2- content	10	11,00	7,38	67,11
7	3- content	15	10,60	7,31	69,01
8	4- content	20	10,01	6,99	69,90
H <sub>2</sub> SO <sub>4</sub> - standard=60					
9	1- content	5	12,30	5,29	43,00
10	2- content	10	11,74	5,17	44,03
11	3- content	15	11,50	5,22	45,42
12	4- content	20	10,64	4,97	46,74

After the decomposition of phosphorite flour to 100% sulfuric acid, the addition of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>-ammonium sulfate salt (5-15%) in the granulation process, the total amount of P<sub>2</sub>O<sub>5</sub> in the fertilizer was 10.74-8.62%, respectively. An increase in plant assimilation form of phosphorus and grain strength of fertilizer was observed from 85.02% to 88.80%. When the phosphoric acid content of phosphorite increases (60-100%) and the total amount of P<sub>2</sub>O<sub>5</sub> in the fertilizer ranges from 10.64-12.30% to 8.62-10.74%, the parts that can be properly absorbed by plants are 43.00-46.74 % to 85.02-88.80%.

For the next experimental process, 4 compositions were selected and the compositions were prepared in ascending order of ammonium sulphate content respectively; Ingredient 1 was added 5% ammonium sulphate in proportion to phosphate, ammonium sulphate in 10% of phosphorite flour, ammonium sulphate in 15% of phosphate 3 and ammonium sulphate in 20% of phosphate flour. The prepared ingredients were decomposed at different rates of sulfuric acid with a concentration of 92.5% (100, 80, 60).

The resulting finished product samples were analyzed on the basis of normative documents, GOST: 20851,2-75, the content of plant-soluble and water-soluble parts of P<sub>2</sub>O<sub>5</sub>, 2% citric acid [7,8,9] and the data in Table 2 below

**Table-2.** Unenriched phospharite pulp prepared by adding ammonium sulfate to it, plant-assimilated and water-soluble parts of P<sub>2</sub>O<sub>5</sub> in the samples formed during decomposition, %

№	The number of content	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	P <sub>2</sub> O <sub>5</sub> , (in-%)		$\frac{P_2O_{5ass}}{P_2O_{5gen}}$
			P <sub>2</sub> O <sub>5gen</sub>	P <sub>2</sub> O <sub>5ass</sub>	
H <sub>2</sub> SO <sub>4</sub> - standard=100					
1	1- content	5	10,74	9,79	91,14
2	2- content	10	10,31	9,49	92,06
3	3- content	15	9,96	9,31	93,46
4	4- content	20	8,62	8,12	94,15

H <sub>2</sub> SO <sub>4</sub> - standard=80					
5	1- content	5	11,46	7,93	69,20
6	2- content	10	11,00	7,73	70,30
7	3- content	15	10,60	7,58	71,53
8	4- content	20	10,01	7,21	72,05
H <sub>2</sub> SO <sub>4</sub> - standard=60					
9	1- content	5	12,30	5,57	45,26
10	2- content	10	11,74	5,40	46,02
11	3- content	15	11,50	5,47	47,55
12	4- content	20	10,64	5,09	47,91

Initially, phosphorite flour (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> was mixed with 2SO<sub>4</sub>-ammonium sulfate salt (5-15%) and the composition of decomposed fertilizers at 100% sulfuric acid was studied. The total content of P<sub>2</sub>O<sub>5</sub> in the fertilizer was 10.74-8.62%. From 91.14% to 94.15%, an increase in the plant assimilation form of phosphorus and the grain strength of the fertilizer was observed. During the decomposition of phosphorite, the amount of sulfuric acid (60-100%) increases, and the total amount of P<sub>2</sub>O<sub>5</sub> in the fertilizer increases from 10.64-12.30%, to 8.62-10.74% from 47.91% to 91.14-94.15%.

In our next experiment, the specified amounts of ammonium sulfate were based on the use of solutions (5%, 10%, 15%, and 20%) dissolved in H<sub>2</sub>SO<sub>4</sub>-sulfuric acid with a concentration of 92.5% in the decomposition process. The percentage of solutions used in the decomposition process is shown in Table 3 below.

**Table 3.** The composition of sulfuric ammonium sulfate acid solutions obtained at a temperature of 20° C

№	Solution composition	Solution composition, mass.%		
		H <sub>2</sub> SO <sub>4</sub>	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> O
1	1- content	88,57	4,76	6,67
2	2- content	84,56	9,09	6,35
3	3- content	80,87	13,04	6,09
4	4- content	77,50	16,67	5,83

The increase in the decomposition coefficient of phosphate minerals under the action of ammonium sulfate can be expressed as follows. The concentration of sulfate ions increases due to the ammonium sulfate salt introduced by the acid solution. In the CaO-P<sub>2</sub>O<sub>5</sub>-H<sub>2</sub>O system, sulfate ions form free H<sub>3</sub>PO<sub>4</sub> as a result of the decomposition of phosphates. Phosphoric acid, on the other hand, is involved in the decomposition reaction of unaffected phosphorite. Ammonium sulphate leads to the formation of crystals of calcium sulphate in large form. Reducing the internal resistance of large-scale calcium sulfate components facilitates the entry of hydrogen ions into the surface of phosphate grains. Due to the three different

forms of carbonates in the Kyzylkum phosphorites, the decomposition of raw materials is accelerated under the influence of ammonium sulfate.

Product samples obtained as a result of the experiment were analyzed on the basis of normative documents, and the data in Table 4 below were obtained.

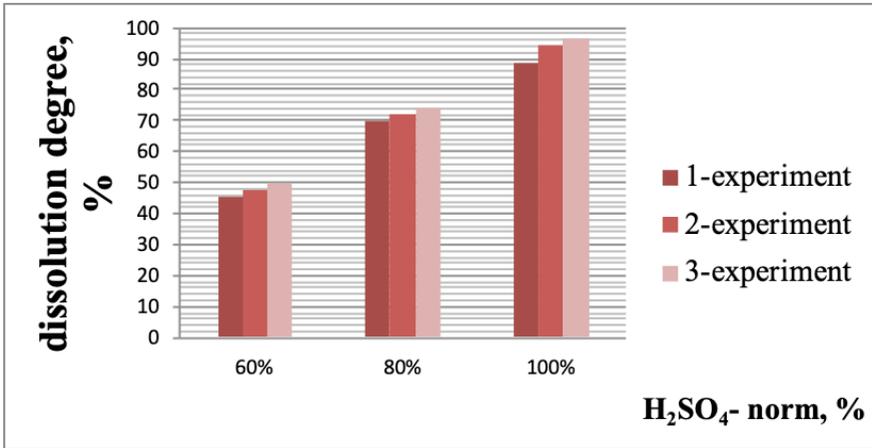
**Table - 4.** The composition of samples decomposed on the basis of different percentage solutions of ammonium sulfate-sulfuric acid in unenriched phosphate rock %

№	Solution in $H_2SO_4$ $(NH_4)_2SO_4$ – share, %	pH begin.	$P_2O_5$ , (in-%)		pH end.	N %	$\frac{P_2O_{5ass}}{P_2O_{5gen}}$
			$P_2O_{5gen}$	$P_2O_{5ass}$			
$H_2SO_4$ - standard=100							
1	5	3,8	10,74	9,56	7,2	0,47	89,10
2	10	3,6	10,31	9,41	7,1	0,95	91,30
3	15	3,4	9,96	9,31	7,0	1,42	93,52
4	20	3,2	8,62	8,29	6,8	1,90	96,13
$H_2SO_4$ - standard=80							
5	5	3,8	11,46	8,03	7,2	0,40	70,10
6	10	3,6	11,00	7,78	7,1	0,80	70,71
7	15	3,4	10,60	7,65	7,0	1,21	72,17
8	20	3,2	10,01	7,43	6,8	1,61	74,20
$H_2SO_4$ - standard=60							
9	5	3,8	12,30	5,65	7,2	0,32	45,90
10	10	3,6	11,74	5,49	7,1	0,64	46,80
11	15	3,4	11,50	4,98	7,0	0,96	48,32
12	20	3,2	10,97	5,50	6,8	1,28	50,12

According to the results of Table 4, as a result of decomposition by solution of ammonium sulfate-sulfuric acid (with 5-20%), when studying the composition of fertilizers, the total amount of  $P_2O_5$  in the fertilizer was 10.74-8.62%, respectively, from 89.10% to 96.13%, an increase in plant assimilation form of phosphorus and grain strength of fertilizer was observed. When the rate of phosphorite-ammonium sulfate-sulfuric acid solution is increased (60-100%), the total amount of  $P_2O_5$  in the fertilizer is from 10.64-12.30%, from 8.62 to 10.74%. Led to a change from 90-50.12% to 89.10-96.13%.

**Conclusion.** In the above experiments, we examined the effect of ammonium salts  $(NH_4)_2SO_4$  - ammonium sulfate on the decomposition of low-grade Central Kyzylkum phosphorites.

If we compare the experimental processes with a high degree of decomposition, ie the maximum value of the ammonium sulfate salt - 20% and the rate of sulfuric acid - 100%, we get a graphical picture, as shown in Figure 1 below.



*Figure 1.  $(NH_4)_2SO_4$  - degree of decomposition of experimental samples with a content of 20%.*

The graph and the results show that the decomposition process does not make much difference in the experiments. However, in the analysis of experimental samples 1 and 2, the amount of nitrogen in the samples of experimental products was not evenly distributed between the granules, and the process of mixing ammonium sulfate in the crystalline state with the phosphorite mass required a lot of energy.

The use of ammonium sulfate crystals in the process of dissolution in sulfuric acid has been shown to be a more efficient method.

The improvement in the grain content of the fertilizer obtained with an increase in the amount of ammonium sulfate in the acid can be explained as follows. In the process of processing the raw material, ammonium sulfate containing sulfuric acid binds small pieces. Phosphate particles form a thin layer on the surface, increasing the mechanical strength of the product. During the formation of grains, the gaps between ammonium sulfate and phosphates are filled with liquid, resulting in the compaction of small particles into large grains.

We see that the decomposition rate of phosphate raw materials under the action of ammonium sulfate sulfuric acid is on average 1.2 times higher when compared to their performance in sulfuric acid. Acid consumption is saved by 20-40%. The addition of ammonium sulfate to the complex phosphorus fertilizer increases the amount of nutrients and improves its brand properties..

Low-grade Kyzylkum phosphorites decompose in ammonium sulfate in sulfuric acid, favorable conditions for obtaining granular NP complex phosphorus fertilizers:

- Ammonium sulfate solution of sulfuric acid with a concentration of 92.5% and the composition of this solution are appropriate:

sulfuric acid 77.50%;

ammonium sulfate 16.67%;

water 5.83%;

- decomposition process time - 10-15 minutes has been proven on the basis of scientific studies.

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激光二极管棒退化加速建模  
**MODELING OF LASER DIODE BAR DEGRADATION  
ACCELERATION**

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通过建立简化的半导体激光二极管热模型, 得出有源区缺陷加速因子与注入电流, 占空比, 散热器温度之间的关系。对有源区缺陷加速的主要影响是占空比和散热器温度参数。平均故障时间值可以通过加速老化测试来评估, 其运行参数值应超过额定值。获得的加速因子值可用于短时间评估激光二极管条的平均故障时间。

关键词: 激光二极管棒, 加速老化试验, 有源区结构退化加速因子。

**Abstract.** *By means of developed simplified thermal model of semiconductor laser diode bar relations between active region defect acceleration factor and injection current, duty cycle, temperature of heatsink were obtained. The major effect on active region defect acceleration has duty cycle and heatsink temperature parameters. Mean time to failure value can be evaluated with accelerated aging tests with setting operating parameter value over nominal. Obtained acceleration factor values can be used for short time evaluation of laser diode bar mean time to failure.*

**Keywords:** *laser diode bar, accelerated aging test, active region structure degradation acceleration factor.*

Laser diode bars (LDB), integrated linear arrays of laser diodes, are widely spread semiconductor laser components used for pumping solid-state lasers, in medicine, material treatment and scientific research [1]. One of major parameters of any semiconductor laser is its lifetime. For modern near infrared range (NIR)

wavelength spectrum LDB of quasi-continuous wave (QCW) operating regime mean time to failure lays in range of 10000...20000 hours or about  $10^9$  pulses and it depends on repetition frequency of pulses [2]. Methods of accelerated aging tests are critical for batch manufacturing. They are based on acceleration of defect growth appeared during manufacturing of LDB [3]. Main aim of that research was to evaluate how electrical and operating parameters of LDB accelerate degradation of LDB structure.

There are 3 mechanisms of LDB failure – rapid, catastrophic and gradual. The reason of catastrophic failure is catastrophic optical mirror damage (COMD) [4] that depends on optical power density on output mirror facet and its temperature. Rapid and gradual failures appear as dark-line defect and dark-spot defect. These defects are based on growth of dislocation count in active region. Initial number of dislocations depends on quality of epitaxial growth of heterostructure and wafer, mechanical stress appeared during mesa forming [3]. It is well known that degradation growth is proportional to temperature of active region and can be evaluated by Arrhenius equation: [5]:

$$R = R_0 \cdot \exp\left\{-\frac{E_a}{k \cdot T_{AR}}\right\}, \quad (1)$$

$R$  – rate constant;  $R_0$  – pre-exponential factor, a constant for each chemical reaction;  $E_a$  – is the activation energy for the reaction, eV;  $k$  – universal gas constant, eV/K;  $T_{AR}$  – absolute temperature of active region, K.

$E_a$  value lays in range of 0,3 ... 1,1 eV for semiconductor AlGaAs/GaAs heterostructure lasers [3]. Equation (1) can be modified for evaluating semiconductor laser mean time to failure (MTTF):

$$t_{MTTF} = A \cdot \exp\left\{-\frac{E_a}{k T_{AR}}\right\}, \quad (2)$$

$t_{MTTF}$  – MTTF, hours;  $A$  – factor for chemical reaction type.

Factor of structure degradation acceleration  $K_{acc}$  determines relation between MTTF and temperature [5]:

$$K_{acc} = \frac{t_{MTTF1}}{t_{MTTF2}} = \exp\left\{\frac{E_a}{k} \cdot \left(\frac{1}{T_{AR1} + P_{th1} + R_{th1}} - \frac{1}{T_{AR2} + P_{th2} + R_{th2}}\right)\right\}, \quad (3)$$

$t_{MTTF1}$  and  $t_{MTTF2}$  – MTTF for active region temperatures  $T_{AR1}$  and  $T_{AR2}$ , hours;  $P_{th1}$  and  $P_{th2}$  – thermal powers dissipated in active region, W;  $R_{th1}$  and  $R_{th2}$  – thermal resistance of active region – heatsink junction, K/W.

Thermal resistance for multilayer structure can be considered as sum of each layer thermal resistance:

$$R_{th} = \sum R_{th i} = \sum \frac{t_i}{\lambda_i \cdot s_i}, \quad (4)$$

$l_i$  – layer thickness, m;  $\lambda_i$  – layer thermal conductivity, W/(m·K);  $s_i$  – layer cross section area, m<sup>2</sup>.

For evaluating how electrical and operating parameters of LDB working regime affect  $K_{acc}$  simplified three-dimensional model of LLD in CS mount type package (figure 1). Geometry of active element was replaced by one GaAs bar where all heat dissipates. Thermostating was realized on bottom of CS mount. Dimensions and thermal conductivity values are placed in table 1.

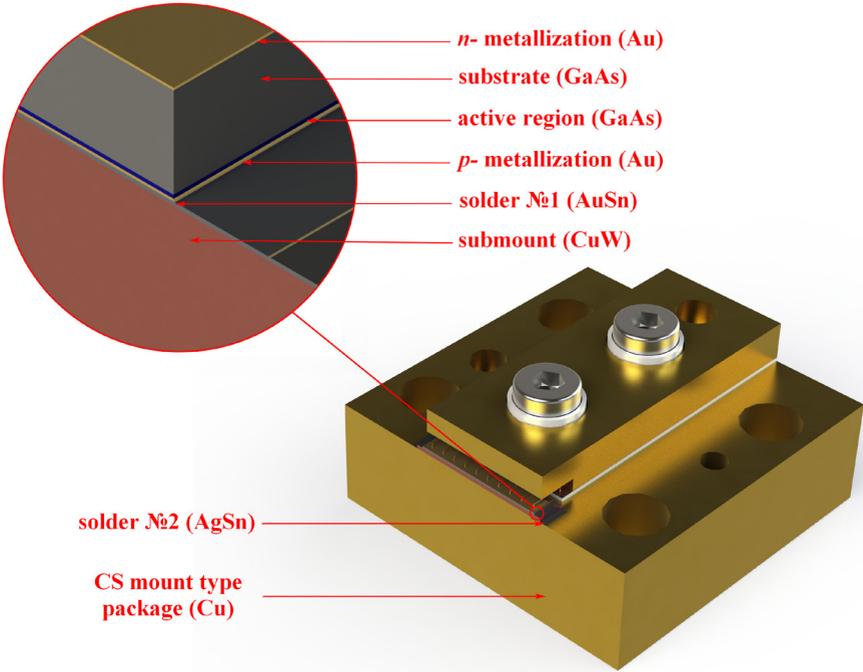


Figure 1. LDB three-dimensional model

Table 1.  
Parameter values of main layers in simplified thermal LDB model

Layer	Material	$l_i$ , mm	$s_i$ , mm <sup>2</sup>	$\lambda_i$ , W/(m·K)
active region	GaAs	0.005	15	46
p-metallization	Au	0.003	15	300
solder №1	AuSn	0.005	16.5	57
submount	CuW	0.3	22	185
solder №2	AgSn	0.005	24	56

QCW operating regime and also heat dissipation were replaced by average value calculated with considering QCW duty cycle.

$$\overline{P_{th}} = DC \cdot (I_{LDB} \cdot V_{LDB} - P_{opt}), \quad (5)$$

$\overline{P_{th}}$  – average value of dissipated heat, W; DC – duty cycle,  $I_{LDB}$  – pulsed value of LDB injection current, A;  $V_{LDB}$  – voltage drop on LDB during injection current pulse, V;  $P_{opt}$  – optical pulse power, W.

