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CONTENTS

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GENESIS AND EVOLUTION OF PUBLIC-PRIVATE PARTNERSHIP

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Annotatsiya: Maqolada tadbirkorlik faoliyatining yangi ko'rinishi sifatida dunyo miqyosida ko'plab mamlakatlarning iqtisodiyotida muhim ahamiyatga ega davlat-xususiy sheriklik munosabatlarining kelib chiqishi va rivojlanish bosqichlari haqida ma'lumotlar beriladi. Berilgan ma'lumotlar asosida sheriklik munosabatlarining rivojlanishi turli murakkab va xilma-xil davrlarni qamrab olganligiga guvoh bo'lish mumkin.

Kalit so'zlar: davlat-xususiy sheriklik, tadbirkorlik, xususiy sektor, infratuzilma, konsessiya.

Аннотация: В статье представлена информация о зарождении и развитии государственно-частного партнерства, которое имеет важное значение в экономике многих стран мира как новая форма предпринимательства. На основе предоставленной информации видно, что развитие партнерских отношений охватывало различные сложные периоды.

Ключевые слова: государственно-частное партнерство, предпринимательство, частный сектор, инфраструктура, концессия.

Annotation: The article provides information on the origin and development of public-private partnerships, which are important in the economies of many countries around the world as a new form of entrepreneurship. Based on the information provided, it can be seen that the development of partnerships has covered various complex periods.

Keywords: public-private partnership, entrepreneurship, private sector, infrastructure, concession.

Introduction. Availability of modern infrastructure is one of essential requirements for the achieving high levels of economic growth and building a strong economy. Developing countries need infrastructure, and developed countries need to create a new type of infrastructure. In general, the whole world is struggling to finance the infrastructure it needs. At the same time, the creation of sufficient infrastructure is one side of the issue, while ensuring efficiency in existing infrastructure facilities and the application of new, innovative methods of management is another. If the private sector is more widely involved in the issue, a well-thought-out policy and effective oversight practices can be used the economy can achieve this goal. For this reason, in the modern world, public-private partnerships are developing and discovering new content in many countries in the reform of infrastructure, as well as the construction of

new facilities and the search for new sources of funding. In turn, these relations have led to large-scale changes around the world, showing the way forward for many countries.

The desire to develop public-private partnerships is an objective phenomenon, a process directly related to the complexities that arise as a result of population growth and ensuring their normal quality of life. According to A.A.Rodina, "many countries around the world have to find new forms of government and control over the development of their economies"[1]. Increasing the socio-economic potential of society through the development of public-private partnerships has led to the formation of a new concept related to the participation of the state in the economy.

Literature review. There is a growing body of research on public-private partnerships around the world. In addition to the research work of scientists, international organizations also have their own opinions on this issue. According to the **United Nations,** PPP is aimed at financing, planning, implementation and operation of services produced and provided by the public sector, and its main features are to ensure long-term provision of services (sometimes up to 30 years), transfer of risks to private investors, public and local structures[2].

The International Monetary Fund (IMF) states that PPP is an agreement aimed at providing infrastructure assets and services by the private sector which traditionally provided by the state[3]. **Scientists E.R.Yeskomb, E. Farquharson** say that PPP is a long-term agreement on the construction, design, management of infrastructure by the private sector, and the purpose of this agreement provides for the use of private sector capital to finance a full or significant part of the facility[4]. According to **Richard Hemming**, a public-private partnership is an agreement with the private sector to traditionally provide infrastructure assets and services provided by the state. In a standard operating contract, the assets of a public-private partnership are owned by the private partner for the duration of the contract, and payments for services rendered are recorded as operating expenses in the public expense accounts[5].

In 2004, French researcher Xavier Bezanson published his book, 2000 Years of Public-Private Partnership Building Systems and Social Facilities[6]. From this it is possible to witness how long these relations have been going on.

Throughout the study, it can be witnessed that there is not much information on the origin of these partnerships and that they focused on the first use of the concept rather than the emergence of the concept.

Research methodology. The concept of public-private partnership in the economy of Uzbekistan is one of the completely new concepts, so the analysis of foreign literature on the study of socio-economic significance of these relations used existing theoretical and empirical research methods as a research methodology. In addition, research methods such as analysis and synthesis, comparison, deduction and abstraction were widely used to organize ideas of the article logically.

Analysis and results. The study of the origin and development of public-private partnerships is important in understanding the nature of partnerships, which are a specific type of public-private partnership. Although the concept of public-private partnership has only recently entered social life, the roots of this relationship go back a very long time. At that time, still public-private partnership relations developed and

formed from its simplest form to the present day, and took on an increasingly complex appearance.

To our mind, depending on the level of development, the evolution of public-private partnerships can be divided into the following periods (Figure 1).

Ancient period (early view of partnership). The appearance of the partnership in this period was very simple, the action of the private party was directly dependent on the kings. The earliest prototypes of public-private partnerships are claimed to have spread directly to ancient Greece and Rome. As an example of the primitive manifestations of the use of private aid for the benefit of society, in the fourth century AD the inhabitants of Athens contributed to the celebration of social holidays, religious ceremonies and the construction of social monuments and buildings. Centuries later, the Roman army used civilian support to occupy much of Europe and seize its riches[7].

At the same time, agreements between the Roman Empire and the private sector in those days led to a 5-year agreement to manage postal networks, as well as the maintenance of highways. However, such an order disappeared with the collapse of the Roman Empire, and in the twelfth and thirteenth centuries the reclamation of lands in the south-western region of France began to manifest itself again in the construction of new fortified cities. In addition, in a concession agreement that at that time had a monopoly in the company (mill, press, bakery, bridge, etc.), the concessionaire spent a certain portion of his income for the society[8].

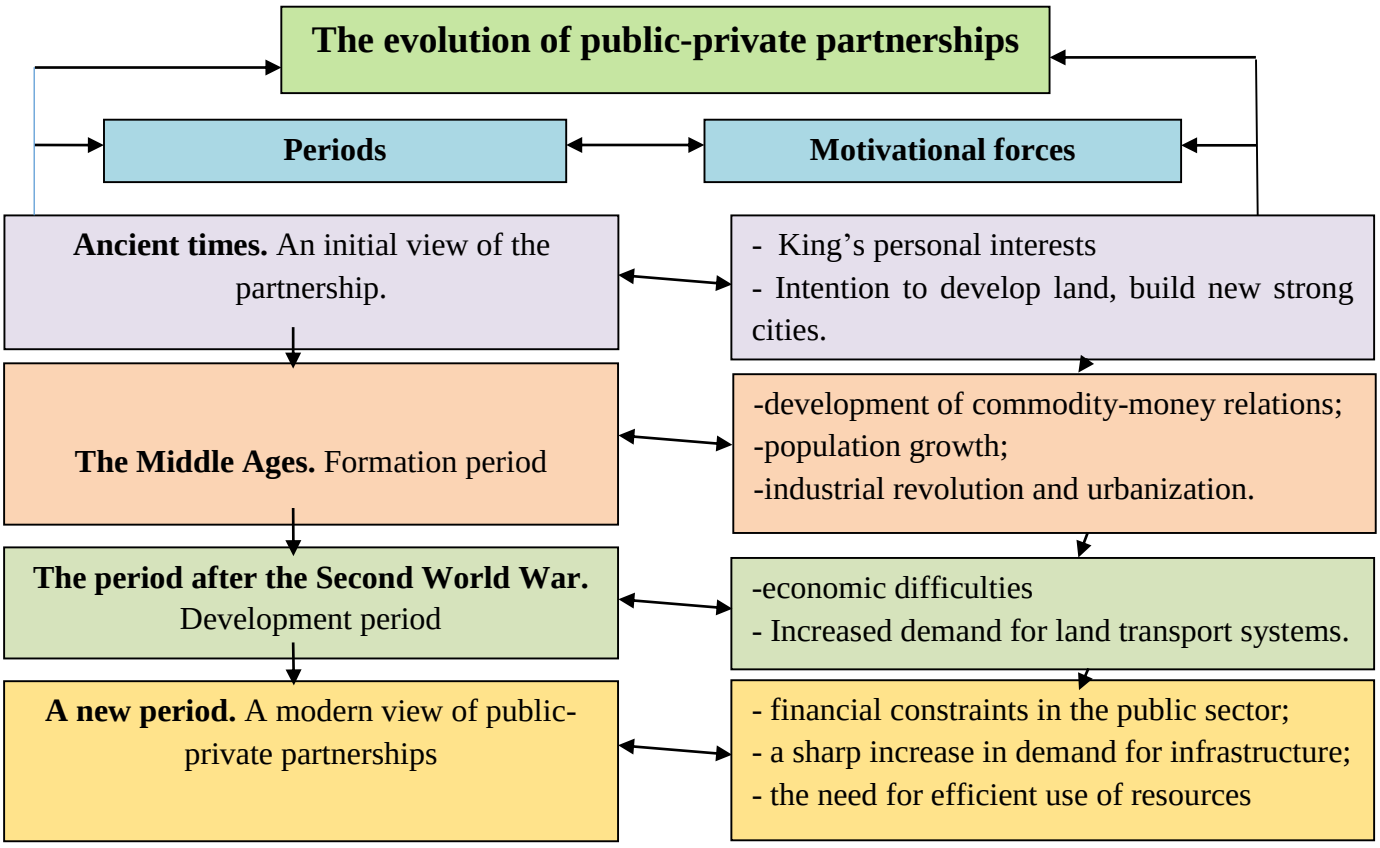
According to Dr. Emmanuel Avuah, the genesis of public-private partnerships goes back to the Ancient Bible. According to him, Pharaoh I at that time forcibly involved his subordinates in this work to build the infrastructure in the society. Their contribution is not only in the form of precious minerals such as gold, silver, diamonds, but also human resources (architects, masons, supervisors). At that time, people wanted to build the world's tallest tower and collaborated on the project to pool resources[9].