Optical power in QCW regime can be calculated from equation (6):

$$P_{opt} = \eta_{slo} \cdot \exp\left\{-\frac{T_{hs}}{T_1}\right\} \cdot (I_{LDB} - I_{thr0} \cdot \exp\left\{\frac{T_{hs}}{T_0}\right\}), \quad (6)$$

$\eta_{slo}$  – slope efficiency at 0 K temperature, W/A;  $T_{hs}$  – heat sink temperature, K;  $T_1$  – characteristic temperature for slope efficiency, K;  $I_{thr0}$  – threshold current at 0 K temperature, A;  $T_0$  – characteristic temperature for threshold current, K.

Voltage drop on LDB can be calculated from equation (7):

$$V_{LDB} = V_{thr} + R_s(T_{hs}) \cdot (I_{LDB} - I_{thr0} \cdot \exp\left\{\frac{T_{hs}}{T_0}\right\}), \quad (7)$$

$V_{thr}$  – forward voltage drop on ideal p-n junction, V;  $R_s$  – series resistance, Ohm.

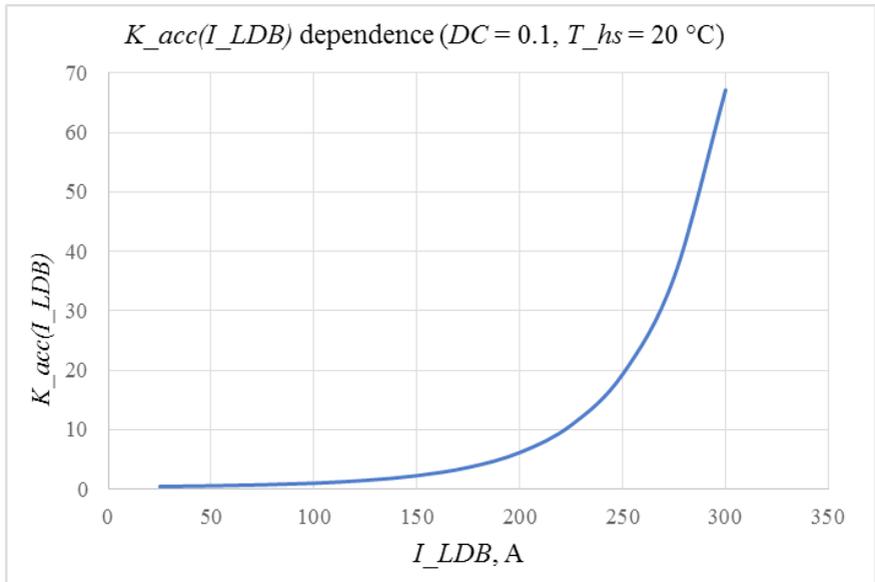


Figure 2.  $K_{acc}(I_{LDB})$  graph

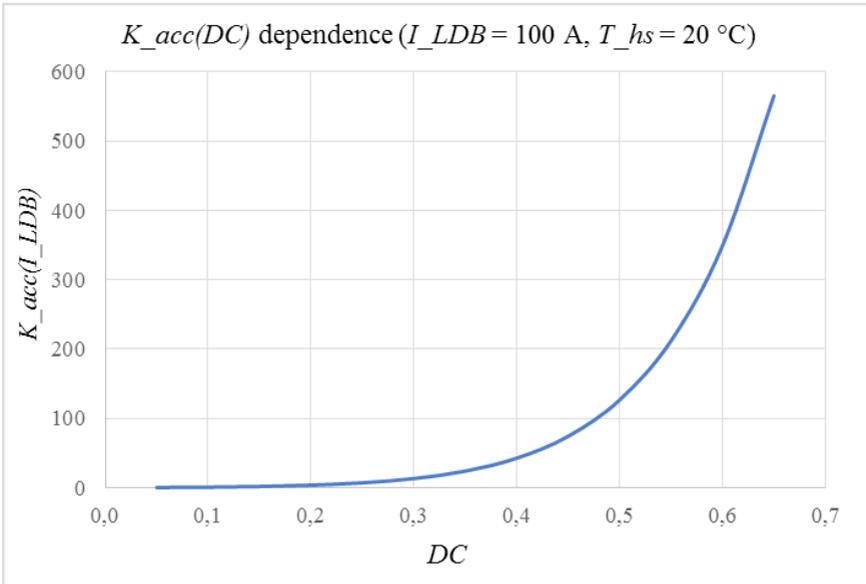


Figure 3.  $K_{acc}(DC)$  graph

Typical values of parameters in equations (5-7) for high power semiconductor AlGaAs/GaAs lasers was taken for modeling [3, 6–8].

By means of modeling relations between active region defect acceleration factor  $K_{acc}$  and several operating parameters of LDB (injection current, duty cycle, heatsink temperature) were obtained (figures 2-4). Nominal set of LDB operation parameters ( $K_{acc} = 1$ ) were adopted as follows:  $I_{LDB} = 100$  A,  $DC = 0.1$ ,  $T_{hs} = 20$  °C. The maximum factor of structure degradation acceleration value was obtained from heatsink temperature, achieved acceleration is about 5-6 thousand times. In real operation it is difficult to ensure the temperature of thermostabilized heatsink above 100 °C, so in this case the contribution of the heatsink temperature to factor of structure degradation is approximately equal to the contribution of the duty cycle – estimated value of the active region defect acceleration factor is not less than 500 times in both cases.

By means of developed simplified thermal model of semiconductor laser diode bar relations between active region defect acceleration factor and injection current, duty cycle, temperature of heatsink were obtained. The major effect on active region defect acceleration has duty cycle and heatsink temperature parameters, the calculated value of the acceleration factor reached 500 times. Mean time to failure value can be evaluated with accelerated aging tests with setting operating parameter value over nominal.

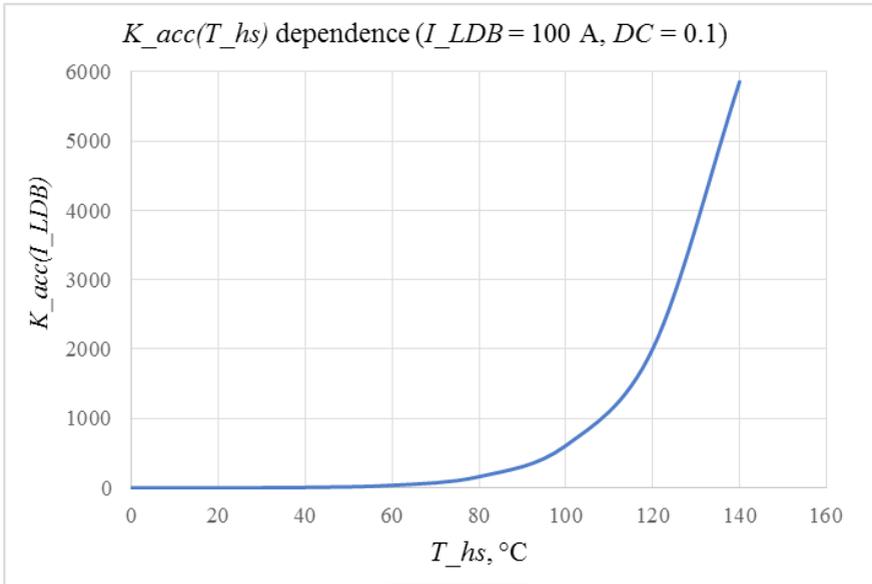


Figure 4.  $K_{acc}(T_{hs})$  graph

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监控道路结构中热状况的变化  
**MONITORING OF CHANGES IN THE THERMAL REGIME IN THE  
ROAD STRUCTURE**

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抽象。描述了在冻结期间高速公路和街道的道路结构中发生的过程，并考虑到了冬季的含量水平，得出了铺装层温度变化的结果。

研究了温度变化影响下季节性冻土中的水分迁移过程，并分析了在自然和气候条件下对道路结构中发生的过程进行建模的现有方法。

关键词：水热状态，道路建设，季节性冻结，冻结带，水分源，水分迁移，温度传感器。

**Abstract.** *The processes occurring in the road structures of highways and streets during the period of freezing are described, the results of temperature changes in the layers of pavement, taking into account the level of winter content, are obtained.*

*Moisture migration processes in seasonally freezing soils under the influence of temperature changes are examined and existing methods for modeling processes occurring in the road structure under the influence of natural and climatic conditions are analyzed.*

**Keywords:** *water-thermal regime, road construction, seasonal freezing, freezing zone, moisture sources, moisture migration, temperature sensors.*

The level of development and the technical condition of the road network significantly affect the economic and social development of both the country as a whole and its individual regions. Considerable funds are allocated annually for the construction and repair of roads, however, the service life of pavement remains low. An analysis of the work of pavements in areas with seasonal freezing shows

that during these periods the most damage and deformation occur in the subgrade and construction of pavement, which are the main problem of low quality roads [1].

At present, one of the main problems in the road industry is the insufficient account of the soil-hydrological conditions of the area, which are estimated approximately from topographic maps and old documents or, at best, from the results of reconnaissance surveys [2]. For all this, with an unsuccessfully selected, albeit short, route, it is not always possible to provide the required values of frost resistance and bearing capacity of road structures, since in designing the choice of the route location is the primary condition, and soil and hydrological conditions are only secondary. In particular, groundwater is often located close to the surface of the earth, and underlying soils are excessively heaving, which increases the material consumption of road structures, since embankments of large heights even from natural sands are required [2].

One of the main tasks of ensuring frost resistance and bearing capacity, as well as reducing material consumption, is the priority application of such design and survey work technology, which would include, with a variant route, geometric modeling of the longitudinal profile, which reduces to the appointment of guidelines for soil and hydrological conditions in the base of the embankment.

When solving problems of increasing the pace of road construction and improving the operational reliability of roads, a promising area of activity is the integrated design of the route and roadbed structures based on the use of an integrated spatial terrain model, elements of geology and hydrogeology of the area [2]. This is possible when conducting field studies at stationary observation points in areas with seasonally freezing soils, with the development of regional (local) recommendations for the design and operation of roads.

The study of the laws of the water-thermal regime of road structures is the subject of many works by both domestic and foreign scientists. In our country, close attention to this problem was drawn at the beginning of the last century, and now this issue not only has not lost its relevance, but, on the contrary, due to the increasing level of motorization and the desire to improve the quality of roads, it attracts ever greater attention of researchers. The first attempts to theoretically substantiate the processes of moisture accumulation in seasonally freezing soils were presented back in S.L. Bastmanova, and N.G. Schweikovsky [3]. Also one of the first issues of moisture migration in freezing soils was considered by the Russian scientist V.I. Stukenberg. In his works, he showed that in the absence of groundwater there is a significant accumulation of moisture. The migration of moisture, he believed, is explained by the combined action of molecular adsorption and capillary forces (crystallization forces), which act on the surface of newly emerging crystals [4].

According to the studies of S. Teber, moisture migration occurs only due to crystallization forces. The reason for the influx of moisture to the freezing zone, according to the scientist, is the higher binding energy of water molecules with ice than with soil [4]. A.F. Lebedev, meanwhile, experimentally proved that the influx of film water to the freezing zone also occurs in the absence of ice, for example, in thawed soil, when moisture evaporates from it [5]. He obtained that film water under the action of molecular adsorption forces moves from thicker to thinner films.

The Swiss scientist R. Ruckley, in turn, believed that the cause of moisture migration is the absorption force, which is a constant value. R. Ruckley calculated the degree of frost resistance depending on the distance to the groundwater level. He adopted 2 hypotheses as the basis for determining the influx of moisture [4]:

The suction power of the soil does not depend on temperature gradients.

Darcy's law applies to the movement of moisture in freezing soil.

The rate of moisture inflow to the freezing front R. Ruckley calculated by the formula:

$$V = K_g \cdot \frac{P_s}{P_w \cdot l}, \quad (1)$$

where  $K_g$  - soil permeability;

$P_s$  - suction power;

$P_w$  - specific gravity of water;

$l$  - distance of ice lenses from groundwater level.

This formula (1) can be used when the groundwater level changes to insignificant limits. If the groundwater level is deep, then the rate of water inflow to the freezing border of the soil will tend to zero, i.e. practically absent. If the freezing front reaches the groundwater level, then the water will be sucked in at a too high speed, which does not correspond to the natural conditions of the heaving process. The disadvantage of this theory is that it does not take into account the vaporous moistening of the soil, which is carried out under the influence of temperature gradients.

A.M. Globus, B.V. Deryagin, V.P. Panfilov et al., who established that in the process of freezing soils, an airtight permafrost layer forms under which the process of thermal diffusion migration of liquid and vapor moisture to the freezing boundary takes place also made a significant contribution to the study of the mechanisms of moisture transfer in soils. However, the studies of these scientists were limited to describing the features of the processes under consideration and did not provide for the consideration of the relationships between the parameters of physical phenomena, which limited their use in solving engineering problems [6].

In the works of scientists V.O. Orlov, A.I. Popov, G.M. Feldman, who studied cryogenic processes, moisture migration issues were considered in connection with the formation of ice structures, which allowed them to be used in assessing heaving of clay soils. At the same time, in these works, insufficient attention was paid to the engineering approach to studying the heaving pressure of soils depending on the specific hydrogeological conditions of the area [6].

The study of the properties of the soil of the subgrade of highways in 1924 was performed by Professor G.D. Dubelier [4]. The author studied the water balance of soils and the change in the soil condition of the subgrade depending on the design of the transverse profile of the road, as well as on soil and hydrological conditions [4]. Thanks to these studies, it became possible to define the main processes of the water-thermal regime of the subgrade.

It should be noted that the ongoing G.D. Dubelier studies, despite their significance, had a number of disadvantages, namely: on the experimental section of the highway there was no coverage and car traffic, i.e. operational factors affecting the water and thermal conditions of the subgrade were not taken into account.

Studies of the water-thermal regime of the roadbed of roads was continued by N.A. Puzakov, in 1927-1928 he was developing a methodology for monitoring changes in the water-thermal regime [7]. For several years N.A. Puzakov under the direction of G.D. Dubelier studied the processes occurring in the subgrade, studied its water balance, resistance to the movement of vehicles, the maximum load of dirt roads during the muddy season. Studying by N.A. Puzakov's of water regime made it possible to obtain a picture of the distribution of consistency in the body of the soil bed [8].

Further studies of the water-thermal regime only gained momentum. In 1936, SoyuzDorNII employees under the leadership of scientists A. Ya. Tulaev and N.V. Ornatsky, in order to study the temperature regime, as well as the processes of movement and accumulation of moisture in the subgrade, organized stationary observations on Karelian, Leningrad, Kashirskaya. Gorky, Kiev and Far Eastern Depth Research Stations [9]. The station's program of work included year-round observations of weather, the distribution of humidity and temperature along the depth and transverse profile of the canvas, the level of groundwater, the depth of freezing and thawing at permanent posts. The monthly leveling determined the magnitude of the vertical displacement of the pavement. The regularities established at these stations became the initial stage of research into the issue of building a stable subgrade and formed the basis for the development of an engineering theory of design of anti-flood measures [9]. The result of the work of A. Ya. Tulaev was the beginning of the development of measures to drain the subgrade. The result of the analysis of the work of various drainage funnels, transverse tubular drains, longitudinal drainage ditches, pipe filters was the proposal of the most

effective drainage structures, taking into account various climatic and soil-hydrological conditions [10].

Research results under the guidance of scientists N.V. Tulaev and N.V. Ornatsky and research N.N. Ivanov and M.Ya. Telegin on compaction of embankments was laid in 1938 as the basis for technical conditions for the construction of roads. In these specifications, it was prescribed that the strength and stability of the subgrade should be ensured under any temperature and humidity conditions that change during the year [4].

Soviet scientists M.P. Kudryavtsev, according to the results of a study of the water-thermal regime of the subgrade, proposed a table of leading elevations of the subgrade edge above the ground. These studies do not have a scientific methodology for determining the elevation of the edge of the subgrade, but this was the first attempt to give recommendations on the designation of the height of the embankment [11].

Systematic field and laboratory observations made with the participation of road scientists G.D. Dubelier, N.V. Ornatsky, N.A. Puzakov, A. Ya. Tulaev allowed during the 30s of the last century to develop engineering solutions to ensure the strength and stability of roads [3]. The results of research conducted by DorNII in the 30s and 40s of the last century were reflected in the works of N.V. Ornatsky, L.A. Preferenceva, V.M. Bezruk, N.A. Puzakov, N.T. Schweikovsky and entered the collection "Regulation of the water regime of road bases", which was released in 1946 under the editorship of Professor N.N. Ivanov [4]. This collection was an analysis of all the work performed at stations, and also contained generalizations on the water-thermal regime of the subgrade and its regulation.

A number of studies of M.N. Goldstein, who proposed the theory of hydration heaving [12]. In addition, on the basis of experimental studies, he showed that when humidity is equal to or close to the lower limit of plasticity, ice does not occur, soil moisture does not increase. At higher soil moisture, approximately equal to the lower plasticity limit of  $+1/4$  of the plasticity number, only a small amount of water passes into the ice lenses [4].

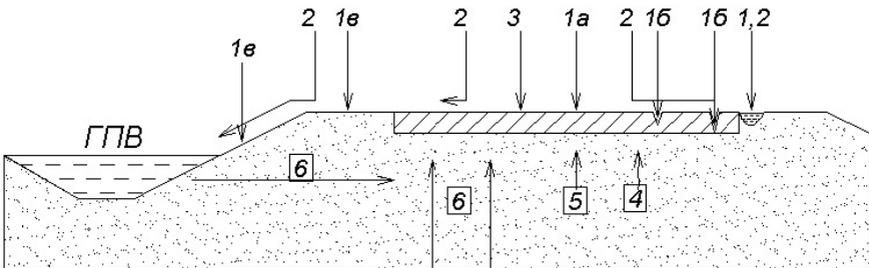
In 1947, Professor A.K. Birul put forward a proposal on the need to study the stability of the subgrade in various environmental conditions of the USSR and the development of regional technical conditions [5]. Under the leadership of A.K. Birul studied the general laws of the water-thermal regime and soil stability of the canvas in the steppe zone. Experimental studies conducted by scientists A.K. Birulem, I.A. Nasic, S.G. Golovanenko, V.M. Sidenko [5] found that the most intense soil moisture of the subgrade from the ditches takes the first 5-10 days, and, as the scientist believed, moisture from the ditches almost does not affect the moisture of the subgrade. Research led by A.K. Birul began the active study of the water-thermal regime and the stability of the subgrade in other parts of the country.

The purpose of the observations was, using the previously obtained generalized regularities of the water-thermal regime, to study the quantitative changes in humidity depending on various natural conditions of the area, for example, such as climate, soil type, nature of the wetting of the area in the most adverse hydrological conditions. As objects of observation, roads with improved and capital types of pavements were considered. Posts were established both in deliberately unstable sections and, to compare, in stable ones [9].

Substantial benefits were made by V.M. Sidenko, who in 1953, on the basis of the Kharkov Automobile and Road Institute, began a study of the water-thermal regime of pavement and roadbed, considering them to be a complex clothing-canvas design [5]. He developed the theory of moisture accumulation in the upper part of the subgrade and the dynamics of moisture in the soil foundations of road pavements in the steppe regions. In addition, he found that soil moisture should be considered as the main indicator in the designation of the estimated soil strength.

To analyze the movement and accumulation of water V.M. Sidenko put forward the principle of differentiated research, according to which the water-thermal regime of pavement and roadbed is classified into 4 design types - diffuse, film, capillary and infiltration. He put the following distinguishing features in the basis of classification [5]:

1. Sources of humidification (see Fig. 1).
2. The degree of permeability of pavement (the presence or absence of cracks in the pavement, and in the clothing of waterproof layers).
3. The distribution of humidity along the depth of the road structure during periods of the year that are unfavorable for moisture.
4. The interval of seasonal fluctuations in humidity, and, consequently, the deformability of the soil.



**Figure 1** - Sources of humidification of pavement and subgrade according to V.M. Sidenko: External: 1 – moisturizing precipitation; 1a – pavement cover; 1b – layers of pavement and a soil base through cracks; 1c – ground of roadsides and slopes; 2 - surface runoff; 3 – atmospheric water vapor; Internal: 4 – water vapor of pore air; 5 – film water; 6 – free water

Currently, there are a number of methods for modeling the processes occurring in the road structure under the influence of climatic conditions. The processes taking place in the subgrade of roads are most fully reflected in the works of professors I.A. Zolotar, N.A. Puzakov, V.I. Ruvinsky, V.M. Sidenko et al. [3]. Most of the methods considered are based on the crystallization-film hypothesis of moisture migration, while the potential theory of molecular mass transfer in a consolidated ground mass is considered basic [9].

One of the main methods for calculating the water-thermal regime of the subgrade that sufficiently accurately meets the calculation requirements is calculation theory of N.A. Puzakov. According to this method, the action of “absorption forces” is taken as the calculated equivalent of the total effect of migration forces [9].

Depending on the sources of humidification, there are 3 calculation schemes:

1. Dry areas with a provided surface water runoff, deep groundwater table and low rainfall.
2. Areas with sufficient rainfall and with difficult runoff of surface water. Moisture accumulation occurs due to the movement of film and capillary-suspended water.
3. Areas with close groundwater table.

This method allows you to determine the depth of distribution of negative temperature in the soil.

The depth of propagation of negative temperature in the soil is carried out according to a parabolic law and can be expressed by the formula [13]:

$$H_t = \sqrt{2 \cdot \alpha_0 \cdot t_z}, \quad (2)$$

where  $\alpha_0$  - coefficient depending on the temperature and climatic conditions of the area,  $\text{cm}^2/\text{day}$  (see Fig. 2).

$t_z$  - freezing duration, days

According to some researchers, the disadvantages of the method of N.A. Puzakova are the following observations [9]:

1. Scientists Ananyan A.A. and A.Ya. Tulaev calls into question the fact of the presence of a critical freezing depth  $z_{\text{cr}}$ , referring to the fact that in accordance with the principle of equilibrium according to N.A. Tsytoovich, the process of migration and ice formation occurs throughout the thickness of the freezing soil.

2. The thermodynamics of the phase transitions of water and the conductive and convective nature of heat transfer in layered road structures are not taken into account.

The rate of influx of water into the freezing zone is described by the formula [13]:

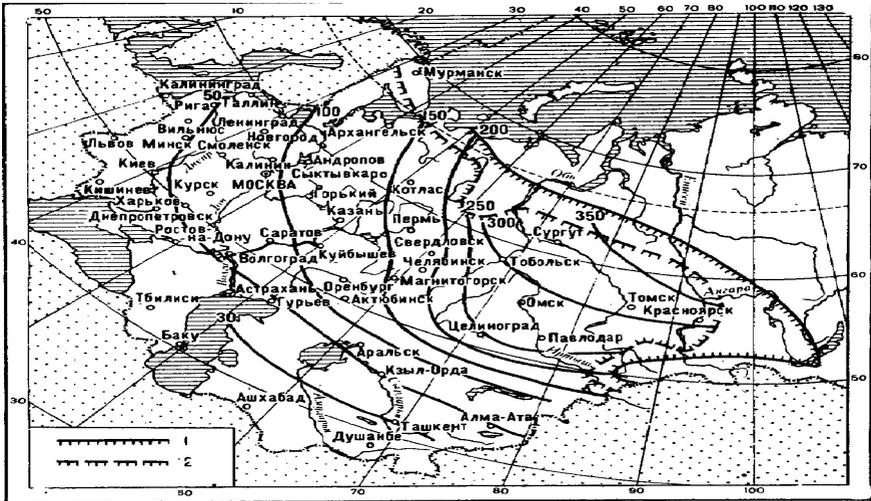


Figure 2 - Map of isolines of climate parameter  $a_0$

$$V = \frac{2K \cdot (W_K - W_0)}{H - z}, \tag{3}$$

where  $K$  - coefficient of capillary moisture conductivity of the soil,  $cm^2/day$ ;  
 $W_K$  - capillary moisture capacity of the soil, in fractions of the volume;  
 $W_0$  - maximum molecular moisture capacity, fractions of volume.

This formula (3) reflects the process of moisture movement only at a freezing depth of a smaller depth of groundwater. In the case  $z = H$  the moisture migration rate is infinitely large. Therefore, this formula is applicable only for  $z = 0,75H$ . For the case  $z = H$ , the prominent scientist M. B. Korsunsky developed an empirical formula [14]:

$$V = \frac{2K \cdot (W_K - W_0)}{0,125 \cdot H \cdot \exp 2,8 \cdot (1 - \frac{z}{H})}, \tag{4}$$

If in the method of calculating the water-thermal regime of N.A. Puzakov freezing boundary is described by the parabola equation, then in the calculation method of I.A. Zolotar, where the moisture migration rate depends on the mode of freezing soil, the freezing rate is described by a linear or parabolic dependence [9].

In the case when the freezing boundary is described linearly, then according to I.A. Zolotar, the rate of moisture migration to the freezing zone will be described by the formula [15]:

$$V_{mu\epsilon} = \frac{\rho_{ck}}{\rho_g} (W_0 - W_x) \cdot F \cdot V_x, \quad (5)$$

where  $\rho_{ck}$ ,  $\rho_g$  - skeleton density of soil and water, t/m<sup>3</sup>;

$W_0$  - initial soil moisture, fractions of volume;

$W_x$  - soil moisture at the freezing border, fractions of the volume;

$F$  - area under the isotherm curve, cm<sup>2</sup>;

$V_x$  - freezing rate, cm/day;

If freezing proceeds according to a parabolic law, then the formula will take the form [15]:

$$V_{mu\epsilon} = \frac{\rho_{ck}}{\rho_g} \sqrt{\frac{\alpha_m}{\pi \cdot \tau}} (W_0 - W_x) \cdot F \cdot V_x, \quad (6)$$

With the depth of freezing of the soil of the subgrade, it is necessary to take into account the freezing rate of the road structure, according to the formula

$$z = \frac{\alpha}{2 \cdot \sqrt{\alpha_m}},$$

where  $\alpha_m$  - coefficient of potential conductivity with the film nature of moisture transfer;

$\alpha$  - freezing rate characteristic of the structure.

Calculation method of I.A. Zolotar is more applicable for predicting the water-thermal regime in the areas of permafrost soils, since it considers moisture migration only as a one-dimensional process with monotonously freezing soil half-space.

Prominent Russian scientist V.M. Sidenko proposed his own methodology for calculating the thermal regime of a road structure [5]:

1. Preparation of the initial data: determine the thickness of the layers of the pavement  $h$ , bulk weights  $\gamma$ , the coefficients of thermal conductivity  $\lambda$  and heat capacity  $C$ , average air temperatures  $t_g$  for a certain period  $\Delta T$ , wind speed  $V$ , soil temperature  $t_{sp}$ .

2. Definition of initial conditions.

3. At the initial time, it is determined by direct observation or calculation of temperature in various planes of the road structure  $t_{1,T} \text{ K } t_{m,T}$

4. Temperature calculation:

- each layer of the road structure is divided into  $m$  parts;
- the numbering of the planes is from bottom to top, combining the zero plane with the ground plane with temperature  $t_{sp}$ .
- the maximum temperature  $\Delta T_{max}$  of each plane are determined, the smallest of the values obtained is taken as the calculated value for the entire road structure;

- heat transfer coefficients  $\alpha$  are calculated;

$$\alpha = \alpha_K + \alpha_H, \tag{7}$$

where  $\alpha_K$  - convection;  $\alpha_H$  - radiation.

- the temperature of the road structure at different times is calculated

$$T + n \cdot \Delta T \tag{8}$$

In order to test the existing methodology, field studies were carried out to monitor temperature changes in the road structure at the experimental site located in the II road-climatic zone. Geographical location of the research site: Perm Krai, Perm, Academician Korolev st. 19a (see Fig. 3). The research site is an almost flat (with a minimum slope) asphalt section, on which a well 3 m deep is arranged (Fig. 4).



**Figure 3** – Layout



**Figure 4** – Tube with research site temperature sensors

The tube is buried to the entire depth of the well, with temperature sensors integrated inside the tube, located in 10 cm increments.

Temperature sensors are capable of measuring temperature in the range of -55 ... + 125, the general view of the device and its operation are presented in Figure 5.



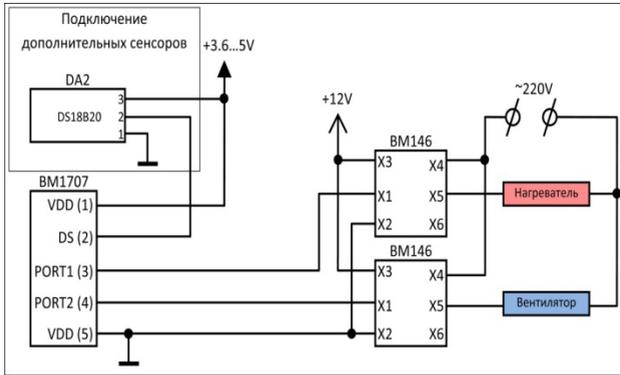


Figure 5 - General look of the device and its operation scheme

The number of temperature sensors was taken equal to 32, while sensor №1 corresponds to the greatest well depth - 3 m, the 32nd sensor is located above the level of asphalt concrete pavement and measures the temperature of the surface air layer (Fig. 6).

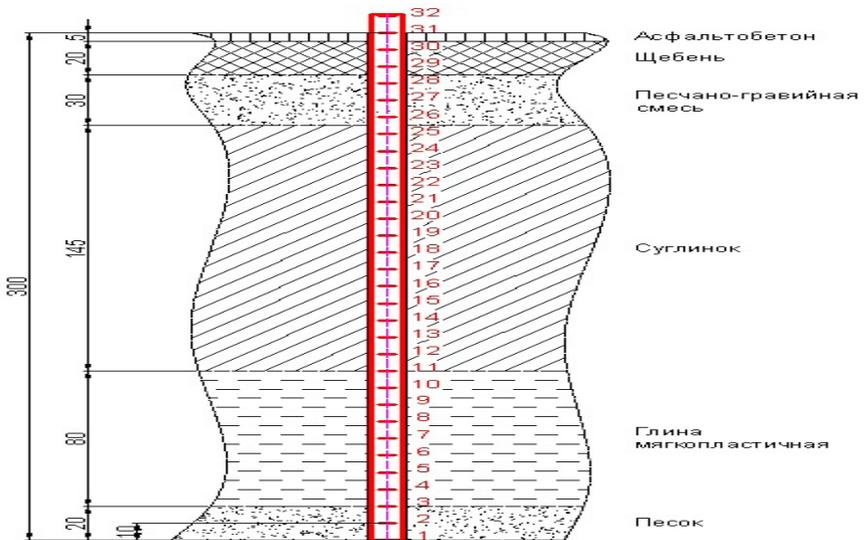


Figure 6 – Arrangement of sensors for measuring temperature in the road structure

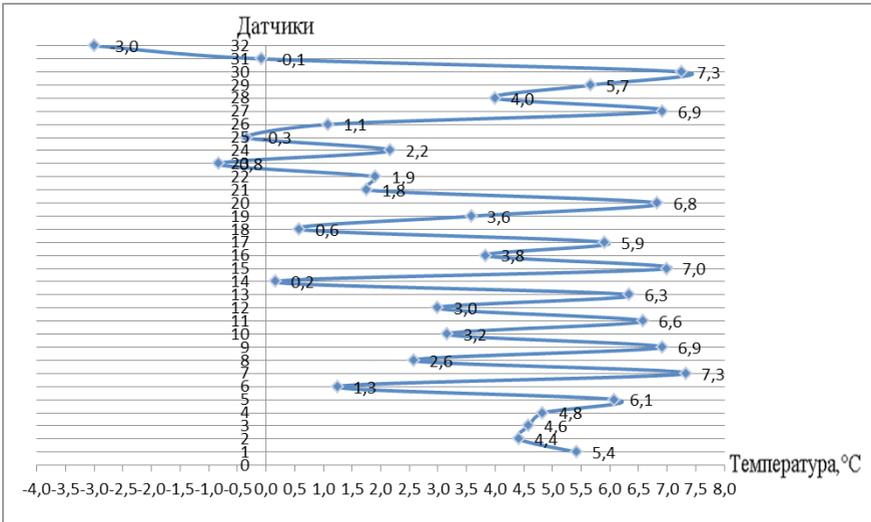


Figure 7– Graph of average temperature in the road structure for the autumn period

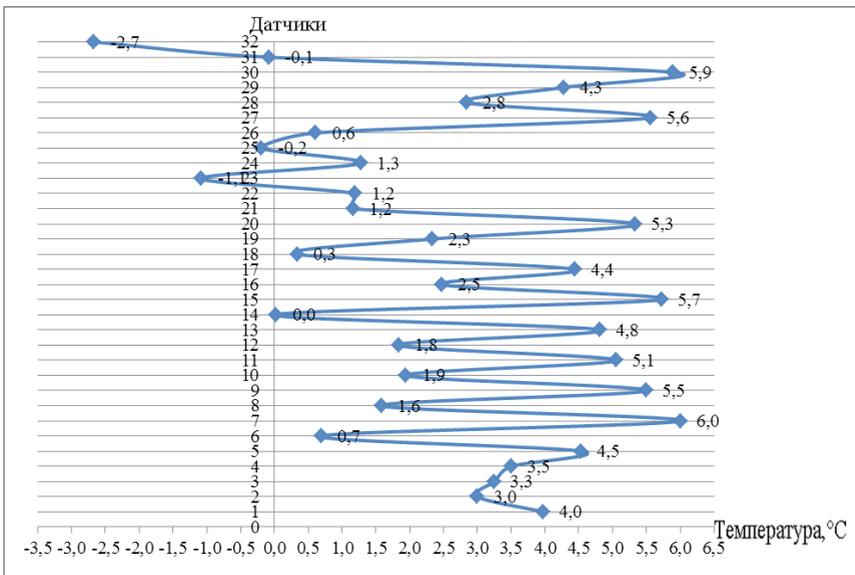
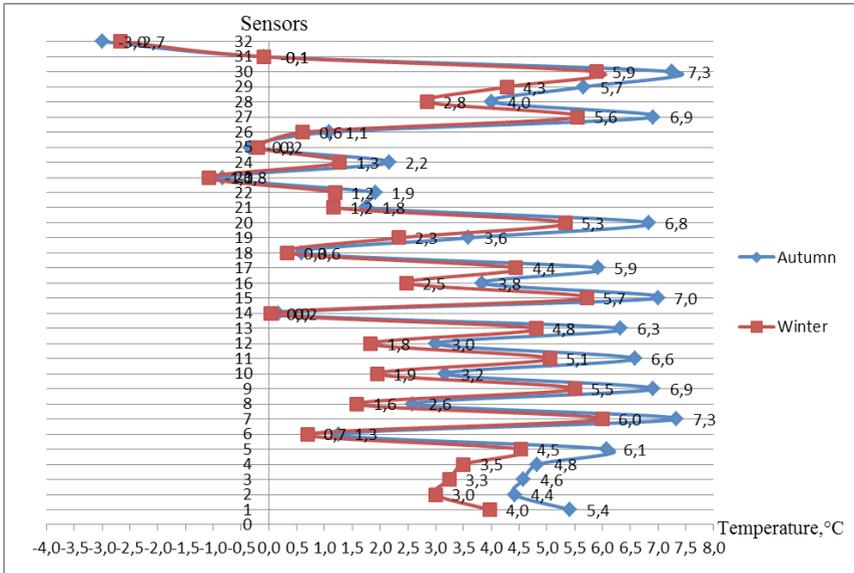


Figure 8 – Graph of average temperature in the road structure for the winter period



**Figure 9** – Graph of temperature changes in the road structure by the seasons of the year

Temperature sensors transmit information to a personal computer, which is connected to the sensors through a wire and a special unit that connects to a personal computer via a USB port. On a personal computer using special software, the received data is saved. The software is the "BM1707.exe" program. Temperature sensors and software for measuring the temperature in the road structure were developed by "Olympus" LLC (Moscow).