The Middle Ages (Formation Period). In the Middle Ages, the need for infrastructure increased as a result of the development of commodity-money relations and population growth. In the 16th and 18th centuries, European countries dug canals, repaired roads, and collected waste in partnership with the private sector.

In Italy, the first concession agreement for the transfer of natural resources to the private sector in the area of 1400 Miano de Medisano was implemented. The deal was carried out for the purpose of oil extraction, which included certain procedures[10].

The first form of public-private partnership in France was given in 1438 by the government to a citizen named Louise de Bernam in the form of a concession by the government to collect payments for goods transported across the Rhine. In France, public-private partnerships continued to take shape. In 1554, it was given to King de Henry II by King Henry II to dig canals and exploit objects in the valley[11]. In 1792, the most successful of the French concession projects was the distribution of mineral water from a source purchased by the Perier brothers under the Perier brand. The construction of the Suez Canal was also reportedly given to a private entrepreneur as a 99-year-old project, but in 1956 the project was forced to be nationalized by the Egyptian government[12].

Figure 1



In 1640, Massachusetts granted Harvard College the right to operate a ferry on the Charles River between Boston and Charlestown. Harvard had the right to operate the ferry and has been profiting from the project for more than 100 years.
However, in 1785, the Charles River Bridge Company asked the state legislature to authorize the construction of a bridge across the river. Proponents of the bridge noted that the two cities are much more developed and that the ferry is no longer convenient. This request was granted and Charles River Bridge was given the right to build the bridge and collect tolls for 40 years. The bridge was convenient for the population and successful for the entrepreneur[13].

Several toll roads built in the United States between 1780 and 1900 are evidence of private participation. In the 1700s, the transportation system in the United States was important to the country. At that time, the first private project to build the bridge was completed, and one of the first American lawsuits involving a public-private partnership project took place.

In the seventeenth century, the vast majority of railway construction projects in the UK were supported by the private sector. There were also 6 water companies in London by 1820.

Later, in the 19th century, the industrial revolution led to urbanization, which resulted in the immediate expansion of the required public transport, energy and sewerage systems, which were carried out on the basis of direct private partnerships[14].The predominance of the idea of liberalism at that time was an important catalyst, especially in the formation of these relations. Directly this required

restrictions on the role of the state in the economy and the formation of the concept of free enterprise. However, the Great Depression of 1929 necessitated a reconsideration of the role of the state and the private sector in the economy.

If we pay attention, we can see that the state is gradually involving the private sector in the performance of its functions, and a new type of relationship between the private sector and the state is being formed in society.

The period after World War II. (Development period). In the post-World War II period, the emergence of economic difficulties in the states necessitated the use of private assistance in order to stand on their own two feet. One of the earliest forms of public service contracting was the implementation of the Poverty Alleviation Program in the United States in the 1960s. Beginning in the 1960s, this relationship began to be widely used in the United States[15]. But the use of the term was not the first appearance of a public-private partnership.

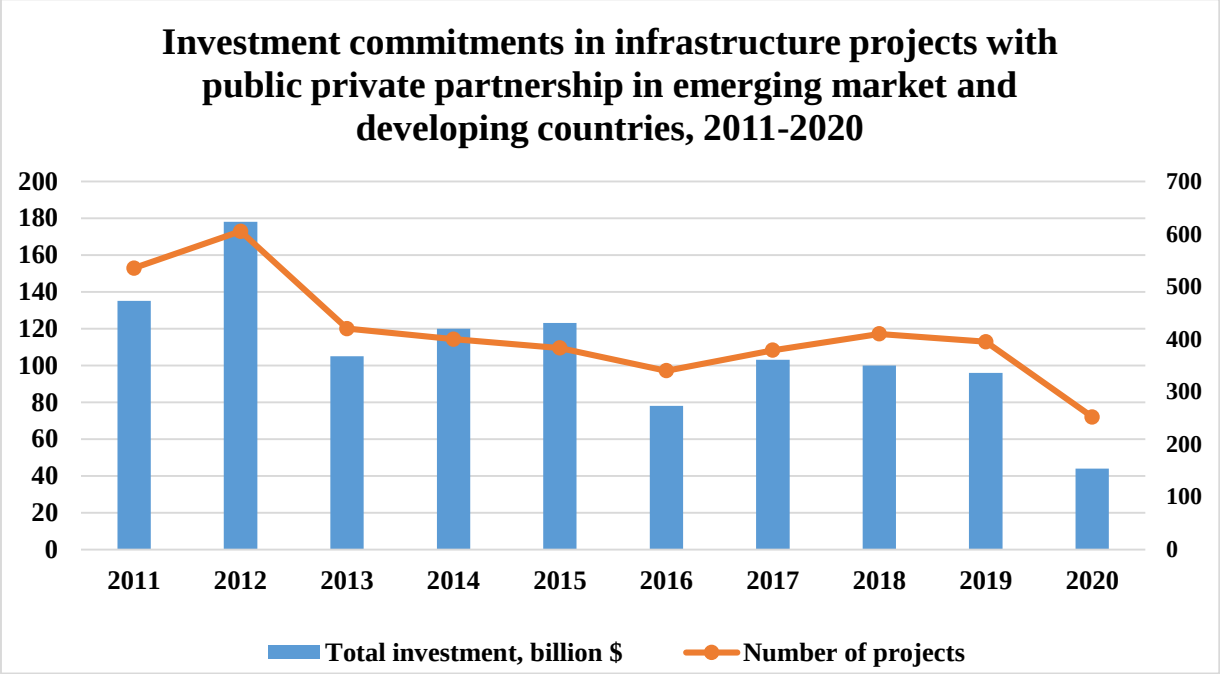
As state funding for federal and state highways became more limited, the involvement of the private sector became increasingly important as the need for land transportation systems increased.

New period (modern view of public-private partnership). In the late 1980s, the role of the private sector in the financing and operation of highways in the United States increased. The financial crisis in the public sector has led to the proliferation of public-private partnerships in the United States and elsewhere. The sharp increase in demand for infrastructure has strained the state's capacity in this area. At the same time, an important factor in the development of partnerships during this period is the desire to make efficient use of available resources. As a result, the scope, appearance and forms of partnerships have expanded tremendously. In 1989, state legislation on public-private partnership was developed in California, USA, and then in 1995 in Virginia[13].

In the 1990s, a new phase in the development of interaction between government and business began in the UK. *The term "public-private partnership" also appeared in the UK in 1992 and was recognized as a new way of managing state property after the Prime Minister John Major announced the concept of a private-financial initiative[16]*. Now this form of partnership has spread all over the world and is used in many fields such as energy, water and sanitation, transportation, airports, hospitals, education, railways and information technology in Latin America and North America, South Asia, East and Central Asia, Europe and Africa.

The COVID-19 crisis has affected many countries, forcing them to divert most of their capital to social security programs and the health care system. As a result, the incident hampered the implementation of infrastructure projects. In 2020, investment commitments on 252 projects will amount to $ 45.7 billion, a decrease of 52% compared to 2019. The number of investment projects decreased by 36% compared to 2019[17].

Figure 2



In conclusion, the development of public-private partnerships has gone through very complex and varied stages until it reaches its current state. From time immemorial, partnerships have opened up new opportunities for the state, and the government has benefited from the effectiveness of partnerships. At the same time, objectively, partnerships in society have developed from a simple system of benefits to the level of modern infrastructure projects.

References:

[1]. B.E.Sazonov. Gosudarstvenno-chastnoe partnerstvo. Dissertasiya. Moskva 2012. www.pppi.ru

[2]. Prakticheskoe rukovodstvo po voprosam effektivnogo upravleniya v sfere GChP/ Organizasiya Ob'edinennix Nasiy. - N'yu-York i Jeneva, 2008. ISBN: 978-92-1-4160403

[3]. Public-Private Partnerships. International Monetary Fund, 2004.

[4]. Yescombe E.R., Farquharson E. Public-Private Partnerships for Infrastructure: Principals of Policy and Finance. 2nd Edition. — Butterworth-Heinemann, 2018. ISBN: 978-0-08-100766-2.