As a result of the measurements, graphs were obtained showing the average temperature in the road structure depending on the time of year (Fig. 7.8), and a graph was also plotted of the difference in average temperature in the road structure in the autumn and winter periods (Fig. 9).

Based on the analysis of various methods of accounting for the water-thermal regime and the obtained research results, it was found that there is a different approach to the design of roads to account for the water-thermal regime in road structures. The results obtained from field studies showed that studying the features of the water-thermal regime of road structures is an important, but at the same time time-consuming task, the solution of which is possible only under the condition of close interaction, both scientists and design engineers and builders.

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记录聚氯乙烯成型中的松弛特性  
**RECORDING OF RELAXATION CHARACTERISTICS  
IN MOLDING OF POLYVINYL CHLORIDE**

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抽象。 本文介绍了影响产品成型过程以达到各种目的的聚合物的基本物理和化学特性，以及在各种温度和应变下聚氯乙烯的松弛曲线。

关键词： 聚合物， 聚氯乙烯， 成型， 松弛， 变形。

***Abstract.** the article presents the basic physical and chemical characteristics of polymers affecting the molding process of products for various purposes, the relaxation curves of polyvinyl chloride in a wide range of temperatures and strains.*

***Keywords:** polymer, polyvinyl chloride, molding, relaxation, deformation.*

Volumetric products for generally technical and engineering purpose made of polyvinyl chloride (PVC) have been widely used in various fields of the national economy: the automotive industry, aircraft, electrical engineering, etc. Vacuum molding is used in the technological process of plastics processing, which provides high operational strength properties and increases technical characteristics of such volumetric products.

The basis of plastic processing processes are physical and physical-chemical processes of structure formation and molding:

- heating, melting, glass-transition and cooling;
- volume and size changes in case of exposure of temperature and pressure;
- deformation accompanied by the development of plastic (irreversible) and highly elastic deformation and orientation of macromolecular chains;
- relaxation processes;
- formation of supramolecular structure, crystallization of polymers (crystallizing);
- destruction of polymers.

These processes can take place simultaneously and inter connected. During the molding process, the polymer heated by a high temperature, deformation by shear, tension or compression and then cooled. Depending on the parameters of these processes, it is possible significantly change the structure, conformation of macromolecules, as well as physical-mechanical, optical and other characteristics of polymers.

At a certain stage of vacuum forming the most responsible are the relaxation processes occurring in the polymer. This occurs when the cooling of the products proceeds slowly and without pressure, for example, when receiving products by extrusion on worm presses. In this case, there may be a change in the size of the product, the so-called "swelling" of the product, may appear roughness and even bumpiness on the surface of the products, change the shape of the product (elastic turbulence). Swelling of products occurs under the action of normal stresses, the action of which is perpendicular to the direction of flow of the jet. Normal stresses arise due to the tendency of oriented molecules to go into a non-stressed state (Wiesenberger effect).

Surface defects and distortion of the product shape are the result of relaxation of uneven stresses arising from unstable flow, which is not a consequence of flow transformation from laminar to turbulent. Even in conditions far from the turbulent flow in the stream of possible non-uniform strain, which is the consequence of shear deformation. Distortion of the form occurs at significant (critical) shear stresses, when the melt flow slips in certain areas of the forming tool, while the flow becomes irregular, which leads to occurrence of significant inhomogeneous stresses [1].

Thus, it is very important to know the relaxation parameters of a particular polymer in order to obtain the technological parameters of molding plastic products.

This article presents the relaxation curves of polyvinyl chloride obtained at a wide range of temperatures and strains. The tests carried out in the laboratory of polymer materials of INEOS RAS named after A. N. Nesmeyanov, head of the laboratory Professor A. A. Askadsky.

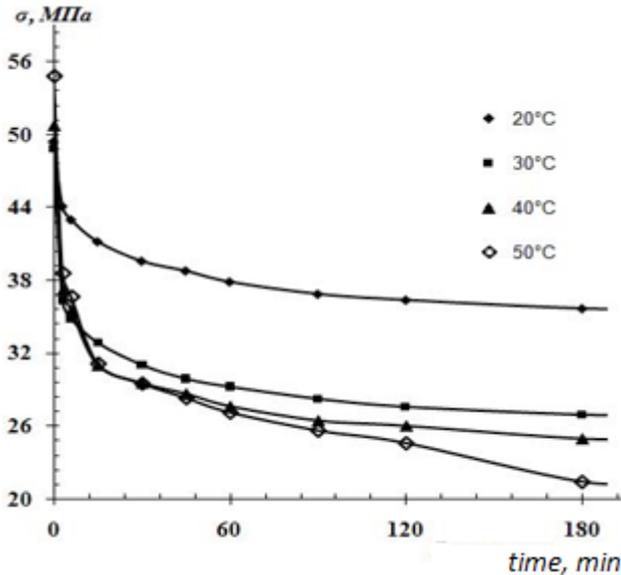
Figure 1 shows PVC stress relaxation curves defined at constant strain at different temperatures. The graph shows that even a small increase in temperature from 20 to 300C is accompanied by a sharp decline in the relaxing voltage, but with a further increase in temperature, the relaxation curves fit into a narrow beam. Only at a temperature of 500C approaching the softening temperature, stress relaxation occurs intensively in the region of long durations of the process.

Calculated values of relaxation processes parameters [2] presented in table 1. The parameter  $\beta$ , associated with the reaction order  $n$  of the interaction of relaxation oscillator, remains approximately the same at all temperatures; the kinetic

constant of the interaction of relaxation oscillator increases with temperature. The correlation coefficient  $r$  pending to 1, and it is always higher when using the T1( $\tau$ ) core than the T2( $\tau$ ) core. The An parameter, associated with the number of non-uniformity in the material has no definite dependence. The value of the initial stress  $\sigma_0$ , determined by calculation, changes little with increasing temperature, and the value of the quasi-equal stress  $\sigma_\infty$ , naturally decreases with temperature increase. The characteristics of the initial  $\sigma_0$  and quasi-equal  $\sigma_\infty$  are the most important characteristics of the relaxation process; they determine the performance of the polymer material.

Figure 2 shows the curves of stress relaxation of PVC in a wide interval of deformation. Such curves make it possible to identify the deformation region in which linear and nonlinear mechanical behavior observed.

As it shown on the figure that the stress relaxation curves naturally shift to the region of high stresses with the growth of deformation, and such a shift occurs smoothly. Modules go sharply down. Thus, nonlinear mechanical behavior starts with very small deformations.



*Fig. 1. PVC stress relaxation curves at different temperatures*

Further, the stress relaxation curves were rearranged as a function of the relaxing module from time (Fig. 3). It can be seen that at deformation of more than 1% the curves of the relaxing module go sharply down. Thus, nonlinear mechanical behavior is observed starting with very small deformations.

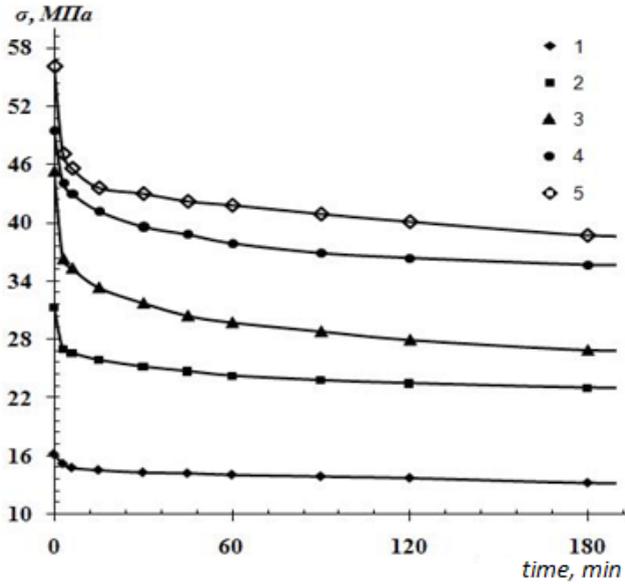


Fig. 2. PVC stress relaxation curves at room temperature determined at different strains (1) – 1%, (2) – 2%, (3) – 2,5%, (4) – 3%, (5) – 3,5%.

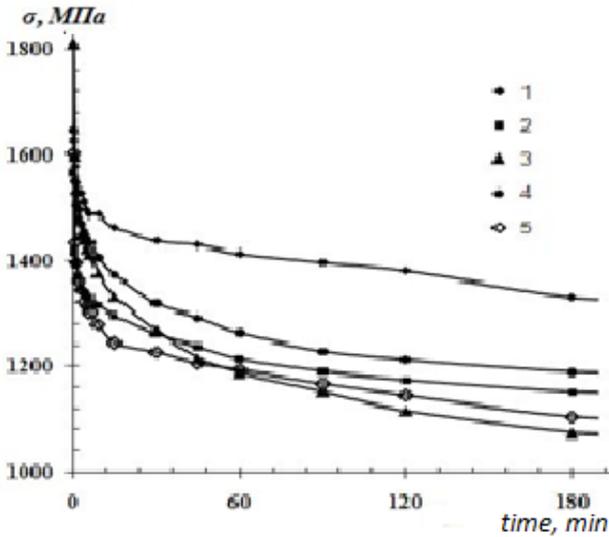


Fig. 3. Correspondence of a relaxing primary PVC module from time, determined by different deformations (1) – 1%, (2) – 2%, (3) – 2,5%, (4) – 3%, (5) – 3,5%.

Two types of stress relaxation curve calculations were performed. According to the first variant, all the stress relaxation curves of the primary PVC were calculated using the Boltzmann-Volterra equation (1).

$$\sigma = \sigma_0 \left[ 1 - \int_0^t T(\tau) d\tau \right]$$

where  $\sigma$  - the relaxing stress,  $\sigma_0$  - the initial stress that develops at the end of the "instantaneous" deformation task,  $T(\tau)$  - the relaxation core,  $\tau$  - the current time, which runs values from 0 to  $t$ ,  $t$  - the final time.

The cores  $T_1(\tau)$  and  $T_2(\tau)$  (2,3) were used [3]

$$T_1(\tau) = -\frac{S_0}{k_B m_1} \left\{ \frac{1}{\left[ \frac{1}{(1+k \tau/\beta)^\beta - \alpha_0} \right] \ln \left[ \frac{1}{(1+k \tau/\beta)^\beta - \alpha_0} \right]} + \left[ 1 - \frac{1}{(1+k \tau/\beta)^\beta + \alpha_0} \right] \ln \left[ 1 - \frac{1}{(1+k \tau/\beta)^\beta + \alpha_0} \right]} \right. \\ \left. \frac{1}{\ln 0.5} \right\} (2) T_2(\tau) = -\frac{S_0}{k_B m_2} \left[ \frac{1}{a\tau^\gamma \ln a\tau^\gamma + (1-a\tau^\gamma) \ln(1-a\tau^\gamma)} - \frac{1}{\ln 0.5} \right] (3)$$

The calculation results are given in table 1. It can be seen that in all cases the correlation coefficient  $r$  when using  $T_1(\tau)$  is higher than the kernel  $T_2(\tau)$ , and approaches 1. The value  $\beta$ , associated with the order of the reaction of the interaction of relaxation oscillators, for all deformations is 0.2, i.e., there is a high order of interaction  $n$ . The interaction kinetic constant does not have a clear dependence on the value of deformation, as well as the value  $A_n$ , characterizing the number of non-homogeneities in the material.

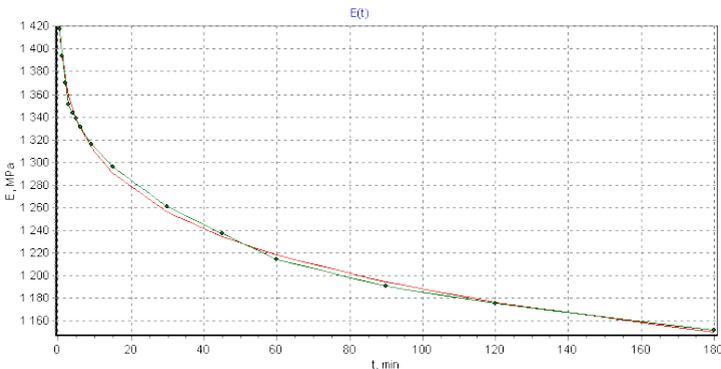
For PVC, according to the studies and the relaxation curves presented above, the nonlinearity of the mechanical behavior occurs, starting with a very small deformation of 2% (Fig. 3). The results of approximation of the relaxation behavior in the nonlinear domain are shown in figure 4 (for deformation of 2%). Since the curve obtained at 2% strain deviates from the curve 1 obtained at 1% strain by more than 5%, the first curve was adopted as the averaged curve, the core parameters  $T_1(\tau)$  are shown in table 2. It should be noted,  $x_{nj}$  for such an "averaged" curve, the correlation coefficient  $r$  is 0.991. For the curve obtained at 2% deformation, the correlation coefficient is 0.999, and the value  $\delta$  is 40 cm<sup>3</sup>/mol (66.4 Å<sup>3</sup> repeating link) (recall that the value  $\delta$  is an excess free volume in which the elementary act of the relaxation process is played out). If we assume that this cavity of excess free volume has a spherical shape, then its size is  $\sim 5,0$  Å<sup>3</sup>.

**Table 1**

*Results of approximation of PVC stress relaxation curves, obtained at different temperatures, deformation 3%*

Temperature	20°C	30°C	40°C	50°C
<b>Core <math>T_1(\tau)</math></b>				
$\beta$	0.3	0.3	0.2	0.3
$k$	0.001	0.01	0.01	0.01
$r$	0.9969	0.9814	0.9871	0.9909
$A_H$	$1.163 \cdot 10^{25}$	$1.101 \cdot 10^{24}$	$1.306 \cdot 10^{24}$	$1.446 \cdot 10^{25}$
$\sigma_o$	58.33	61.95	59.86	66.09
$\sigma_\infty$	31.91	27.31	23.72	15.04
<b>Core <math>T_2(\tau)</math></b>				
$a$	0.0306	0.05	0.05	0.0306
$\gamma$	0.5	0.5	0.5	0.5
$r$	0.9924	0.9504	0.9775	0.9778
$A$	$8.098 \cdot 10^{23}$	$2.605 \cdot 10^{23}$	$2.503 \cdot 10^{23}$	$6.263 \cdot 10^{23}$
$\sigma_o$	46.49	42.87	42.84	43.19
$\sigma_\infty$	35.60	28.04	26.48	22.22
<b>Experimental value</b>				
$\sigma_{HAB}$	49.40	48.82	50.76	54.76
$\sigma_{ROH}$	35.70	26.96	24.97	21.37

The next stage of the calculation was to compare the relaxation curves obtained at deformations of 1, 2 and 2.5% (Fig. 4). The results showed (table. 2) that although the relaxation curve obtained at 2.5% deformation is in the nonlinear domain of mechanical behavior, the excess free volume  $\delta=0$ . In this case, the correlation coefficient  $r = 0.997$ , i.e. close to 1.



**Fig. 4.** Relaxation modulus curves for primary PVC at 2% deformation (points correspond to the experiment, the curve without points is calculated).

**Table 2.**  
*The parameters of approximation of relaxation curves in PVC  
 in the nonlinear domain of mechanical behavior*

$\varepsilon_0, \%$	Parameters	
	r	$\delta, \text{sm}^3/\text{mol}$
1.0	0.999	0
2.0	0.998	40.0
2.5	0.997	0
3.0	0.998	380.7
3.5	0.992	0

In conclusion, it should be told that relaxation are of great practical importance in the processing of polymers, and the processes occurring in this case can be understood and explained only using the theory of relaxation phenomena [1-3].

Practical conclusions can be drawn as follows: for the rapid development of orientation of macromolecules in the process of obtaining fibers and PVC films, it is necessary to increase the shear stress during molding and reduce the cooling time of the melt, so that the process of disorientation does not occur. When forming products by extrusion and injection molding, if it is necessary to reduce the anisotropy of shrinkage and mechanical strength, it is desirable to reduce the viscosity of the melt by increasing the temperature or using polymers with a lower molecular weight. Conversely, when a high anisotropy is needed, the relaxation time should be large, which is achieved by lowering the melt temperature and increasing the viscosity or by rapidly cooling the products.

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关于生产调理硝酸铵添加剂的问题  
**TO THE QUESTION OF PRODUCING CONDITIONING  
AMMONIUM NITRATE ADDITIVES**

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摘要。 已经开发了一种从当地白云石生产硝酸镁(调理添加剂)的技术。 进行计算并制定生产硝酸镁的技术方案, 给出工业试验的数据, 并确定过程的最佳技术参数。 已经确定了每1吨硝酸铵的白云石消费率, 这提供了颗粒所需的强度。

关键词:硝酸铵,白云石,硝酸,硫酸铵,硝酸镁,调理添加剂。

**Abstract.** *A technology has been developed for the production of magnesium nitrate (conditioning additive) from local dolomite. Calculations are made and a technological scheme for the production of magnesium nitrate is developed, data from industrial tests are given, and optimal technological parameters of the processes are identified. The rate of dolomite consumption per 1 ton of ammonium nitrate has been established, which provides the required strength of granules.*

**Keywords:** *ammonium nitrate, dolomite, nitric acid, ammonium sulfate, magnesium nitrate, conditioning additive.*

## Introduction

Ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ) is a universal nitrogen fertilizer containing 34.4% nitrogen. It is produced in granular form. It is soluble in water. It is quickly acquired by plants, can be applied on all types of soils and under all cultures. They bring it, as the main fertilizer, and to top dressing, especially for winter crops, providing a yield increase of up to 5 centners per 1 hectare. The result of its application: regulates the growth of vegetative mass; increases the content of protein and gluten in the grain; increases crop yields.

The output of ammonium nitrate, a valuable fertilizer, is increasing.

A feature of ammonium nitrate and products based on it is thermal instability due to its oxidizing properties, which threaten spontaneous decomposition with heat generation, during storage, in the absence of heat removal and ventilation, in the presence of organic substances [1]. Safety during its storage, use, production continues to be the focus of attention of specialists. Ammonium nitrate and fertilizers containing it are classified as “hazardous” in many national and international standards. In accordance with the UN classification used in international transport regulations, ammonium nitrate belongs to class 5.1. - oxidizing substances [2].

So, there is a patent [3] relating to the production technology of ammonium nitrate with magnesia additive. The method includes introducing into the melt of ammonium nitrate a magnesia additive obtained by decomposing magnesium-containing raw materials with nitric acid, neutralizing the mixture, evaporation and granulation, while the magnesia additive is treated with a reagent containing phosphoric acid and / or its salts to a mass ratio of  $\text{P}_2\text{O}_5/\text{Fe}$  in the magnesia additive solution 1.6-3.5, and as a reagent, a solution is used after the separation of calcium from the nitric extract of natural phosphates. The method allows to increase the strength of the granules of ammonium nitrate by 10-18% and apply magnesium nitrate solutions with a high content of impurities, in particular iron, as the magnesia additive, while maintaining the quality of the finished product.

There is a method [4] for the preparation of non-caking ammonium nitrate, according to which a magnesia additive is introduced into its melt — a solution of magnesium nitrate obtained by decomposing caustic magnesite with nitric acid, treating the solution with excess caustic magnesite and separating the precipitate, the mixture is neutralized with ammonia, evaporated and granulated. The disadvantage of this method is the increased consumption of caustic magnesite and low filterability of the precipitate due to the formation of finely divided iron hydroxide that precipitates when the solution is treated with excess caustic magnesite.

A known method [5] for the preparation of magnesia additives by decomposition of caustic magnesite GOST (State Standard) 1216.

The content of the components of caustic magnesite

Index	I class	II class	III class
MgO, not less	87	83	75
Impurities, not more than CaO	1.8	2.5	4.5
R <sub>2</sub> O <sub>3</sub>	2	-	-
SiO <sub>2</sub>	1.8	2.5	4.0
Loss on ignition	6	8	8
Moisture	1.5	1.5	1.5

The decomposition of caustic magnesite is carried out with 40-45% nitric acid in an amount of 105-110% of the stoichiometric. In a reactor filled with 40% nitric acid in an amount of 1333 ml, taking into account a 5% excess, caustic magnesite of the composition is slowly poured, %: MgO - 84.16; CaO 4.17; R<sub>2</sub>O<sub>3</sub> - 3.58; SiO<sub>2</sub> - 2.78 in the amount of 236 g with thorough stirring. As a result of the release of reaction heat, the reaction mass is heated to 108 ° C, the degree of dissolution of magnesite is 96%. Insoluble precipitate is separated by filtration. The solution in an amount of 1070 ml has the composition: excess nitric acid, 10.9% MgO, 0.56% CaO and 0.5% R<sub>2</sub>O<sub>3</sub>, the dried precipitate in an amount of 160 g has the following composition: Mg(NO<sub>3</sub>)<sub>2</sub> - 64,9%, Ca(NO<sub>3</sub>)<sub>2</sub> - 4.74%, R<sub>2</sub>O<sub>3</sub> - 8.15 in terms of nitrate.

The disadvantages of the method is that during the interaction of magnesite with 40-45% nitric acid as a result of temperature increase to 108 ° C or more due to the decomposition of nitric acid, a rapid evolution of nitrogen oxides is observed, while the corrosion of the equipment increases and the degree of use of magnesite does not exceed 97.5-98.0%.

There is a patent [6] of the Republic of Uzbekistan for a method of preparing a conditioning additive in ammonium nitrate.

Dolomite additive is used at a number of enterprises in the CIS countries and European countries. Dolomite contains 30-31% CaO and 19-20% MgO and is used as a conditioning additive that binds water in a melt of ammonium nitrate, which allows obtaining a practically anhydrous product. Its use reduces the caking of ammonium nitrate by increasing the strength of the granules. Dosing of solutions of calcium and magnesium nitrate is carried out in solutions of ammonium nitrate, supplied to the evaporation, based on the content in the finished product of the amount of nitrate salts of 0.2-0.5% (in terms of CaO).

A conditioning additive can be prepared both from dolomite and from a mixture of dolomite with magnesite. GOST (State Standard) 2-85 on ammonium nitrate allows the use of calcium-containing additives, including and dolomite.

In this regard, the tasks of the chemical industry of Uzbekistan are: improving the physicommechanical properties of nitrate by reducing the moisture content by evaporation of nitrate solutions to a mass concentration of at least 99.7%, as well as the introduction of magnesia additives Mg(NO<sub>3</sub>)<sub>2</sub>; improving its marketability

by selecting a conditioning additive that reduces thermal instability and caking due to hygroscopicity and modification transitions.

**Objective:** to reduce the consumption of magnesite and nitric acid, the preparation of a conditioning additive in ammonium nitrate; development of optimal conditions for the processing of dolomite from local deposits into magnesium nitrate - a conditioning additive that increases the thermal stability of commercial ammonium nitrate by dissolving dolomite in weak nitric acid to obtain solutions of nitrate salts of calcium and magnesium of the highest concentration. At the present time, imported magnesite and brucite are used as conditioning additives at the enterprises producing republican ammonium nitrate. At the same time, local dolomite can serve as a raw material for the production of magnesium nitrate, which follows from an analysis of publications on this topic.

### Methodology

The magnesium-containing raw materials in the republic are dolomite deposits of Dekhkanabad, Navoi, Tashkent, Ferghana regions. In dolomite, Mg and Ca are in the form of carbonates, with up to 30%  $\text{CaCO}_3$  and 20-21%  $\text{MgCO}_3$ . The content of MgO and CaO was determined according to GOST 23673.1-79. It was established that Mg - raw materials - dolomite of Dekhkanabad, Kashkadarya region (MgO 20-21 wt.%), Meets the requirements of GOST 23672-99 to it: they must be at least, % wt: MgO 19; CaO 34, FeO - not more than 0.05.

### Experimental results

As a result of decomposition of dolomite with nitric acid, solutions containing calcium nitrate and magnesium nitrate are obtained. At present, at JSC Maxam-Chirchik, the concentration of melt of ammonium nitrate supplied to granulation is 99.6%. Moisture in the amount of 0.4% is bound in the form of crystalline hydrates of calcium and magnesium nitrate  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ ;  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

The following studies and tests were carried out: - on the dissolution of dolomite in nitric acid; - on the use of nitric acid solution of dolomite and a mixture of solutions of nitric acid dolomite and magnesite, as an additive to ammonium nitrate. According to their results, a technical decision was made to produce ammonium nitrate at JSC Maxam-Chirchik with the addition of: - only dolomite; - a mixture of dolomite and magnesite. The rate of dolomite consumption per 1 ton of ammonium nitrate has been established, which provides the required strength of the granules.

In the production of ammonium nitrate with a conditioning additive in the form of a mixture of nitric acid solution of dolomite and magnesite, the consumption of magnesite is reduced by 50 ÷ 60%, the strength of the granules is more than 0.8 kg/granule, the nitrogen content, according to GOST 2-85, is not less than 34%. The content of calcium and magnesium in the finished product, in terms of CaO, does not exceed 0.4%.

Dolomite in the ammonium nitrate shop of the enterprise enters in a powdered state and is sent to dissolution reactors by the existing pneumatic transport. The use of dolomite or a mixture of dolomite and magnesite does not require additional capital investments. Dolomite dissolution, solution cleaning, dosing and all other processes are carried out on the existing equipment of the workshop. Additions were introduced into the technical and technological documentation of the workshop, and approval was obtained from consumers of ammonium nitrate for the introduction of dolomite-magnesite additives in its composition.

The cost-effectiveness of partial replacement of magnesite with dolomite was calculated. So, the consumption rate of magnesite PMK-87 on tons of ammonium nitrate is 2.4 kg. When magnesite is completely dissolved, 2.09 kg MgO passes into the solution. Of this amount, 7.73 kg  $Mg(NO_3)_2$  is formed; this salt can bind moisture in the form of  $5.64 \text{ kg } Mg(NO_3)_2 \cdot 6H_2O$ . Such an amount of moisture is contained in the melt of ammonium nitrate with a concentration of  $\sim 99.4\%$ . The practical concentration of melt of ammonium nitrate entering the granulation is  $\sim 99.6\%$ .

A method for preparing a mixed nitric acid solution of magnesite and dolomite was developed, technological parameters and a sequence of operations were established. It consists in the following (on the example of an experimental batch). A condensate of juice vapor in an amount of  $7.8 \text{ m}^3$  is supplied to an industrial reactor with a volume of  $35 \text{ m}^3$ , then 58% nitric acid in an amount of  $10 \text{ m}^3$ . The reactor contains  $18 \text{ m}^3$  of nitric acid with a concentration of  $\approx 35\%$ . The supply of magnesite powder to the reactor from the silos is carried out by a feeder system: the gateway feeder doses magnesite from the silo to a screw conveyor, from which the magnesite powder enters the loading chamber of the pneumatic elevator and then, drained by air, through the pipeline to the reactor. Magnesite is loaded into the reactor through a pipeline with a start-up under the level of a solution of nitric acid to reduce the entrainment of magnesite. The magnesite powder is loaded into the reactor in 2 stages by turning on the feeder system for a period of time sufficient to supply 1600-1700 kg of magnesite. After each operation of the supply of magnesite is an excerpt  $40 \div 60$  minutes

During exposure, air is introduced into the bubblers of the reactor to ensure mixing of the reaction mass. After the second operation, the residual acidity is 240-250 g/l, then dolomite in the amount of 1800 - 1900 kg is fed in the same order in 5-6 doses and dissolved. The residual acidity at the end of the dissolution of dolomite will be 60-70 g/l. After the decomposition reaction is completed, the reaction mass from the reactor is discharged into a settling tank for purification from insoluble materials. The clarified solution from the tank is pumped to the neutralization compartment. The total concentration of a solution of magnesium nitrate and calcium nitrate, in terms of MgO and CaO, is 16-

17%. The concentration of the solution, in relation to magnesium and calcium nitrates, is 40-42%.

### Conclusions

Based on the work carried out, a technological scheme and technology for the preparation of a mixed nitric acid solution of magnesite and dolomite were developed to produce a solution of magnesium nitrate and calcium nitrate for use as a conditioning additive in ammonium nitrate.

A pilot plant has been created for the production of such a solution for the needs of the production of ammonium nitrate of JSC Maxam-Chirchik, and a method for preparing a conditioning additive from magnesite and dolomite has been developed and tested, which allows reducing the consumption of imported magnesite, while maintaining physical and chemical properties.

It has been shown that nitric acid solutions of calcium and magnesium are used as a conditioning additive in ammonium nitrate.

The technological parameters and sequence of operations are established.

In this case, caustic magnesite and dolomite are used in the following ratio of components, wt.%. caustic magnesite - 40-50, dolomite - 50-60.

The implementation of the method allows reducing the consumption of magnesite in 2 ÷ 2.5 times.

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评估自然灾害对住宅建筑物和社区造成的破坏的新方法  
**NEW METHODOLOGY FOR ASSESSING DAMAGE TO  
RESIDENTIAL BUILDINGS AND NEIGHBORHOODS CAUSED BY  
NATURAL DISASTER**

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注解。地震是最危险的自然现象之一，相对于其他自然现象，地震在经济领域造成巨大损失。地震会损坏建筑物的结构。由工业和自然影响（尤其是地震）造成的损害取决于这些现象的许多参数的大小。

关键词：经济损失，状态评估，损坏，紧急情况，结构技术条件，物理磨损，磨损差异，

大规模破坏评估。

**Annotation.** *One of the most dangerous natural phenomena is earthquakes, which cause enormous damage in the economic sector, relative to other natural phenomena. An earthquake will damage the structures of buildings and structures. Damage caused by industrial and natural impacts, in particular, an earthquake, depends on the magnitude of many parameters of these phenomena.*

**Keywords:** *economic damage, assessment of condition, damage, emergency condition, technical condition of the structure, physical wear, wear differences, mass damage assessment.*

Correct determination of damage in relation to the affected buildings and structures is an urgent task at the stage of solving reconstruction work, as well as solving the issue of compensation for damage to the facility to insurance companies. Today, a lot of litigation is precisely the amount of damage determined by insurance companies.

The article considers the issue of assessing the standard cost of damage to building structures caused by an earthquake, which is typical for our region. In this case, the determination of the degree of physical deterioration by external signs of damage is used. Determining the level of technical condition of the object is carried out by establishing at the time of inspection all deviations (deformations, damages) from the design provisions, as well as the causes of their occurrence and possible consequences.

Physical deterioration is a “translating” indicator of a technical condition on an economic.

Then it is an urgent task when planning overhauls, reconstruction, in determining and predicting the remaining service life, with a real assessment of the technical and economic conditions of buildings and structures, in a word - for monitoring the hard-building activities, which are the country's main fund.

Determining the real degree of the technical condition of buildings is one of the main tasks in determining the costs of restoration of buildings of residential and public buildings.

Determining the actual degree of technical condition of buildings is one of the main tasks in determining the cost of re-installation of residential and public buildings.

To date, several regulatory documents are used to assess the physical depreciation of civil, in particular, residential buildings and several methods are recommended [2-4]. However, to determine the damage from various natural and man-made impacts, there is no methodology for determining the amount of damage. Determining the extent of damage is incorrect and incorrect.

Consideration of the issue is as follows.

Specialists found that the accumulated physical wear and tear was about  $\Phi = 10\%$  before the object was insured that the condition of the building was “good” on the scale of the technical condition [2-4], that is, no visible defects or damage were found in the form of cracks. Past earthquakes affected the building significantly. The owner turns to the insurance company (if the object was insured) for damages. The company attracts specialists, or their specialists “determine” the damage caused by natural disasters. Specialists establish the size, shape and number of damaged areas. Next, a defective act is drawn up by the estimator, with the help of which the volume of repair work is determined. The composition of the work will mainly be the repair of cracks in plastering and painting.

It should be noted that in our example, cracks in the bearing and self-supporting structures were unacceptable by the norms, i.e. the building was in disrepair. The fact that the cost of the damage was estimated using the estimated method of calculation does not correspond to reality for the following reasons:

- firstly, it is necessary to determine the technical condition of the building according to the indicators of physical deterioration at the time of insurance of the facility;
- secondly, cosmetic repairs only restore the appearance of structures and buildings in general, and the technical condition, in particular, the strength and stiffness of structures will be significantly reduced due to the appearance of unacceptable cracks;

- thirdly - in the presence of significant damage, the difference in the cost of buildings (the amount of damage) before and after a natural disaster will be significant.