[5]. Public Investment and Public-Private Partnerships. Addressing Infrastructure Challenges and Managing Fiscal Risks. Edited by Gerd Schwartz, Ana Corbacho, and Katja Funke. Palgrave Macmillan Ltd, 2008.page 264

[6]. Bezan¸con, X. (2004). 2000 ans d'histoire du partenariat public-priv´e pour la r´ealisation des ´equipements et service.

[7]. Louis Witters, Revital Marom, and Kurt Steinert, Alcatel-Lucent. The Role of Public-Private Partnerships in Driving Innovation. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2012-chapter2.pdf

[8]. Overview of PPP experience. https://ppiaf.org/sites/ppiaf.org/files/documents/toolkits/highwaystoolkit/6/pdf-version/1-21.pdf
[9]. Dr. Emmanuel Awuah.Teh Genesis of Public-Private Partnerships (PPPs)-Reviewed Edition,2019. https://www.linkedin.com/pulse/genesis-public-private-partnership-ppp-emmanuel-awuah
[10]. Вихрян А.П. Концессия (исторический экскурс) // Вестник Минимущества России. 2003.
[11]. Борщевский Г.А. Государственно-частное партнерство. М.: Юрайт, 2018. С. 70-75.
[12]. Н.Г. Степанова. Особенности развития партнерских отношений государства и бизнеса.
[13]. https://www.lorman.com/resources/a-brief-history-of-public-private-partnerships-16968
[14]. Public-Private Partnerships.A Basic Introduction for Non-Specialists. Nathan Associates February 2017
[15]. United States department of transportation Report to congress on public-private partnerships. December 2004. https://www.fhwa.dot.gov/reports/pppdec2004/
[16]. https://www.lawteacher.net/free-law-essays/commercial-law/origin-of-public-private-partnerships-commercial-law-essay.php
[17]. Public participation in infrastructure. Global report. World Bank. 2021. Page 10.

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THE ESSENCE, ROLE AND SIGNIFICANCE OF REGIONAL MARKETING IN THE REGIONAL SOCIO-ECONOMIC DEVELOPMENT SYSTEM

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Annotatsiya: Maqolada hududiy marketingning hududni ijtimoiy-iqtisodiy rivojlantirishdagi mohiyati, o‘rni va ahamiyati o‘rganilgan. “Hududiy marketing” tushunchasining mohiyatini nazariy tahlil qilish natijalari keltirilgan. Tahlil natijalari asosida hududiy marketingni amalga oshirish mexanizmi modeli ishlab chiqilgan. Mualliflik yondashuviga ko‘ra, har bir hudud – hududiy rivojlanish va hudud mavqeining mustahkamlanishiga ta’sir ko‘rsatuvchi va iste’molchilarning ehtiyojlarini qondirish uchun zarur bo‘lgan, tabiiy, moddiy-ishlab chiqarish va ijtimoiy resurslar borasida o‘z raqobat afzalliklarining muayyan nisbatiga egaligi bilan ajralib turadi. Hududiy marketing, bu borada, hududda ishlab chiqarilgan yoki import qilinadigan tovarlar va xizmatlarga iste’molchilar talabini shakllantirish, qayta shakllantirish va qondirish jarayonini ta’minlaydigan, iste’molchilarga yo‘naltirilgan marketing usullari, vositalari, tamoyillari va texnologiyalari majmuidir.

Kalit so'zlar: hudud, hududiy marketing, mexanizm, mohiyati, marketing majmuasi va dasturi, marketing tadqiqotlari, marketing maqsadi va strategiyasi, hududiy marketing samaradorligini baholash.

Аннотация: В статье изучена сущность, роль и значимость регионального маркетинга социально-экономическом развитии региона. Приведены результаты теоретического анализа сущности понятия «региональный маркетинг». Исходя из результатов анализа разработана модель механизма реализации регионального маркетинга. Согласно авторскому подходу, каждый регион отличается наличием определенного соотношения своих конкурентных преимуществ по природному потенциалу, материальному производству и социальным ресурсам, которые влияют на региональное развитие и укрепление позиций региона и необходимы для удовлетворения потребностей потребителей. Региональный маркетинг в этой связи представляет собой совокупность ориентированных на потребителя маркетинговых методов, инструментов, принципов и технологий, обеспечивающих процесс формирования, переформирования и удовлетворения потребительского спроса на товары и услуги, производимые или ввозимые на территорию.

Ключевые слова: регион, региональный маркетинг, механизм, сущность, маркетинговый комплекс и программа, маркетинговые исследования, маркетинговая цель и стратегия, оценка эффективности регионального маркетинга.

Abstract: The article studies the essence, role and significance of regional marketing in the socio-economic development of the region. The results of the theoretical analysis of the essence of the concept of "regional marketing" are given. Based on the results of the analysis, a model of the mechanism for the implementation of regional marketing has been developed. According to the author's approach, each region is distinguished by having a certain ratio of its competitive advantages in terms of natural material production and social resources, which affect the regional development and strengthening of the position of the region and are necessary to satisfy the needs of consumers. Regional marketing, in this regard, is a set of consumer-oriented marketing methods, tools, principles and technologies that provide the process of formation, re-formation and satisfaction of consumer demand for goods and services produced or imported in the territory.

Key words: region, regional marketing, mechanism, sustainability, marketing complex and program, marketing research, marketing goals and strategy, assessment of regional marketing effectiveness.

Introduction. It is well recognized that a territory's resource potential determines the socioeconomic growth and structural specialization of the economy of that region. It follows that there is a lever of resources that can be used to build a national economy with useful socioeconomic development parameters in a particular region, and that using these resources, it is necessary to decide the directions of complex and proportionate socioeconomic development of regions. In setting the production rates appropriate for the territorial resources available and in accordance with customer requirements, territorial marketing is particularly crucial.

In order to create the region's attractiveness and its economic, social, labor, and similar resources, it is required to produce a thorough analysis of the development prospects of the region. Regional marketing is crucial in this situation since it helps identify the region's potential and develop distinctive advantages over other regions. The context impacts the applicability of the chosen study topic and the significance of the field.

Literature Review. We may discover a variety of ideas that, to varying degrees, represent the problems with employing a marketing strategy in the administration of the territory under the conditions of the market economy in both local and international economic literature. For instance, terms like «regional marketing,» «place marketing,» «city marketing» «territorial marketing» and «intra-regional marketing» might be used. Although each of the aforementioned groups has unique characteristics, they are all related in some ways. Territorial marketing is one of these categories that is most frequently employed (place marketing). The regional marketing category's essence is frequently shown using the economic-geographic and marketing strategyResearchers like A.M. Lavrov, V.S. Surinin, V.I. Butov, V.G. Ignatov, N.P. Keretova, and T.V. Sachuk recommended utilizing the economic-geographical technique to analyze the regional marketing category. A.M. Lavrov and V.S. Surnin were among the pioneers in the field of regional economy to introduce the idea of «territorial marketing» into scholarly discourse in 1994. They claim that rather than studying market interactions at the micro-level, «territorial marketing» tries to research them at the meso-level (district, city, and region level) [1].

The marketing strategy is the second method for defining the key elements of modern management of a city or particular area under the circumstances of a market economy. A.L. Gaponenko, G.V. Gutman, and E.P. Golubkov might be cited as examples of this method. Regional marketing, in this perspective, «represents a set of measures to attract new economic agents to the area, city,» In this instance, concentrating on both local inhabitants and visitors can be fairly successful.

Scientists from Russia who have discussed the use of a marketing strategy in the creation of substantial regional structures include I.V. Arzhenovsky, G.L. Bagieva, V.P. Barancheeva, S.V. Besfamilnaya, V.I. Butova, D.V. Vizgalova, L.Gaponenko, O.N. Jiltsova, V.G. Ignatova, N.P. Ketova, Particularly intriguing are the works of Surnina, O.A. Tretyak, A.V. Shiskina, and O.U. Yuldasheva.

Analysis and results. It is fascinating in every aspect to examine the collected foreign expertise in effective territory administration. Although the term «territorial marketing» does not appear in the works of Western scientists, it is frequently used in conjunction with the term «place marketing,» which refers to marketing of administrative-territorial structures at the national level. F. Kotler and his coworkers give regional marketing particular focus in their writings. They frequently employ the idea of «place marketing» and think that marketing offers a whole strategy for resolving local issues. According to F. Kotler, marketing strategy planning should be done in collaboration with regional businesses, government organizations, and residents of the area. It highlights that marketing is essential for enhancing the regional community's capacity to adjust to market changes and to improve the community's viability in a cutthroat business climate. The development of a community framework

that enables satisfying the demands of all the major institutions of society is what regional strategic marketing aims to achieve. The following, according to F. Kotler, are the primary responsibilities of regional marketing: defining and diagnosing the current state of the community, its primary issues, and their root causes; identifying potential solutions to current issues based on the resources and capabilities of the community, the values formed in the community; enacting systemic changes in society; and creating a step-by-step long-term investment plan [2]. Such a strategy is thought to be particularly pertinent as it specifies the marketing cycle's components and displays the essence of the idea of regional marketing as a tool of the local economy.

He highlights the importance of regional marketing (including city marketing) in bolstering the position and reputation of the region, luring representatives of industrial production there, and promoting the region itself, which is in line with the opinions of A. Dayan F. Kotler. In other words, it is obvious that the goal of regional marketing is to promote a positive image of the area.

In his scholarly writings, A.P. Pankrukhin gave the idea of «territorial marketing» careful consideration. In his first definition of «territorial marketing,» he claims that the area as a whole is its object and that marketing may be done both inside and outside of it. Later, A.P. Pankrukhin characterizes it as follows after somewhat changing his mind on the subject:

1) territorial marketing, also known as area-oriented marketing or territorial marketing, is marketing that is done based on the interests of areas, internal and external businesses;

2) «Creating, developing, and successfully promoting the region's competitive advantages within the interests of this region, both inside and outside of it, as well as internal and external entities, is the goal of territorial marketing, which is marketing that treats the region as an object of attention and promotion in a holistic manner»;

3) «Area-oriented marketing is a particular meaning of the term «territorial marketing» that reflects the details of the area's marketing relationships and their stage of development for certain goods and services» [3].

Territorial marketing is thus described by T.V. Sachuk as «a new philosophy of territory management based on a new understanding of the responsibilities and tasks of local government bodies» [4]. As a result, it is necessary to establish the state's involvement in assuring the execution of regional marketing and to focus its interventional efforts on promoting regional development.

Different interpretations of «territorial marketing» are possible. It should, on the one hand, be in line with the structures and procedures of state regulation, and, on the other hand, be able to accurately represent the status of the local economy and help the area become more competitive. It should go without saying that regional marketing is a very difficult topic to understand. The goal of regional marketing is to ensure and promote the region's competitiveness at the regional level in the outside world.

Theorists and practicing scientists expanded the scope of research to clarify the competitive advantages of the region and further strengthen them using «territorial marketing,» which is thought of as a comprehensive concept, in order to increase scientific and practical interest in studies of regional competitiveness and strengthen its position.

Regional marketing is not a fundamentally new idea, but like most marketing theories and studies, its roots are American. For instance, the selling of lands in the 1850s in the «Wild West» was of particular importance in luring people to transfer to new regions, according to Finnish scientist Seppo K. Rainisto's dissertation study work. In the meanwhile, tourism to British and French coastal destinations is widely promoted [5]. Based on numerous promotional mediums, territory marketing was seen as the primary method of promoting the territory as a desirable travel destination.

Later, scholarly monographs started to appear in which territorial marketing is emphasized as a key component of a region's economic growth plan. The opinions of American academics D. Ashworth, D. Bailey, and H. Wood (Ashworth G. J., Voogd H., 1989), which explain sales procedures, are fairly intriguing in this regard [6]. The core of this strategy is the requirement to take into account the local heterogeneity of the national markets of the majority of countries, even though these particular aspects are widely used in the development of marketing programs for these markets. Later, F. Kotler used this strategy extensively in the development of marketing programs for a number of large American companies to operate successfully in national markets.

Later, in 1993, D. Haider, F. Kotler, and I. Reins published the findings of their combined study in the area of «territorial marketing.» It also amply illustrates the modern world's mentality of consumerism [7]. As the key growth directions in the promotion of the region, investment, tourism, image, and social attractiveness are significant. The first examples of branding and marketing strategies for focused promotion of areas in the development of advertising campaigns for cities, regions, and nations are shown below based on the opportunities and conditions that existed at the time.

Professor S. Ward of Oxford Brookes University released his article titled «Marketing Territories: The Marketing and Promotion of Cities and Megapolises in 1850-2000» in September 1998 (Ward S.W., 1998) [8]. In contrast to F. Kotler and his colleagues, who saw regional marketing as a byproduct of the latter half of the 20th century, he attempted to explain the history of the birth of the practice in it. S. Ward describes in detail the experience of industrial and touristic cities in Great Britain and the United States from the 18th century and draws the necessary conclusions about the viability of artificially managing the competitiveness and attractiveness of the regions through purpose-oriented information and advertising activities.

The introduction of the idea of «internal marketing of locations» into scientific communication is S. Ward's contribution to the growth of the notion of regional marketing. The core idea behind this strategy is that it heavily relies on promotional techniques and resources meant to attract outsiders or tourists rather than current locals. To put it another way, it compares internal marketing with marketing that is uniformly targeted at local residents. The author views the connection between external and internal marketing in the fact that the territory's primary internal marketing objectives are constrained in comparison to external marketing's primary objective of attraction. Additionally, he makes the comparison between internal territorial marketing and demarketing, a strategy that is currently very popular in Europe. Investors, visitors, and new residents are drawn to the area as a result of improved communication, population growth, and capital mobility.

The demands of particular groups of people are given particular emphasis in the interpretations of the majority of authors to disclose the substance of the notion of regional marketing, and it is highlighted that this is the foundation of the regional development management system. Additionally, we can draw the conclusion that regional marketing is one of the levels of regional marketing, which investigates the potential uses of natural, production, and social resources in order to develop the region socio-economically and boost its competitiveness, and includes the idea of managing the region in accordance with market principles.

In 1994, A.M. Lavrov and V.S. Surnin introduced the term «territorial marketing» to economic literature for the first time [9]. Regional marketing, which is heavily focused on the application of the economic and geographical approach rather than marketing theory and practice and is targeted to the mesolevel, is highly regarded by the authors for its contribution to assuring the growth of regions.

In summarizing the opinions of scientists like V.S. Surnin, the Russian researcher A.P. Pankrukhin and a number of foreign scientists, in particular A. Dayan and F. Kotler, as well as Russians - I.V. Arzhenovsky, A.M. Lavrov, A.L. Mnachkyan, and K.B. Norkin - define regional marketing as a marketing activity based on the interests of the territory, its internal and external [10]. The author makes a distinction between «territory marketing» and «intra-territory marketing» while analyzing the notion of «territorial marketing». Regional marketing, for instance, focuses on territorial offices of the state government that serve the local community. Although «intra-regional marketing» and «territorial marketing» are both defined in the same way, they differ in the specifics and stage of development of marketing connections between regional bodies about certain commodities and services [11].

Regional marketing, as defined by V.I. Butov, V.G. Ignatov, and N.P. Ketova, is based on the distinctive way of thinking of leaders at the regional level (operating in selected markets) of individual population groups, enterprises, and businesses situated both within and outside of that region. They see it as a type of activity intended to meet their needs for information, technology, and the like. A.L. Gaponenko claims that the primary types of regional marketing are the sale of land, houses, agricultural structures, and investments. According to the aforementioned author, territorial and municipal (administrative-territorial structures) marketing is a collection of actions intended to entice economic agents to the territory who substantially contribute to its growth utilizing marketing methods to the territory's development [12].

The demands of particular groups of people are given particular emphasis in the interpretations of the majority of authors to disclose the substance of the notion of regional marketing, and it is highlighted that this is the foundation of the regional development management system. Additionally, we can draw the conclusion that regional marketing is one of the levels of regional marketing, which investigates the potential uses of natural, production, and social resources in order to develop the region socio-economically and boost its competitiveness, and includes the idea of managing the region in accordance with market principles.

The core of any area is a city, hence it stands to reason that urban marketing is the lowest level or subsystem of regional marketing. One of the key areas of research and study in this field at the moment is various facets of city marketing. Researchers like