**The main part.** How to determine the amount of damage? In such cases, the cost of damage is as follows [7]

$$S_u = C_3 - F_2, \tag{1}$$

where  $C_3$  is the cost to pay damages;

$$C_3 = C + C_{indr}, \tag{2}$$

where  $C$  is the direct cost of restoration work;

$$C = \sum_{i=1}^n \left( \frac{C_{i1}}{C_k} + \frac{C_{i2}}{C_k} + \dots + \frac{C_{in}}{C_n} \right) + C_u, \tag{3}$$

where  $C_{i1}, \dots, C_{in}$  is the cost of ensuring the technical condition of damaged sections of the  $i$ -type structure;

$S_k$  - the cost of ensuring the technical condition of the construction of the  $k$ -th type;

$n$  - the number of structural types in buildings;

$C$  - the cost of restoring auxiliary structures and finishing work.

Bevel - indirect costs (costs for the development of design and estimate documentation for the restoration of the facility and other unaccounted costs). Then the formula (2) will be:

$$C_3 = \sum_{i=1}^n \left( \frac{C_{i1}}{C_k} + \frac{C_{i2}}{C_k} + \dots + \frac{C_{in}}{C_n} \right) + C_u + C_{indr}. \tag{4}$$

It should be noted that the restoration eliminates the damage to structural elements, i.e. provided by the initial qualities (strength, rigidity...) of the object. For this, information on the physical depreciation of buildings in general at the time of insurance will be needed. Therefore, in the process of insurance of a building object should be evaluated according to the technical condition. where  $\Phi_2$  is the depreciation value accumulated during the period from the moment of insurance (event No. 1) to the earthquake that occurred (event No. 2).

$$\Phi_2 = \Phi - \Phi_1, \tag{5}$$

where  $F_1$  is the amount of physical deterioration of the building, determined at the time of insurance;

$F$  - the amount of physical deterioration of the building, determined before the event number 2. Then we rewrite formula (1) as follows:

$$C_y = \left( \sum_{i=1}^n \left( \frac{C_{i1}}{C_k} + \frac{C_{i2}}{C_k} + \dots + \frac{C_{in}}{C_n} \right) + C_u + C_{koc} \right) - \Phi_2 \tag{6}$$

Therefore, the sequence is determined by the normative cost of damage. However, the sequence has a number of difficulties, in particular in the definitions of “ $C_3$ ”.

In order to determine  $C_3$ , a restoration project is being developed, including working drawings for structural reinforcement. Based on the project, an estimate is drawn up for the work to be carried out, including finishing work. The project includes the calculation of the design of the existing state, taking into account damage, deformation, etc. Also, the calculation is made after work to ensure the initial strength, rigidity and stability of structures.

For the assessment of the damage caused - the company turns to appraisal organizations. As you can see, the whole procedure requires a professional approach to business.

In order to assess the damage according to the above sequence or according to the method that is currently being estimated by the calculation method, the appraisal organization in both cases will have to bring in the appropriate organization involved in the development of design estimates.

Appraisers themselves still do not have an approved methodology or rules for assessing damage to buildings and structures caused by natural disasters.

If there is no corresponding regulatory framework for assessing the physical deterioration of buildings and structures, producing mechanical damage due to an external sign of damage (quantitative assessment), then a qualitative assessment of the technical condition is used, as an assessment of the limiting conditions or reliability assessment of structures.

But, a qualitative assessment establishes the boundary conditions for safety margins or deformability. Moreover, performing a series of calculations for the building as a whole is a laborious process.

The task of a qualitative assessment of the technical condition can be posed in a probabilistic statement. In the probabilistic statement of the problem, information about the malfunction should contain information about the methods, cost, labor intensity and duration of restoration and repair. For the economic assessment of damage, it should be established to which technical categories the structural failure belongs. The technical category consists of 5 conditions, the same as in the quantitative assessment, each of them shows a condition from “good” to “emergency”. In the information on reliability, the analysis of the consequences of a malfunction takes an important place. Therefore, solving the probabilistic statement of the problem also requires high qualifications in processing the results obtained by instrumental examination.

If physical wear in our understanding is a technical and economic characteristic, then we propose a method for assessing the difference in wear of building structures and buildings in general, determined before and after the event, that the

evaluator himself can determine the amount of wear based on BC 2.01.16-97 [1]. However, this source is also not acceptable when it comes to natural disaster (see introduction [1]).

Accumulated physical depreciation, in this case, is not the result of natural aging; by the nature of the appearance, it is physical deterioration of mechanical origin. The natural aging of structural elements in such cases can only be a “catalyst” for the ongoing process.

Thus, we present a general procedure for assessing damage to structures and buildings in general, based on an assessment of the difference in the physical characteristics of building structures between events:

- The corresponding physical deterioration is determined before the “ $\Phi$ ” and after the “ $\Phi_s$ ” event, with the establishment of the appropriate categories of the technical condition of the building:

F is determined by the formula (5)

$$\Phi = \Phi_1 + \Phi_2$$

defined as the sum of the depreciation accumulated before the event and as a result of the event

$$\Phi_s = \Phi + \Delta\Phi = \left( \sum_{i=1}^n \Phi_1 \frac{P_i}{P_k} + \sum_{i=1}^n \Phi_2 \frac{P_i}{P_k} \right) + \sum_{i=1}^n \Delta\Phi \frac{P_i}{P_k} \quad (7)$$

Where

- the amount of physical wear and tear on the damaged parts relative to the entire structure at the time of insurance;
- the amount of physical wear and tear on the damaged parts relative to the entire structure between events No. 1 and No. 2;
- the amount of physical deterioration of the damaged parts relative to the entire structure accumulated during event No. 2.

The definition of “ $\Phi_s$ ” is not difficult. The specialists of the insurance company (if available, if the company is absent can attract specialists who have the appropriate license for the inspection of buildings and structures), the actual condition of the building should be assessed with the category determined by the technical condition, relevant photographs;

- The corresponding physical wear “ $F_1$ ” is determined using the information received at the time of insurance (event No. 1) with the establishment of the categories of the technical condition of the building;

- The corresponding physical wear “ $\Phi_2$ ” is determined using the normative method (according to the estimated service life [2]) of the assessment, taking into account the corresponding standard service life of short-lived and long-lived (non-replaceable) structures. “ $\Phi_2$ ” is determined when the time from the moment of insurance for the event has been significant (depreciation-accumulated between events);

$$\Phi_2 = \frac{T_3}{T} \cdot 100 \quad (8)$$

where  $T_3$  is the time between events No. 1 and No. 2

$T$  is the standard service life of structural elements.

•  $\Delta\Phi$  is determined as follows

$$\Delta\Phi = (\Phi_s - \Phi) + \Phi_1, \quad (9)$$

Thus, the amount of wear caused by event No. 2 is established. The cost of damage is according to this method.

$$C_1 = S_v - \Delta F, C_2 = S_b - \Phi, \quad (10)$$

$$S_u = C_2 - C_1 \quad (11)$$

where  $C_1$  is the residual value of the building excluding event No. 2

$S_2$  - residual value of the building, taking into account event No. 2

$S_b$  - the replacement value of the building at the valuation date.

When assessing the market value of the damage, some market factors are taken into account, such as the lost profits from the operation of the facility (if the recovery period requires a considerable time).

The given sequence of calculation of damage from natural disasters is typical at the building level. However, natural disasters, regardless of nature, cause buildings and structures on a certain scale. Therefore, topical issues are the mass assessment of damage caused by a natural disaster. To carry out this kind of assessment, the entire array of objects must be divided into groups according to a certain homogeneity criterion (purpose, design solution, typology, materials used, number of storeys, etc.). For this group, large structural elements (parts of the building) are distinguished [5]. The share of each structural element in the total cost is determined

$$C_{yuy}^{Mo} = K_{y\delta} \cdot \sum_{j=1}^M \sum_{k=1}^K \cdot C_{yuy,jk}^{Mo} \quad (12)$$

$K_{ud}$  - rise in price;

- the cost of damage to the  $k$ -th structural element in the  $j$ -th group of objects with a mass assessment of  $1 \leq k \leq K$ :

$$C_{yuy,jk}^{Mo} = C_j \cdot \delta_k \cdot \beta_{CPk}, \quad (13)$$

where  $C_j$  is the value of the  $j$ -th group of objects according to the selected uniformity criterion, taking into account wear  $1 \leq j \leq M$ ;  $\delta_k$  - share of the  $k$ -th structural element in the total cost for the  $j$ -th group;  $\beta_{CPk}$  is the average degree of destruction of the  $k$ -th structural element for the  $j$ -th group.

$$\beta_{CPk} = \frac{\sum_{i=1}^{N_j} \beta_{ktij}}{N_j}$$

where is the degree of destruction of the k-th structural element for the i-th object of the j-th group; is the number of objects in the j-th group.

### Conclusions

The proposed calculation method for determining the magnitude of damage to building structures and a complex of buildings caused by natural or man-made factors is acceptable for urban planning in emergency situations, for monitoring urban development objects, and also for predicting possible damage from natural or man-made impacts.

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基于折叠配置可生成多种桁架结构设计的潜力

## A POTENTIAL TO GENERATE A WIDE RANGE OF DESIGNS FOR TRUSS STRUCTURES BASED ON FOLDED CONFIGURATIONS

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抽象。增加产品重量效率的任务要求使用新的建设性和高科技解决方案，以最大限度地提高复合材料的性能特性。本文演示了使用用于生产折叠结构和定向铺设连续纤维的技术制造桁架填充物的可能性。定向纤维铺设技术使您可以最大程度地提高复合材料的强度特性，这是由于增强纤维沿着杆的轴心根据当前载荷的位置而定。折叠技术的使用为创造多种结构形式的桁架填充物提供了广泛的可能性，这些桁架填充物包括用于具有平坦成形表面，弯曲形状以及可变高度的面板的填充物。创建杆结构时，可以使用粗纱或高强度碳纤维，玻璃纤维，玄武岩纤维或芳纶纤维束，它们可以与反应热塑性塑料和热塑性塑料结合使用。

关键词：桁架施工，定向铺设，折叠结构，复合材料，夹芯板

**Abstract.** *The tasks of increasing the weight efficiency of products require the use of new constructive and high-tech solutions that maximize the functional properties of composite materials. This article demonstrates the possibility of creating truss fillers using technologies for producing folded structures and directional laying of continuous fiber. The technology of directional fiber laying allows you to maximize the strength properties of the composite due to the location of the reinforcing fibers along the axis of the rods in accordance with the current loads. The use of folding technology opens up wide possibilities for creating a variety of structural forms of truss fillers, including fillers for panels with flat forming surfaces, a curved shape, and also variable height. When creating rod structures, rovings or bundles of high-strength carbon, glass, basalt or aramid fibers can be used, which can be combined with both reacto- and thermoplastics.*

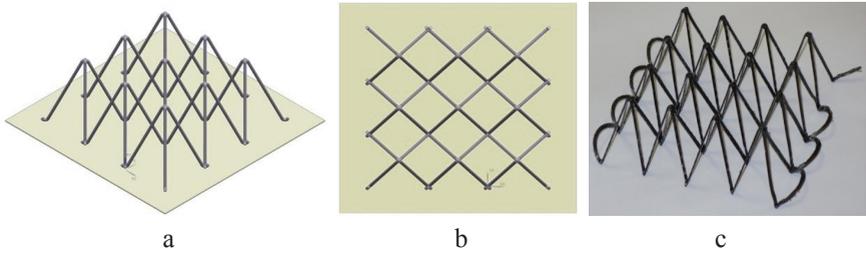
**Keywords:** *truss construction, directional laying, folded structures, composite materials, sandwich panels*

The development of resource-saving and highly efficient products requires the use of new design and technological solutions in the field of lightweight structures for aviation, transport and spacecraft. Particularly promising in this regard is the use of polymer composite materials to create directionally reinforced products in which the fibers are positioned in such a way as to effectively absorb the current load. One of the directions for creating such products is the development of fillers for sandwich panels using volumetric truss structures in which truss are optimally positioned and have sufficient rigidity to effectively absorb current loads. The purpose of creating such placeholders is devoted to this article.

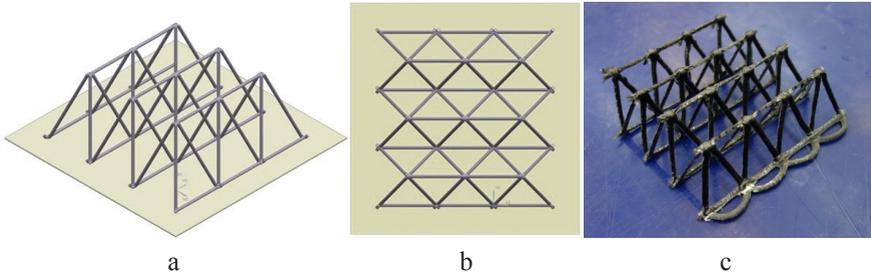
The proposed technology is based on the idea of compatibility of the main geometric features of truss structures and folded structures, the main of which is their flatness to the plane. This creates an invaluable technological advantage, as it allows the use of flat mesh preforms to obtain volumetric truss aggregates. The main methods for obtaining such preforms are the method of directional laying of continuous fiber (Tailored Fiber Placement, TFP) [1], which can be implemented using specialized laying machines or robotic complexes.

Unlike folded structures made of sheet materials, the elements of the mesh preform form a system of interconnected truss located along the faces and edges of the folded structure in a bulk state. Variations in the layout of the folded structure, the thickness of the roving, and the folding scheme make it possible to obtain a wide variety of truss structures with different base surfaces, both in the form of a linear corrugation and folded in rows [2, 3] or pole structures [4]. In these truss structures, elements can form pyramidal, tetrahedral, x-shaped structures or mesh surfaces.

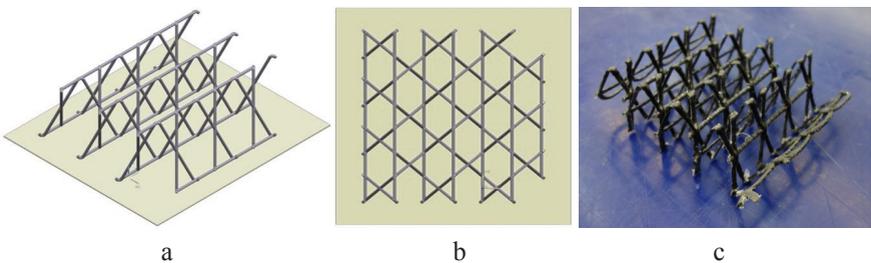
The simplest option for producing truss structures by folding is to use a base surface in the form of a linear corrugation. Fig. 1 shows the well-known truss structure with a pyramidal structure. For it, a net on the plane has the form of a grid with an elementary module in the form of a rhombus (Fig. 1, *b*). The arrangement of truss elements on the surfaces of a linear corrugation provides great opportunities for modifying the truss structure both in density and in its appearance. This modification allows you to change the strength and elastic characteristics of the filler in different directions of the panel. For example, as shown in fig. 2, the additional arrangement of the longitudinal truss element along the generatrix of the linear corrugation will allow to connect elementary modules with each other and increase the bending stiffness of the filler. And when the markup is shifted by half the height of the face of the linear corrugation, as shown in fig. 3, when truss structure is folded, the structure becomes X-shaped, which will have significantly different strength and rigidity from the original pyramidal structure.



**Fig. 1.** *Pyramidal truss structure based on linear corrugation: a – truss structure based on linear corrugation, b – net, c – truss structure sample*



**Fig. 2.** *Truss structure with longitudinal reinforcement along the vertices of the pyramidal elements: a – truss linear corrugation structure, b– net, c – truss structure sample*

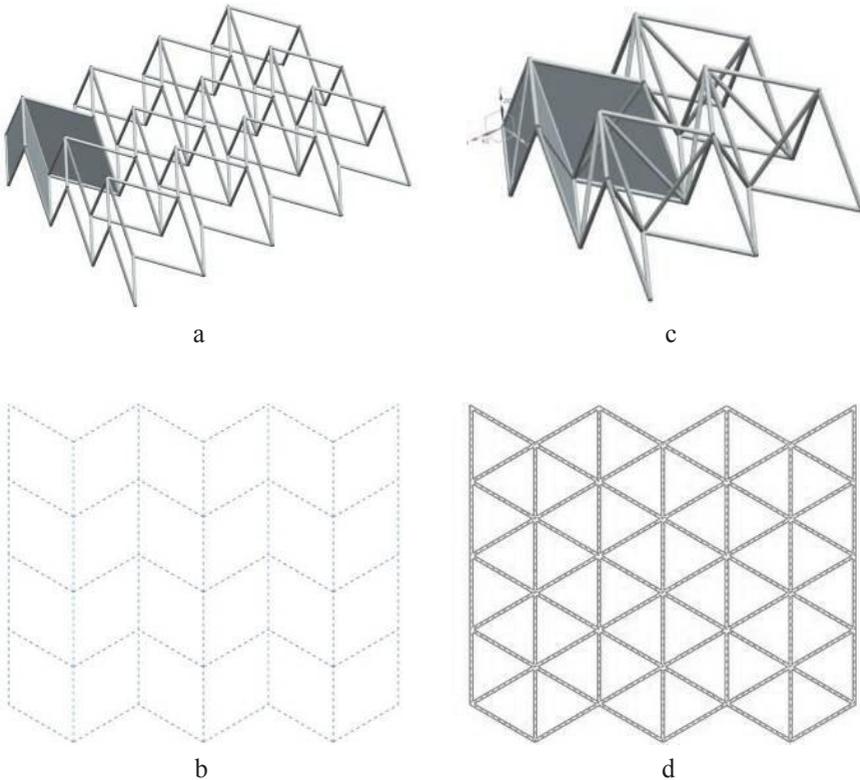


**Fig. 3.** *X-shaped truss structure with longitudinal reinforcement: a – linear corrugation truss structure, b – net, c – truss structure sample*

**Four-beam row folded structures** are the most concise in their configuration. The simplest of them is the azimuthal structure of the z-corrugation type (Fig. 4, a). When creating a mesh preform, it is assumed that truss should be located along the edges of the folded structure in accordance with its marking (Fig. 4, b). Fold-

ing the preform from a flat state to a volume state can be carried out by various methods, including using transformable equipment [5, 6]. In contrast to the typical pyramidal structure, the vertices of the pyramids are connected truss with each other, forming zigzag lines. These lines lie in the planes of the skin and increase the strength of their connection with the aggregate.