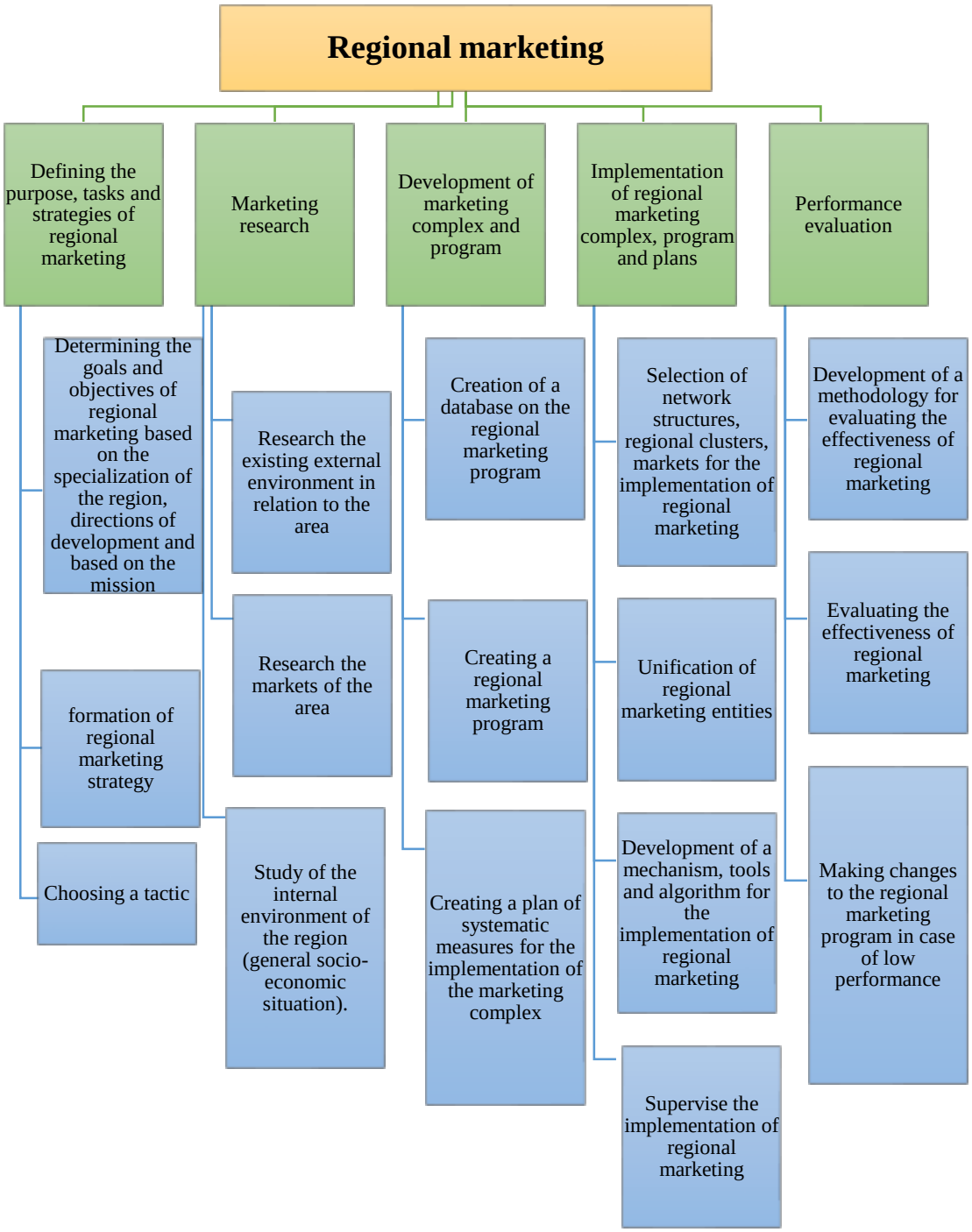
P.V. Kuchtin and A.A. Levov, for instance, differentiate between urban real estate and urban address marketing as a way of development to suit human requirements in quest of the most pleasant living environment inside the urban marketing environment [13]. T.V. Usakova in the narrow interpretation of the concept of «city marketing» refers to the consideration of business interests as an important element of the development of the city's economy and its social sphere [14]. The most important task of city marketing was emphasized in the scientific research of T.M. Orlova as a collection of systematic measures to develop new competencies and utilize those that already exist to draw economic agents to the city, which allows to increase the well-being of the local population [15].

In a variety of scholarly literatures, the notion of municipal marketing is defined. These academic sources define municipal marketing as a management strategy that considers and analyzes market requirements, demand, and supply in order to direct government agencies' attention toward the creation of certain goods and services in the industrial and non-industrial sectors. Municipal marketing, in a nutshell, is the promotion of both urban and rural places.

Some academics favor studying «place» marketing over studying areas in terms of their administrative-territorial systems. For instance, S.N. Andreev describes location marketing as a collection of tactics intended to sustain or alter customers' relationships to a particular «place» in his scientific research, which divides two significant categories of interests: commercial and non-commercial interests. While the non-commercial area of activities contains items of cultural and historical significance, the commercial field of activities is directly tied to the interests of producing firms [16]. The definition provided by S.V. Alekseev is based on the developer's viewpoint and is comparable to that of O.V. Jerdeva. In a limited sense, it implies placing real estate and land into economic circulation; in a wide sense, it involves enhancing the area's attractiveness.

According to the author's methodology, each region differs from others by having a specific ratio of its competitive advantages in terms of the production of natural resources and social resources, which have an impact on regional development and the strengthening of the region's position as well as being required to meet consumer demands. In order to create, reshape, and satisfy customer demand for products and services made in the area or imported there, a collection of consumer-oriented marketing tactics, tools, philosophies, and technology are known as territorial marketing. management of regional socioeconomic processes to promote the entrance and sale of labor, services, and goods in the current markets, to boost the competitiveness of regional goods and services, to support production's mobility, and to quicken the fund return of regional production funds. According to us, the economic core of regional marketing may be seen in the ways it affects several facets of the regional economy's conventional economic life. A steady flow of money is required for the region's overall development, and this flow is dependent on the direct and indirect levers of control over the marketing and socioeconomic processes. In this regard, it's important to provide beneficial circumstances for the execution of economic operations in the area and to tell investors of the favorable environment that has been established.

Having studied the existing research, we developed a model of the implementation mechanism of regional marketing (Figure 1).



Picture-1. The mechanism of implementation of regional marketing: methods, tools and elements

Conclusion and Recommendations. The fundamental objective of regional marketing is to plan and model marketing operations in the region in order to fulfill consumer wants while utilizing the resources of the region, according to a summary of the views and opinions of scientists. The socio-economic indicators of the region will show good dynamics if the locals are content with the circumstances established for the area of their habitation and economic activity, if the tourists' and investors' expectations are reasonable. The economic indicators of the regional system represent the author's opinions on the usage of regional marketing techniques.

According to our definition, «Territorial marketing is the coordination of the economic and management activities of the entities of the territorial management system through regulation and coordination of their development in order to coordinate the needs and production capabilities of consumers of territorial resources.

References:

[1]. Lavrov A.M., Surnin V.S. Economic reforms: municipal aspects. Development of municipal marketing and trends. Kemerovo: Kuzbassvuzizdat, 1994. P.54.
[2]. Marketing mest. Privlechenie investment, enterprise, hotel and tourism in the city, commune, region and strane Evropy/ F. Kotler, K. A. Splund, I. Rein, D. Haider. SPb.: Stockholm School of Economics, 2005. P.55.
[3]. Pankrukhin A.P. Municipal administration: territory, M.: Logos, 2002. S. 55.
[4]. Sachuk T.V. Basic strategic management of municipal education: ucheb. posobie/ Karel. gos.ped. flour Petrozavodsk, 2001. S. 45.
[5]. Rainisto, K. Seppo (2003) Success factors of place marketing: a study of place marketing practices in northern europe and the united states / K. Seppo 180 Rainisto. – Business Doctoral Dissertations 2003/4, Helsinki University of Technology, Institute of Strategy and International. – P. 11-16
[6]. Bailey, J.T. Marketing cities in the 1980s and beyond. / J.T. Bailey. – в American Economic Development Council, Cleveland University Press, 1989. – P. 57
[7]. Kotler, Ph. Marketing places Europe: How to attract investments, industries residents and visitors to cities, communities, regions and nations in Europe / Ph. Kotler, C. Asplund, I. Rein, D.H. Haider. Pearson Education, Harlow, 1999. – P. 302.
[8]. Ward, S.V. Selling Places: The marketing and promotion of towns and cities 1850-2000. / S.V. Ward. – E & FN Spon, London, 1998. – P. 269.
[9]. Lavrov, A.M. Economic reforms: regional aspects. Ch. 2. Regional marketing and tendency ego development / A.M. Lavrov, V.S. Surnin. - Kemerovo, 1994. - S. 3
[10]. Pankrukhin, A.P. Marketing territory / A.P. Pankrukhin. - Peter, 2006. - 416 p.
[11]. Pesotskaya, E.V. Modelirovanie sotsialno-ekonomicheskogo razvitiya malykh i srednih gorodov Rossii: monografiya / E.V. Pesotskaya. -SPb.:SPbUEF, 1994.-159 p.
[12]. Gaponenko, A.L. Theory of management: uchebnik / A.L. Gaponenko; pod obshch. ed. A. L. Gaponenko, A.P. Pankrukhina. - M.: Izd-vo RAGS, 2003. -558.
[13]. Kukhtin, P.V. Management of the housing and communal complex as an object of municipal property: monograph / P.V. Kukhtin, A.A. Levov, M.E. Stadolin. - M.: Karpov E.V., 2004. - 262 p.
[14]. Uskova, T.V. Problems of socio-economic development of regions / T.V. Uskova [Electronic resource] - Access mode: http://www.gosbook.ru/node/70001 (Date of access: 06/24/2016)
[15]. Orlova, T.M. Management of city development: Methodological recommendations to local administrations for the promotion of cities / T.M. Orlov. - M.: Holding company TICOM, 2001. - S. 7-9.

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METHODS FOR IMPROVING INDEPENDENT LEARNING METHODS

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Annotatsiya – maqolada mustaqil ta'lim metodlari haqida batafsil ma'lumotlar keltirilgan. Shu bilan birga bu metodlarni yanada takomillashtirish haqida bir qancha usullar keltirilgan va misollar yordamida tahlil qilingan.

**Kalit so`zlar:** Mustaqil ish, malaka, bilimlarni tizimlashtirish, aqliy mehnat, o`quv matnlari, nazorat testlari turlari.

Аннотация – статья содержит подробную информацию о методах самостоятельного обучения. При этом представлены и проанализированы с помощью примеров несколько путей дальнейшего совершенствования этих методов.

Ключевые слова: Самостоятельная работа, умения, систематизация знаний, интеллектуальная работа, учебные тексты, виды контрольных испытаний.

Abstract - the article contains detailed information about the methods of independent education. At the same time, several ways of further improvement of these methods are presented and analyzed with the help of examples.

Key words: Independent work, skills, systematization of knowledge, intellectual work, educational texts, types of control tests.

Introduction. A distinctive feature of our time is the trend towards the integration of knowledge. There is an intensive interpenetration of ideas and methods of various scientific directions. New disciplines appear at the intersection of sciences. This is due to the need for a multidimensional vision of each phenomenon.

An integrated approach to solving problems of a technical, economic, and environmental nature is especially needed at the present time in the period of rapid development of scientific and technical thought.

Taking into account the tasks facing modern education, we can say that teaching methods are methods of mutually related activities of a teacher and a student aimed at implementing a competency-based approach, the best assimilation of knowledge, instilling certain skills and abilities, developing cognitive activity, independence and creative abilities. The implementation of various methods and methodological techniques should form students' conscious, systematic and solid knowledge.

Literature review. The main advantage of natural science disciplines is that students encounter many natural facts and phenomena in the process of life, therefore they have some knowledge of the disciplines they study. The task of the teacher in the learning process is to transform seemingly long-known facts into scientific knowledge, while teaching students to correctly express their opinions and think independently [1].

To improve the educational process, it is necessary to use both long-proven methodological techniques (didactic material, workbooks, test tasks, test papers, oral

surveys, and others), as well as innovative forms of education using computer technology, multimedia equipment, distance learning. The combination of methods will allow to implement the tasks at a higher level [2].

Educational and methodological work should also be aimed at improving traditional methods. When conducting lectures and practical classes in the natural sciences, the teacher introduces the student to the problems of the topic being studied, interests her in complex aspects. At the same time, multimedia lectures, educational films, and computer testing are used to optimize perception. Unfortunately, the large amount of material studied often does not allow delving into important and interesting details of the topic. Such methods as special courses, circle work, independent work of students come to the rescue.

Analysis. In a modern university, special attention is paid to independent work. This type of activity is not just an important form of the educational process, but should become its basis, one of the ways to adapt to professional activities in the modern world. The teacher should teach the student not to passively consume knowledge, but to be its active creator [3]. Consequently, independent work should move from the method of consolidating the material covered to the method of forming a creative personality capable of self-development, self-education, and innovative activity.

Methods of problem-based and developmental learning can be widely used. At the same time, a cognitive problem is posed that requires an active independent search [4]. The teacher directs the students' activities to establish cause-and-effect relationships, to discover new facets of the subject under consideration.

Methods for improving training sessions are diverse. Their choice depends on the curriculum, specialization features, professional orientation, goals and objectives of training. All methods and methodological techniques in teaching natural sciences should be closely interconnected and aimed at finding interdisciplinary connections [5]. The choice of method will then be successful and optimal when the best results are obtained in a short study time.

The cost-effectiveness of the method, achieving the maximum effect with the least amount of time is one of the most important tasks of the educational process.

In the organization of educational and methodological work, the ability of the educational system to respond quickly to the changing demands of society is of paramount importance, and innovation is a condition for creating a mechanism for adapting to the new economic, social and demographic situation in the country and region [6].

Discussion. Extracurricular work - the study of scientific and special literature, preparation for classes, writing essays, reports, completing assignments on topics submitted for independent study. It is controlled and evaluated through tests, questions for self-control, tests. Tasks can be differentiated as mandatory (the minimum required for mastering by everyone without exception, the timing and form of reporting can be variable) and optional for everyone, individual: expanding the scope of knowledge or correcting depending on the readiness of the student and his interest in the discipline [7].

By purpose:

1. Current study of the material (CSM) - homework, work with lecture notes, note-taking of primary sources, preparation for seminars, laboratory work.

2. Educational and research work (ERW) - the implementation of individual weekly, monthly, semester tasks, independent study of the topic, preparation of an abstract, report, message, analysis of special literature [8].

3. Research work (R&W) - the implementation of term papers and theses, the preparation of scientific reports, articles, etc.

A.K. Buryak refers to the main varieties of independent work work with a book, observation, experiment, design, modeling, problem solving. A large place in the educational activities of students is occupied by independent work with a book: educational, additional, reference, normative. Tasks for working with the book should be varied, ranging from commented reading to the implementation of practical exercises based on the literature read [9]. These tasks can be the following:

- commented reading (“Read part of the text and explain how you understand it”);
- drawing up a plan of the material read;
-selection of extracts on the questions asked, note-taking of the text;
- preparation of abstracts on several literary sources;
- drawing up a plan of the provisions formulated in the literary source, and their implementation in practice (“Read the article, tell or describe how you use the acquired knowledge in practice”);
- search for an explanation of individual terms in dictionaries, reference books, encyclopedias;
-Performance of practical tasks with the use of normative, reference literature.

Homework as a type of independent work of students. A peculiar form of organization of independent work of students is self-study of students to do homework. They represent a logical continuation of the classroom lessons, are conducted on the instructions of the teacher, who instructs the students and sets the deadlines for completing the task. Unlike other forms of organization of the educational process, the time spent on this work is not regulated by the schedule [10].

The mode and duration of work is chosen by the student himself, depending on his abilities and specific conditions, which requires him not only mental, but also organizational independence. Homework is an independent learning activity of students that complements the lesson and is part of the learning cycle. Its special functions are to develop the ability to study independently, determine tasks and means of work, and plan teaching. It develops thinking, will, character of the student. Its main purpose is to consolidate the knowledge and skills acquired in the classroom, develop skills, assimilate new material.

Scientists identify the following conditions for the success of homework: students have the skills of independent work, pedagogical guidance and control over homework. The latter requires appropriate dosing, limiting the amount of homework, a clear formulation of tasks and recommendations for implementation, timely verification and evaluation.

In secondary vocational schools, the following types of homework are used, depending on the goal:

1. The goal is the primary acquisition of knowledge (learning new material).

Types of homework: reading a textbook, primary source, additional literature; drawing up a plan of the text, taking notes of what has been read, a graphic representation of the structure of the text; extracts from the text; work with dictionaries and reference books; familiarization with regulatory documents; observations.

2. The goal is to consolidate and systematize knowledge.

Types of homework: work with lecture notes, re-work on the material of the textbook, primary source, additional literature;

drawing up a plan for answering specially prepared questions; drawing up tables, graphs, diagrams; study of regulatory documents; answers to control questions; preparation for the presentation at the seminar; abstracts and reports, compilation of bibliography.

3. The goal is the application of knowledge, the formation of skills.

Types of homework: solving problems and doing exercises according to the model; performance of settlement and graphic, design works, situational production tasks, preparation for business games; preparation of course, diploma projects; experimental work.

Along with homework assignments common to all students, individual assignments can be used. Individual homework assignments are often given in order to fill in the gaps that students have in mastering the educational material. Also, individual homework can be offered to students who show a special interest in a particular academic discipline. Such tasks not only stimulate the development of students' creative abilities, but also contribute to the exchange of knowledge in the classroom, create a creative atmosphere, the joy of intellectual communication.

Individualization of homework assignments can be carried out by partial individualization of the assignment common to the entire study group, the use of individual or group homework assignments instead of (or in addition to) frontal assignments, and the use of optional (desirable) assignments along with mandatory homework assignments.

Conclusion. The teacher must correctly determine the volume and content of homework, tell students how to complete assignments, what techniques and methods to use, what is the methodology for independent work. Here, the systematic instructions of the teacher and the demonstration of samples of the completed task are very important, as well as the exercises of students in the application of certain methods of independent work.

Along with general instructions, instruction has an important place, orienting students to independent work on a specific material. The attention of students is drawn, first of all, to the amount of work that should be done; to repeat what was previously learned; on the methods of work that are more appropriate to use; to the organization of self-control.

Also, when doing homework, it should be borne in mind that some academic disciplines require a large amount of time to master, while others require regular work

(daily). When mastering the first, comprehension prevails, and the second - memorization or accumulation of the impact effect.