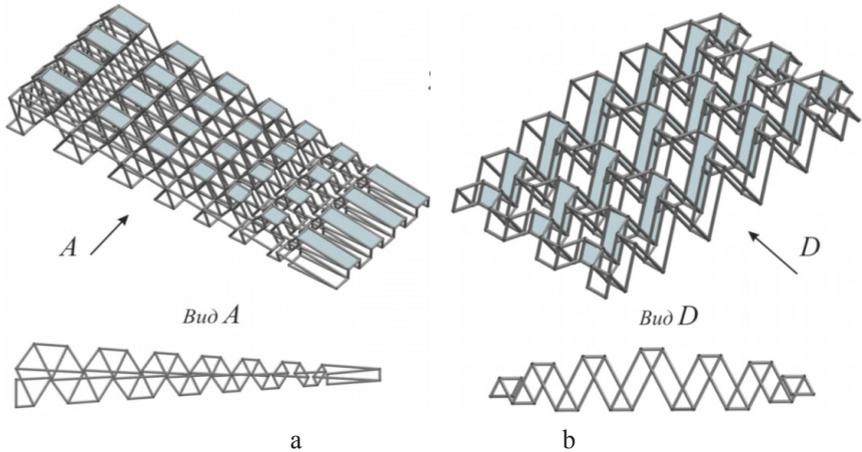
If we add truss on the net, which is located on the short diagonal of the parallelogram faces of the z-corrugation, we obtain a more stable design with a periodic cell of a pyramidal shape (Fig. 4, c, d).



**Fig. 4.** Truss structures with a base surface in the form of a zigzag corrugation:  
a - general look of truss structure in a raised state (option 1);  
b - marking the base surface of the structure in the form of a zigzag corrugation;  
c - general look of the structure in a raised state (option 2);  
d - fiber reinforcement layouts for truss structures (option 2)

**Structures with variable height and curvature of envelope surfaces.** The use of folded four-beam reversing structures as the basis makes it possible to create truss structures with a wedge-like shape (Fig. 5, *a*). This is achieved through the use of markup modification techniques, changing the amplitude of zigzag lines and the pitch between them. The advantage of the design is the presence of faces in the surfaces adjacent to the skin. In the figure they are tinted. Additionally, their surface can be reinforced with fibers using TFP technology, which will provide increased strength of the connection with the skin.

Fig. 5 *b* shows a truss construction with ogive shape of envelope surfaces. It was obtained by modifying the zigzag corrugation [7]. The curvature of the envelope surfaces is achieved by selecting the distances between the zigzag lines on the marking (Fig. 5, *c*). For better reading of the figure, the faces obtained by modification are tinted.

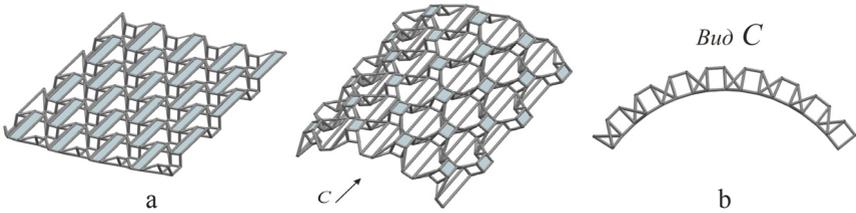


**Fig. 5.** Truss structures based on reversed row folded structures with modified layout: *a* – wedge-shaped truss design; *b* – truss structure with ogive envelope

**Six-beam row structures** [8]. Six-beam row structures are a convenient geometric basis for constructing truss structures with curved envelope surfaces and a large area for mating with skin. Of the variety of six-beam structures, reversible ones are most suitable, a typical periodically repeating fragment of which consists of two reversibly oriented elementary six-beam modules.

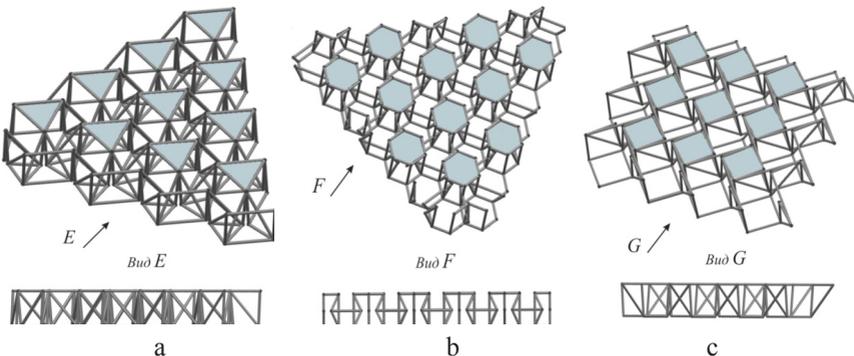
Fig. 6 *a, b* show structures with a flat truss block and a block with the transverse curvature of the envelope surfaces. The advantage of structures is the presence of pads in envelope surfaces and the connection of these pads truss over the shortest distance. Structures also have intersecting truss, providing additional rigidity.

It should be noted that a flat or curved format of blocks in the longitudinal as well as transverse directions is specified at the design stage of the net. This is achieved by purposefully setting different values of the amplitude of the zigzag lines (for curvature in the longitudinal direction) or changing the distance between the markings of the sawtooth lines.



**Fig. 6.** Truss designs based on six-beam reversing structures:  
*a* – flat structure; *b* – curvilinear structure.

**Pole structures.** Four- and six-beam structures have two planes of mirror symmetry. Therefore, truss structures built on their basis will have mechanical characteristics that differ in various directions. A greater degree of isotropic properties can be obtained by using pole structures as the base surface, as shown in fig. 7. The first structure (Fig. 7, *a*) belongs to the class of triostructures [9]. Typical periodically repeating fragments (elementary modules) that form it have a third degree of axial symmetry. This provides the construction with the same properties in three directions.



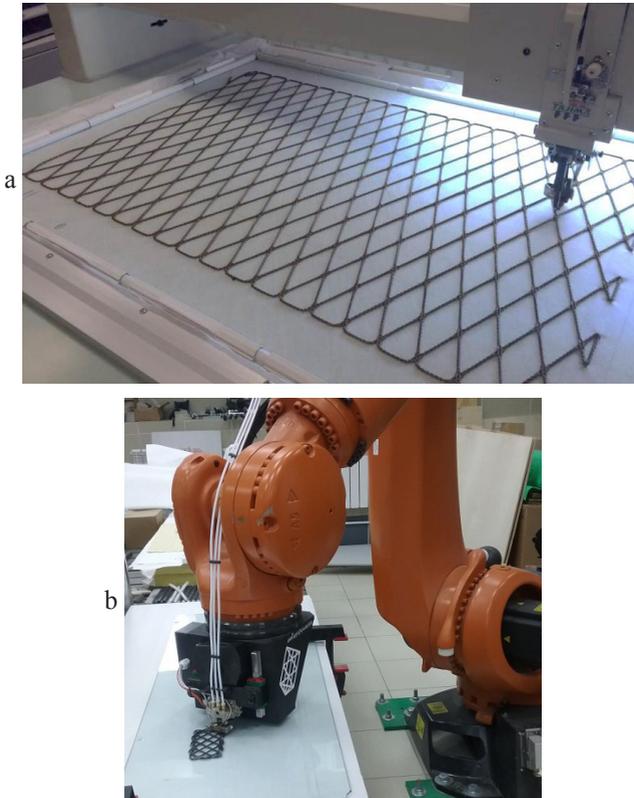
**Fig. 7.** Truss constructions based on modified pole structures:  
*a* – triostructures; *b* - hexagonal *c* - quadrostructure

The structure in fig. 7 *b* consists of modules with a sixth degree of axial symmetry, which determines the same properties in six directions.

It is possible to construct a structure with an elementary module of the fourth degree of symmetry (Fig. 7, c). It will have the same properties in two directions. The listed pole structures are synthesized by modifying the parent structures, respectively, of the trio-S, hexa-S, and quadro-S. A distinctive feature is the presence of triangular, hexagonal and square faces in envelope surfaces.

Among the advantages of pole structures, the following should be noted:

- the presence of polygons in envelope surfaces. If they are reinforced by the TFP method, then high strength of the connection with the skin will be ensured;
- constructs with a pole structure from the state of a flat block easily fit on a surface of double curvature;
- truss connecting the upper and lower surfaces are located not only vertically, but also at an angle, which increases the stability of the structure when shear forces occur.



**Fig. 8.** Technological equipment for directional laying of preforms: a – TFP carbon laying machine; b – Anisoprint robotic complex with a laying head for laying out carbon fiber and consolidating it with thermoplastics.

The possibility of applying the technology of directional fiber laying and folding was confirmed during experimental work on the creation of prototypes of truss aggregates and sandwich panels with their use. Directional fiber laying can be carried out by TFP machines using dry carbon (Fig. 8, *a*), as well as robotic complexes for laying carbon fiber consolidated with thermoplastics (Fig. 8, *b*).

### **Conclusion**

The result of this work is the development of a technology for producing truss aggregates by the method of directional laying of fibers and folding in accordance with the selected base surface of the folded structure. Mathematical dependencies are obtained for determining the truss marking parameters and folded structures. The proposed technology for combining the folding method and creating directionally reinforced mesh preforms has the following advantages:

- the possibility of realizing a wide variety of forms of structures and choosing the most rational structures for practical use;
- high automation of the process;
- effective implementation of the functional characteristics of composite materials and high specific strength characteristics of panels using truss aggregates;
- the potential use of thermoplastic materials consolidated with carbon fiber to create mesh preforms, which allows to bring this technology to a new technological level and significantly reduce the molding cycle of such structures.

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优化用于生产高科技纤维素的植物原料的水合脱木质素工艺  
**OPTIMIZATION OF THE PROCESS OF HYDROTROPIC  
DELIGNIFICATION OF PLANT RAW MATERIALS FOR THE  
PRODUCTION OF HIGH-TECH CELLULOSE**

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根据IENICA数据库 ([www.ienica.net/cropsdatabase.htm](http://www.ienica.net/cropsdatabase.htm)) 中显示的数据, 世界上有90多种草本植物, 有望在燃料, 能源和化学工业中作为替代来源。在这些植物中, 以芒草属的草本植物为特征, 其特征在于纤维素分解物质的生产率提高。这项工作优化了植物材料的水溶脱木质素工艺, 以获得高科技纤维素。结果表明, 使用过苯甲酸, 温度为60°C, 持续时间为60分钟, 可以从芒草中国“金条”中获得最大的纤维素收率。

关键词: 纤维素, 药草, 可再生资源, 水溶性木质素化, 芒草。

*According to the data presented in the IENICA database ([www.ienica.net/cropsdatabase.htm](http://www.ienica.net/cropsdatabase.htm)), there are more than 90 species of herbaceous plants in the world that are promising as alternative sources in the fuel and energy and chemical industries. Among such plants, an herbaceous plant of the Miscanthus genus is distinguished, which is characterized by increased productivity of cellulolytic substances. The work optimized the process of hydrotropic delignification of plant materials in order to obtain high-tech cellulose. It is shown that with the use of perbenzoic acid, a temperature of 60°C and a duration of 60 minutes, it is possible to achieve the maximum yield of cellulose from Miscanthus Chinese "Gold Bar".*

**Keywords:** *cellulose, herb, renewable sources, hydrotropic delignification, Miscanthus.*

Due to the fact that forest resources are hardly renewable and in Russia a lean attitude towards the forest is emerging, the issue of finding alternative renewable sources other than wood is promising and relevant. In addition, it is necessary to think about environmental issues related to the production and use of energy resources. Much attention is paid to the possibilities of using plant materials for the production of technical pulp. The creation of energy-saving low-waste technology for processing plant components containing a large amount of cellulose is a fundamental and relevant direction in the development of biotechnology in all countries. The source of raw materials for such products may be sunflower husk, straw, corn waste, etc.). According to the data presented in the IENICA database ([www.ienica.net/cropsdatabase.htm](http://www.ienica.net/cropsdatabase.htm)), there are more than 90 species of herbaceous plants in the world that are promising as alternative sources in the fuel and energy and chemical industries. Note that all types of herbaceous plants are easily cultivated and unpretentious to climatic and seasonal conditions. Among such plants, one can distinguish a herbaceous plant of the *Miscanthus* genus. *Miscanthus* is characterized by increased productivity of cellulolytic substances and the ability to actively grow and grow even in difficult climatic conditions (low temperature conditions, soil lacking nutrients). Another advantage of a plant of the *Miscanthus* genus is that it is practically resistant to pests and diseases, which reduces the economic cost of treating it with chemicals.

The plant biomass of an herbaceous plant of the genus *Miscanthus* can be independently used in industry as a source for producing composite materials, building elements, fuel briquettes or fuel, as well as for the production of paper, chlorophyll, a nutrient component for microorganisms, plants, and much more [1, 2].

Thus, *Miscanthus* is a promising raw material for the production of industrial pulp, the need for which has increased over the past twenty years. Scientific research is already underway on the possible use of *Miscanthus* for the production of technical pulp.

The work is aimed at optimizing the process of hydrotropic delignification of plant materials of the herbaceous plant Chinese *Miscanthus* "Strictus" in order to obtain high-tech cellulose.

At the first stage of the research, the preparation of the plant biomass of the herb *Miscanthus* Chinese "Gold Bar" was carried out. The process was conducted according to a standardized procedure and the results of optimizing the hydrotropic delignification process using an alkaline solution of NaOH are presented in table 1

The results presented in table 1 indicate that the maximum yield of cellulose (78.68%) from the plant biomass of the herb Chinese *Miscanthus* "Gold Bar" is observed at a process duration of 90 minutes and a temperature of 60°C.

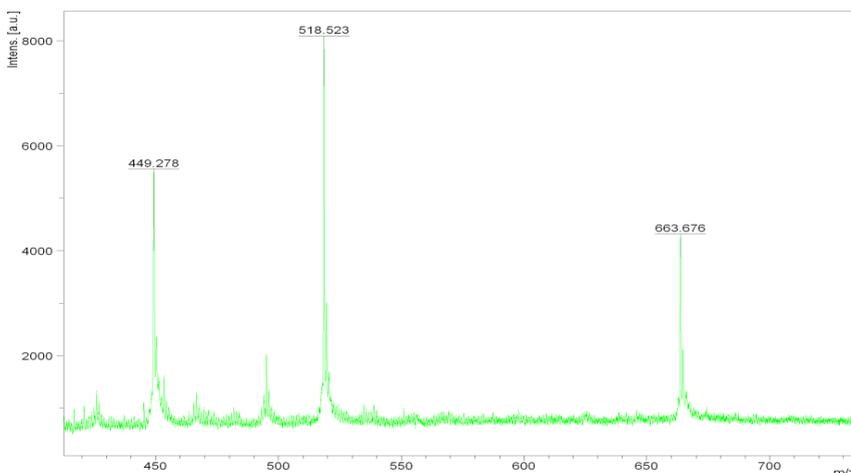
**Table 1** – Optimization of the hydrotropic delignification process for producing high-tech cellulose from plant biomass of a herbaceous plant *Miscanthus Chinese "Gold Bar"* using an alkaline solution of NaOH

№	Duration of the process, min	Cellulose yield,%, at an appropriate temperature, °C			
		20	40	60	80
1	30	3,13±	17,38±	21,44±	42,33±
2	60	3,56±	26,19±	54,63±	68,97±
3	90	4,22±	32,10±	<b>78,68±</b>	71,57±
4	120	5,12±	42,85±	63,08±	68,21±

The results of the study of oligosaccharides and lignin extracted in the process of obtaining technical cellulose from the biomass of the herbaceous plant Chinese miscanthus “Ferner Osten” are presented in Figure 1.

As a result of the analysis of the obtained MALDI-TOF mass spectrometry data, a conclusion was drawn about the structure of lignin fragments extracted into an alkaline solution (Figure 2).

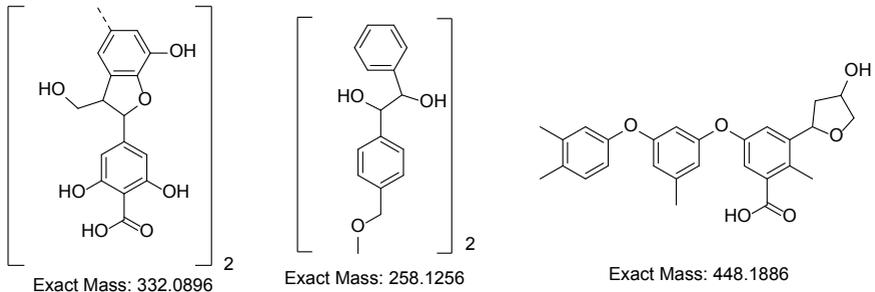
The results of the study of oligosaccharides and lignin extracted in the process of obtaining cellulose from the Miskantus Chinese "Gold Bar" method of hydrotropic delignification shown in Figure 1 show that a signal with a mass of 663.676 m/z corresponds to a phenylcumaronic acid dimer, a signal with a mass of 518.523 m/z corresponds to 1- (4-methoxyphenyl) phenyl) -2-phenylethane-1,2-diol dimer; and a signal with a mass of 449.278 m/z corresponds to a phenoxy-phenylcoumaric acid fragment.