References:

[1]. Bordovsky G.A. Models and methods of internal and external evaluation of the quality of education in universities. - St. Petersburg: Prince. house, 2008. - 338 p.
[2]. Vasilyeva E.Y. System monitoring of the educational environment of the university (Northern State Medical University) // University management: practice and analysis: Publishing house "Non-commercial partnership" (Yekaterinburg). -FROM. 24-34.
[3]. Galeeva R.B. Marketing research in education: monograph. - M.: Dashkov i K., 2007. - 159 p.
[4]. Golyshev I.G. Management of the quality of education at the university: the search for a model. - Cheboksary: New time, 2006. - 150 p.
[5]. Kiseleva M.V. Involvement of university students in assessing and improving the quality of education // Bulletin of KSU named after. ON THE. Nekrasova, 2016. T. 22. - pp. 142-147.
[6]. Orlova E.A., Kamenets A.V., Urmina I.A. Workshop Sociocultural problems of youth. -Tutorial. Moscow: RGSU. - 196 p.
[7]. Selezneva E.N. Problems of spiritual and moral education in the education strategies of the XXI century. Scientific and methodological manual. - M.: RGSU, 2009. - 45 p.
[8]. Urmina I.A. The concept of life success in the youth environment. Textbook. - M.: Izd-vo RGSU, 2011. - 139 p.
[9]. Freud Z. Introduction to psychoanalysis: Lectures. - M.: Nauka, 1991. - 456 p.
[10]. Shchedrovitsky G.P. Selected works. - M.: Shk. cult. politics, 1995. - 800 p.

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SPECIFIC ASPECTS AND PRINCIPLES OF THE METHOD OF ORGANIZING INDEPENDENT EDUCATION OF STUDENTS

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Annotatsiya – Ushbu maqolada ta’lim jarayonini modernizatsiyalash, zamonaviy axborot va pedagogik texnologiyalarni ta’limda joriy qilish, masofaviy ta’limni tashkil etishda axborot-kommunikatsiya imkoniyatlaridan keng foydalanish yo‘lida amalga oshiriladigan ishlar hamda masofaviy ta’lim o‘quv jarayoniga mobil ilovalarini joriy etish masalalari ko‘rilgan.

Kalit so'zlar: axborot texnologiyalari, masofaviy ta'lim, mobil ilova, smartfon, planshet.

Аннотация: В данной статье речь идет о модернизации образовательного процесса, внедрении современных информационно-педагогических технологий в образование, широком использовании информационно-коммуникационных

возможностей в организации дистанционного образования, внедрении мобильных приложений в образовательный процесс дистанционное обучение.

Ключевые слова: информационные технологии, дистанционное обучение, мобильное приложение, смартфон, планшет.

Abstract: This article deals with the modernization of the educational process, the introduction of modern information and pedagogical technologies in education, the wide use of information and communication opportunities in the organization of distance education, and the introduction of mobile applications into the educational process of distance education.

Key words: information technology, distance education, mobile application, smartphone, tablet.

Introduction. Today, it is no coincidence that ensuring the penetration of information and communication technologies into every household has become one of the priority tasks. This creates a great ground for the development of distance education in our country.

Modernization of education is one of the most important tasks of today's developing socio-economic policy of Uzbekistan. In such conditions, the problem of improving the quality of education at all levels is particularly urgent. Historically, various methods have been used to improve the quality of education at each stage of development. Currently, it is an urgent issue to improve the quality of education by changing the methods of students' educational activities, that is, by using the systematic-activity approach.

Literature review. In recent decades, the introduction of information and communication technologies (hereinafter referred to as ICT) to education has become one of the important directions of education modernization. At the same time, computer and Internet technologies themselves are rapidly developing: personal computers are increasingly being replaced by wireless and mobile devices; Increasingly, smartphones and mobile phones with computer functions are appearing in the consumer market.

Therefore, it is important to develop distance education based on the needs of the times. Because the implementation of this system has the following advantages [1, p 2-5]:

1. To contribute to the guarantee of educational opportunities for citizens by creating new forms of education in our country.

2. According to the requirements of the times, every person will be able to develop in all aspects throughout his life and receive professional education.

It serves to significantly increase the potential of higher education among the population.

3. The process of teaching students to work independently serves to implement.

In general, the ability of a person to work on his knowledge, hard work, setting goals and helping to achieve them.

4. It serves to increase the quality of education by reducing the active study load of professors and teachers.

5. There will be an opportunity to develop adult education.

6. Employees who want to get a higher education or a second specialty can study without being separated from production, it shows that they can easily make the contract payment through their work.

7. It is reflected in the reduction of students-students' dependence on housing and other economic burdens.

Analysis. There are new opportunities for modernization of educational methods in the conditions of the information society. Through the use of new ICT, it is possible to bring education to a new level by using it in the daily practice of actively developing and modern students of higher education. The latest research shows that in modern conditions, through the need to use innovative approaches to education, with the help of developing modern types of educational activities - searching and comparing information from several sources, applying the knowledge gained to solving practical problems, working in groups, including the use of modern ICT, students'; It is important to achieve new learning outcomes.

Most teenagers today have mobile phones with wireless Internet access - a fact that has been proven in extensive research. Students use handheld devices in their daily practice. Compared to desktop computers, they change the design of the learning environment. The possibilities of teaching Uzbek using mobile technologies today are described only in economic and medical publications in individual cases.

Students actively use social network services for communication, information search and storage. With the development of these services, publications on the use of social networks in education began to appear. Issues of using mobile and network technologies in educational activities are being actively developed due to their high practical importance. However, this area is still underexplored.

Today, the local education system faces a serious question - to what extent can technical innovations become new educational technologies?

The United Nations Educational, Scientific and Cultural Organization (UNESCO) guidelines state: “In a world where dependence on communication and access to information is growing, mobile devices will not be a passing phenomenon. As the power and capabilities of mobile devices are constantly growing, they can be used more widely as educational tools.” (M.West, S.Vosloo, 2013, p. 42).

Project activities are one of the types of work that form students' independence and initiative. The practice of using mobile and network technologies is related to solving educational problems - through student groups (teams) homework, project discussion, development of a common solution, etc. are discussed. Working on a project is related to problem formulation and formulation, creation of activity algorithms, control and evaluation of the project process and results - cognitive universal actions. Group work in the network is related to planning cooperation in the field of education, determining the goals and functions of participants, as well as methods of interaction - communicative educational activities defined in the State Educational Standard.

The indicated factors indicate the high and relevance of the chosen direction of research - the use of mobile and network technologies to modernize the educational activities of students.

The analysis of research on the problem of finding means of developing students' cognitive activity, as well as the study of pedagogical experience in solving this problem, made it possible to identify the following contradictions:

On the one hand, changes are taking place in the environment in which modern students, representatives of the "digital generation" grow up and live (smartphones, social networks, active use of the Internet, constant use of large amounts of data), which makes it possible to provide remote educational opportunities for the new generation. creates an opportunity. On the other hand, the educational system remains indifferent to such changes, these opportunities are not used to achieve new educational results.

Thus, the problem of the research is aimed at identifying the factors that allow to eliminate the gaps between the potential and feasible possibilities of using mobile and network technologies in the educational activities of students at the basic higher education level, and to find a solution to the level of possibility.

Discussion.

We should pay special attention to the following:

- what is the uniqueness of the current stage of higher education informatization?
- what opportunities do mobile and network technologies have in solving current pedagogical problems?
- under what conditions can mobile and network technologies be used as new educational technologies?

The purpose of our research led to finding a solution to the following questions:

1. Determine the changing tasks of modernizing the educational activities of students in the information society.
2. To study the real use of mobile and network technologies by students in their educational and daily activities.
3. To determine the possibilities of using mobile and network technologies to modernize students' educational activities.
4. To identify obstacles in the use of mobile and network technologies in the independent educational activities of students in higher education and offer conditions for their elimination.

The purpose of this research work is to create new content - a new generation of e-learning materials, and these developed materials are intended for:

- to activate the student's independent educational activities, to change their attitude towards independent education;
- change the position and nature of student activity;
- to change the nature of the relationship between the teacher and the student. That is, to introduce a fundamentally new mobile application, to increase efficiency by turning the principles of teaching into an innovative action.

Conclusion. Learning practical activities with the help of this ICT leads to the emergence of generality for the distance form of education. It is intended for teachers to control, direct, study together in groups, and set the goal of independent education. It is up to teachers to shape the future of learning. The goal is to teach students in a modular manner based on the consistency of their individual needs.

The main goal of this work is to understand that independent education is not a task that the student needs to hand over to the teacher, but that it is a type of education

aimed at expanding the scope of his knowledge and self-perception of the necessary knowledge, skills and abilities.