**Figure 1** – The results of the study of the aqueous phase of the reaction mixture after delignification by MALDI-TOF spectrometry

As a result of the analysis of the obtained MALDI-TOF mass spectrometry data, a conclusion was drawn about the structure of lignin fragments extracted into an alkaline solution (Figure 2).

The results of the study of oligosaccharides and lignin extracted in the process of obtaining cellulose from the Miskantus Chinese "Gold Bar" by method of hydrotropic delignification shown in Figure 1 show that a signal with a mass of 663.676 m/z corresponds to a phenylcumaronic acid dimer, a signal with a mass of 518.523 m/z corresponds to 1- (4-methoxyphenyl) phenyl) -2-phenylethane-1,2-diol dimer; and a signal with a mass of 449.278 m/z corresponds to a phenoxy-phenylcoumaric acid fragment.



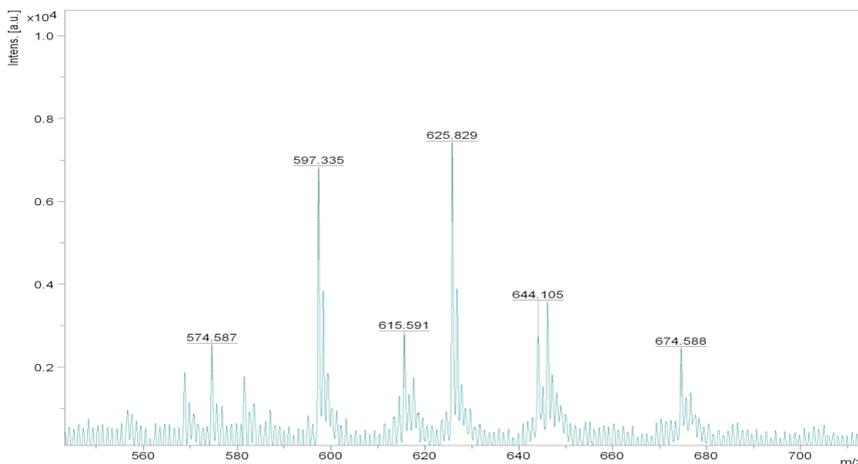
**Figure 2** – The structure of lignin fragments extracted in the process of producing technical cellulose from biomass Miskantus Chinese "Gold Bar" by hydrotropic delignification using an alkaline solution of NaOH

The results of the selection of technological parameters for the production of technical cellulose from Miskantus Chinese "Gold Bar" biomass by hydrotropic delignification under oxidation conditions with peracetic acid are presented in Table 2. The analysis of the results indicates that the optimal parameters for the production of technical cellulose from biomass of Miscanthus Chinese "Gold Bar" by hydrotropic method delignifications under oxidation conditions with peracetic acid are a process duration of 90 minutes and a temperature of 60°C.

The results of a study of the structure of oligosaccharides and lignin extracted in the process of producing technical cellulose from Chinese "Gold Bar" miscanthus biomass by hydrotropic delignification using peracetic acid, obtained by the MALDI-TOF method, made it possible to identify characteristic fragments A – 574.587 m/z and B – 674.588 m/z of lignin in the range of 500-700 m/z (Figure 3).

**Table 2** – Optimization of the hydrotropic delignification process for the production of high-tech cellulose from plant biomass of the herbaceous plant *Miscanthus Chinese "Gold Bar"* using peracetic acid

№	Duration of the process, min	Cellulose yield,%, at an appropriate temperature,°C			
		20	40	60	80
1	30	4,12±	9,88±	23,69±	34,55±
2	60	4,14±	15,44±	54,68±	55,07±
3	90	4,94±	33,04±	<b>89,60±</b>	87,03±
4	120	5,21±	44,17±	83,87±	72,55±



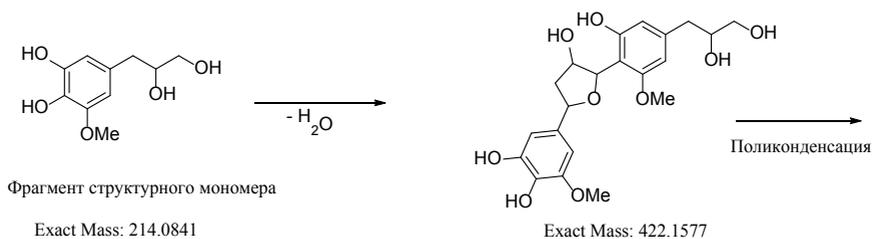
**Figure 3** – MALDI-TOF spectrum of the aqueous fraction after oxidative delignification of dry miscanthus biomass

An analysis of empirical data on the study of hydrotropic delignification of producing high-tech cellulose from plant biomass of the herb *Miscanthus Chinese "Gold Bar"* using perbenzoic acid (table 3) showed that the process parameters are optimal for 60 minutes and a temperature of 60°C.

The results of the study of oligosaccharides and lignin extracted in the process of producing technical cellulose from the biomass of Chinese miscanthus "Gold Bar" by hydrotropic delignification under oxidation with perbenzoic acid, obtained by the MALDI-TOF method, are presented in Figure 4.

**Table 3** – Optimization of the hydrotropic delignification process for the production of high-tech cellulose from plant biomass of the herbaceous plant *Miscanthus Chinese "Gold Bar"* using perbenzoic acid

№	Duration of the process, min	Cellulose yield,%, at an appropriate temperature,°C			
		20	40	60	80
1	30	5,64±	17,19±	78,03±	66,44±
2	60	6,32±	26,56±	<b>96,33±</b>	88,07±
3	90	8,19±	44,90±	89,10±	74,20±



**Figure 4** – The structure of the fragment of the lignin monomer extracted with oxidative delignification

Thus, the parameters for the production of industrial cellulose from the biomass of *Miscanthus sinensis* “Gold Bar” by the method of hydrotropic delignification using different extractants were selected:

- 1) chemical reagent – sodium hydroxide, temperature 60°C, process duration 90 min;
- 2) chemical reagent – peracetic acid, temperature 60°C, process duration 90 min;
- 3) chemical reagent – perbenzoic acid, temperature 60°C, process duration 60 min;

Thus, in order to obtain high-tech cellulose from plant biomass of Chinese *Miscanthus*, oxidative delignification technology in the presence of perbenzoic acid can be applied.

To implement the technological process for producing technical cellulose from the biomass of a herbaceous plant of Chinese *Miscanthus*, the following procedures must be performed:

1. Grind the herb to a size of 1.0–2.0 cm.
2. Dry biomass of the miscanthus Chinese "Gold Bar" in the amount of 10-20 g is placed in a round-bottomed two-necked flask equipped with a magnetic stirrer, reflux condenser and thermometer.

3. Add perbenzoic acid to plant biomass.
4. Add an aqueous solution of hydrogen peroxide to the plant biomass.
5. Add distilled water and concentrated sulfuric acid to the plant biomass.
7. Stir the reaction mixture for  $60 \pm 2$  min at a temperature of  $60 \pm 2^\circ\text{C}$ .
8. Separate by centrifugation at  $3900 \pm 50$  rpm.
- 10 Rinse the resulting cellulose with two portions of distilled water.
11. Dry the washed cellulose to constant weight in an oven.

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使用神经网络技术自动确定ECDIS中船只位置的可能性  
**THE POSSIBILITY OF USING NEURAL NETWORK  
TECHNOLOGIES ON AUTOMATING THE DETERMINATION OF  
THE VESSEL LOCATION IN AN ECDIS**

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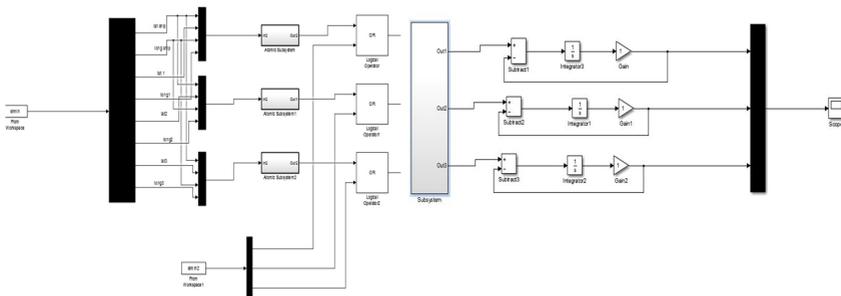
**Abstract.** *New automated observational methods using neural network technologies are proposed. The relevance of the topic is due to the complexity of the interaction of ergodic systems in the modernization of classical methods for determining the location of a vessel in automated navigation systems. All set goals of the work are realized and can be recommended for implementation on the ship.*

**Keywords:** *ECDIS, neural networks, ship positioning, Grossberg networks, competitive neural network.*

The solution to the problem of automating of the vessel position determination (VPD) in an electronic chart display and information system (ECDIS) is due to a contradiction, on the one hand, the presence of conservative methods for determining the location of a vessel (“human”), and on the other, the existence of many automated navigation systems (“machine”). Ignoring this contradiction can lead to emergency situations. To optimize the human-machine system, automation of VPD in ECDIS is proposed using neural network technologies that automatically resolve these contradictions.

ECDIS facilitates the work of the navigator, allowing you to devote more time to observing, diverging and solving navigation problems. However, accident rate is not decreasing, and the number of accidents due to human error remains the same [1]. The safety of navigation has been significantly affected in recent decades by an increase in the number of ships. Therefore, research in the direction of solving this problem based on the combination of classical navigation methods and neural network technologies is relevant.

We will consider achieving this goal using the example of VPD in three bearings [2], implemented using the Simulink graphical simulation environment (Fig. 1), which requires entering the observer's location in the geographic coordinate system and the geographic coordinates of three coastal objects. For automatic operation of the system, it will be sufficient to use the throughput integrator of a competitive neural network [3]. In the future, using the full model of the neural network, it is possible to solve navigation problems by known methods.



**Fig. 1.** General view of the VPD model for three bearings, built in the Simulink environment [4]

The start of the system is shown in Figure 2. The program, receiving data in the form of the ship's numeric coordinates from the satellite navigation system leaving the *simin* block, (*latship* and *longship* - the ship's latitude and longitude numerals; and three landmarks: *lat 1* and *long 1* - the numeral latitudes and the longitude of the first landmark, *lat 2* and *long2* - the calculated latitude and longitude of the second landmark, *lat 3* and *long 3* - the calculated latitude and longitude of the third landmark) taken from ECDIS, by taking values from the electronic map (the latitude and longitude of the vessel and the latitude and longitude for three landmarks) transfers these geographical coordinates to the *Automic Subsystem*, *Automic Subsystem 1* and *Automic Subsystem 2* blocks, where the geographical coordinates are converted to polar using the well-known formula (1) [5]:

$$tgB = \frac{(\lambda_a - \lambda) \cos \varphi_m}{\varphi_a - \varphi} \quad (1)$$

where  $B$  – countable bearing,  $\lambda_a$  – landmark longitude,  $\lambda$  – vessel longitude,  $\varphi_a$  – landmark latitude,  $\varphi$  – vessel latitude,  $\varphi_m$  – intermediate latitude ( $\varphi_m = \varphi$ ).

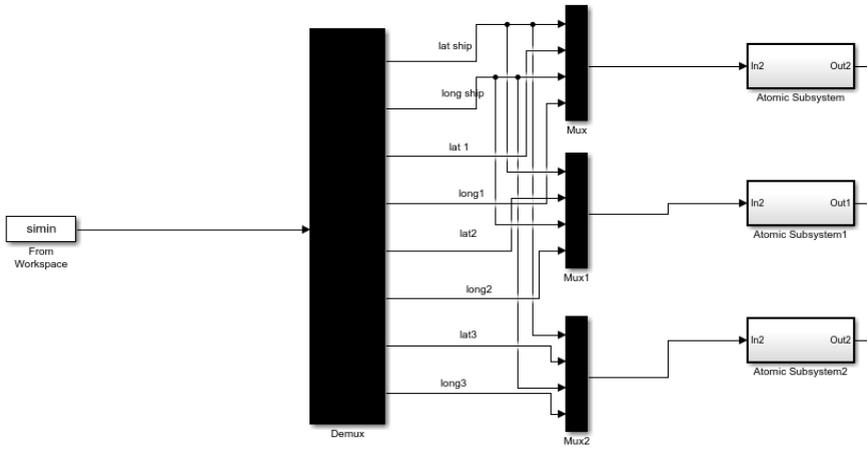


Fig. 2. Obtaining the coordinates of the vessel and landmark

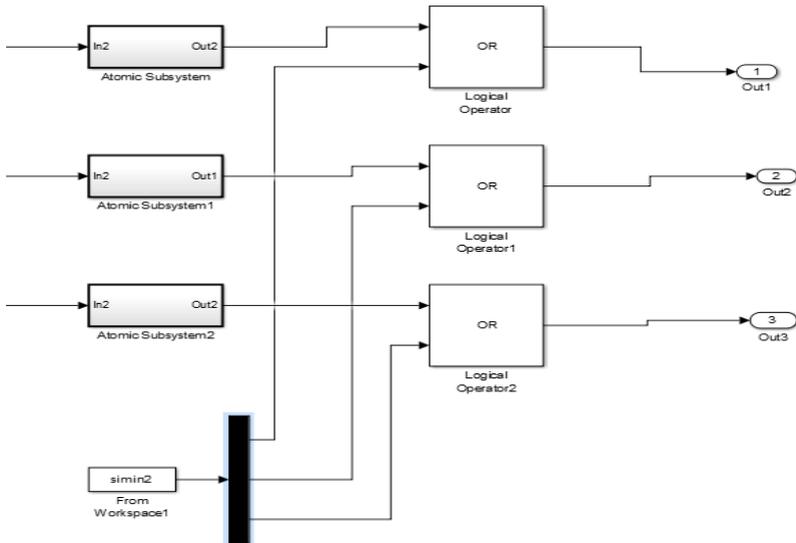


Fig. 3. Selection of reference values

From the second data block *simin 2*, the values of bearings obtained when capturing the illumination of landmarks using a ship radar when the Overlay function is turned on (Fig. 3) [6] are supplied. These measured bearings are necessary for the system to select reference values.

Since the illumination of the coastal reference point on the ship’s radar is not a point, but represents a certain area with many point targets, the continuously arriving values of the measured bearings of these points are analyzed and compared with countable bearings in the *Logical Operator* blocks until a reference value is generated bearing. The obtained values go to the next block - a competitive neural network.

The reference value will be accepted by the neural network as true only if the accuracy condition is satisfied. If the conditions are not met, the selection of the reference bearing will continue until the error is minimized and the choice of the best opportunity for observations is ensured (Fig. 4).

In the future, with a potential calculation, iterative selection achieves the optimal accuracy of the observations. Checking the system’s performance was carried out with downloaded data, as close as possible to real (Fig. 5).

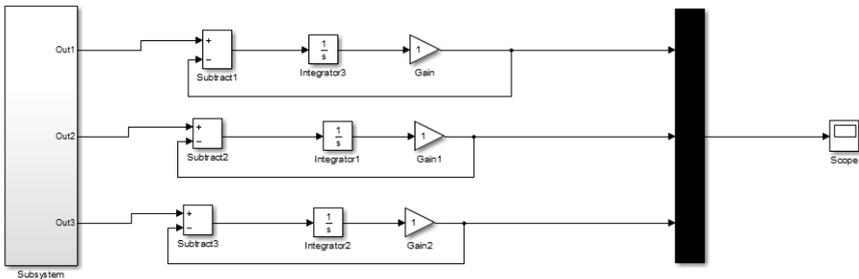


Fig. 4. The operation of the neural network

1	2	3	4	5	6	7	8	9
1	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
2	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
3	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
4	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
5	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
6	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
7	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
8	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
9	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316
10	51.0783	1.4166	51.1333	1.4766	51.0216	1.4000	51.1133	1.3316

Fig. 5. Simulation data

As a result of several iterations, the optimal shift was found with respect to the calculated coordinates and, as a result, the observed coordinates were obtained:

$$\begin{aligned} \varphi_c &= 51^\circ 05', 0 \text{ N}, \\ \lambda_c &= 001^\circ 25', 0 \text{ E}, \\ \varphi_o &= 51^\circ 16', 2 \text{ N}, \\ \lambda_o &= 001^\circ 24', 0 \text{ E}. \end{aligned}$$

Since the speed and accuracy of observations are the main safety factors for navigation, the speed of observation allows the skipper to spend more time observing and assessing the situation, which is especially necessary in coastal waters, canals and narrownesses.

The high accuracy of the VPD is potentially determined by the use of the Grossberg continuous competitive neural network with two levels, classical navigation methods for determining the location of a vessel at sea, as well as data from an electronic map. At the same time, the speed of observation increases significantly due to the working system, the principle of which is based on training and comparing the recorded values from the reference ones.

In conclusion, we note that the presented system has shown its operability with the help of simulation data in the framework of the methodology for determining the location of a vessel using three bearings of coastal landmarks.

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