References:

[1]. R.A. Eshchanov. Modernization of education is the need of the times. //Education technology. #4. - 2011. - p. 2-5.
[2]. M.T. Shirinbaeva. Implementation of distance education in the context of the development of Internet technologies. //Education technology. #3(47). - 2014. -p.67-69.
[3]. N.O. Joraeva. Some instructions on the organization of independent educational activities in the educational process. Education and innovative research. Issue #3 of 2021. pp. -170-176
[4]. Jorayeva N.O. Methods of organizing independent education. Modern problems of applied mathematics and information technologies (materials of the international scientific-practical conference). May 11-12, 2022. pp. -488-489
[5]. Usmanova Nasiba Yunusovna. (2021). Classification Characteristics Of Financial Investments, Factors And Methods Of Influence On Investment Activity. CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES, 2(2), 90-94. Retrieved from https://cajotas.centralasianstudies.org/index.php/CAJOTAS/article/view/77
[6]. Usmanova Nasiba. (2022). Innovative Economic Development of Uzbekistan: Trends and Prospects. The Peerian Journal, 5, 175–179. Retrieved from https://www.peerianjournal.com/index.php/tpj/article/view/123
[7]. Nasiba U. Innovative Economic Development of Uzbekistan: Trends and Prospects //The Peerian Journal. – 2022. – T. 5. – C. 175-179.
[8]. Usmanova N. Y. DIGITAL ECONOMY IN UZBEKISTAN //Современные проблемы социально-экономических систем в условиях глобализации. – 2020. – С. 163-166.
[9]. Usmanova N. Y. WAYS OF DEVELOPING DIGITAL ECONOMY IN UZBEKISTAN //Theoretical & Applied Science. – 2020. – №. 2. – pp. 101-105.

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FORMATION OF PROFESSIONAL COMPETENCES OF STUDENTS IN DISTANCE EDUCATION

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Annotation: Axborot technologyLari sanoatning speaker, innovation tabiati an'anaviy kasblar tarkibini "modernization qilish"ga olib keladi, mutahassislarning yangi funksiyalarini belgilaidi, ularga egalik qilish kompyuter ilmlari va dasturlash texnologiyalarini yuklash hodimlarning kasbiy mahoratgazhralmasor. Ishning sog'lomlashtirish dasturlari va texnologiyalari texnologiyasini qutqarish bo'yicha yangi kompyuter kasblarini topish zarurati bilan bog'liq. Makolada kompyuter ilmlari va

dasturlash texnologiyalari ta'lim yo'nalishlari talabalarini tayerlashda masofaviy texnologiyalardan yo'naltirish masalalari ochib berilgan va talabalarning kasbiy kompetentsiyalarini ko'rib chiqish amaliyotiga yutilgan amaliy masalalarni muhokama qilish.

Kalitsizlar: dasturum ta'minot, masofaviy ta'lim, kompyuter ilmlari va dasturlash texnologiyalari, bilimlarni nazarat qilish, rivozh kasb mashqlari, uz-uzini tarbiyalash zharayoni kompetensiyalari.

Аннотация: Динамичный, инновационный характер индустрии информационных технологий приводит к "модернизации" состава традиционных профессий, определяет новые функции специалистов, владение которыми становится неотъемлемой частью профессиональных навыков сотрудников в области компьютерных наук и технологий программирования. Актуальность работы обусловлена необходимостью поиска новых подходов к формированию профессиональных качеств будущих специалистов в области информатики и технологий программирования. В статье описываются особенности использования дистанционных технологий в обучении студентов по направлению подготовки "Информатика и технологии программирования" и рассматриваются вопросы практического подхода к формированию профессиональных компетенций студентов.

Ключевые слова: программное обеспечение, дистанционное обучение, технология информатики и программирования, контроль знаний, развивающие задания, процесс самообразования, профессиональная компетентность.

Annotation: The dynamic, innovative nature of the information technology industry leads to the "modernization" of the composition of traditional professions, defines new functions of specialists, ownership of which becomes an integral part of the professional skills of employees in the field of Computer Science and programming technology. The relevance of the work is due to the need to find new approaches to the formation of professional qualities of future specialists in the field of Computer Science and programming technologies. The article describes the features of the use of remote technologies in the training of students in the direction of Computer Science and programming technologies education and discusses the issues of the practical approach to the formation of student professional competences.

Keywords: software, distance learning, computer science and programming technology, knowledge control, developing tasks, self-education process, professional competence.

Introduction. The constant development of information technology sets out completely new tasks and principles of work for universities: not only providing high-quality education in a narrow scope of the future profession, but also training all professional skills and abilities that allow the student to perform his duties quickly and efficiently in the work environment. The change in the requirements for the training of bachelors is associated with the emergence of new types of non-standard, theoretical and practical problems of a systematic and interdisciplinary nature, which do not have non-standard, clear and simple solutions. In a rapidly changing information society, it is necessary to prepare not only a specialist who is able to carry out activities in a

particular field, but also a person who is able to master something new, make decisions independently, is ready to educate himself and is able to change himself.

Distance education has become very popular in recent years. The use of distance learning technologies allows to increase the effectiveness of the educational process, the level of awareness and preparation of students, systematize knowledge, individualize learning. This gives impetus to the development of self-learning skills, the formation of certain literacy in working with information sources, this is one of the indispensable conditions for the subsequent professional growth of bachelors. The main criteria for the selection of tools for the organization of e-learning include: funktsionality, reliability, stability, cost, availability of tools for content development, availability of a knowledge verification system, ease of use, scope and extent, prospects for platform development, cross-platform distance learning systems. One of the most common "ways" to create a system of distance learning for a long time is to translate the text of these instructional materials into HTML and place them on the websites of educational institutions. However, to date, access to educational materials only through the Internet is not enough to talk about a complete educational system that allows you to formulate the necessary competencies [1].

Research Methodology. Distance learning involves not only reading the study material, but also active understanding of it and the practical application of the acquired knowledge and skills.

The preparation of bachelors in the field of Computer Science and programming technology with the use of Distance Learning Technologies has a number of features, among which it is possible to distinguish:

- Availability of multi-threaded programming languages and used development tools;
- A constantly improving method of teaching and learning part-time computer scientific and innovation-oriented technology requiring information technology;
- If the student is required to do a lot of independent work without constant contact with the teacher - practice-oriented training.

These factors have a significant impact on the organization of the learning process with the use of distance learning technologies and require a lot of methodical work from the teachers. At the same time, the main focus will be on the disciplines that provide basic training for future programmers: the basics of programming; data processing structures and algorithms; the development and implementation of database applications.

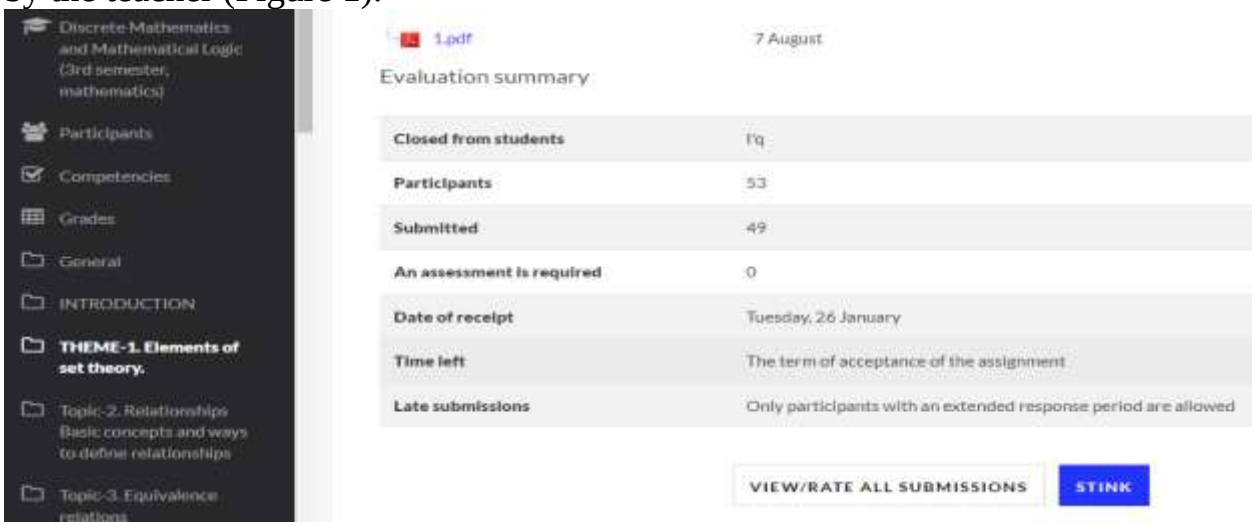
The main element of the mastering of science is the independent work of students, which includes working with developed electronic manuals, the preparation of algorithms for solving problems in the subject of Science, and writing programs in one of the programming languages according to the developed algorithm. In the process of solving problems, the maximum share of the new material is studied and the necessary professional competence is formed. In this regard, the system of practical tasks plays an important role in the preparation of future programmers.

The implementation of educational, practice-oriented tasks is aimed at mastering the methods of activity by students in the conditions of learning and application of Information Technologies. The process of problem solving involves the formulation of

the problem and its understanding by the student, looking for a solution to a problem, the analysis of the solution and the examination of the performance of the programs, the evaluation of the result obtained. The result of assimilation in solving problems is not only to multiply the samples given by the teacher, but also to obtain them independently. By solving problems, the professionalism of students is formed. The set of tasks for practical realization provides for purposefulness, diversity, interdependence, continuity and gradual complication of work [2].

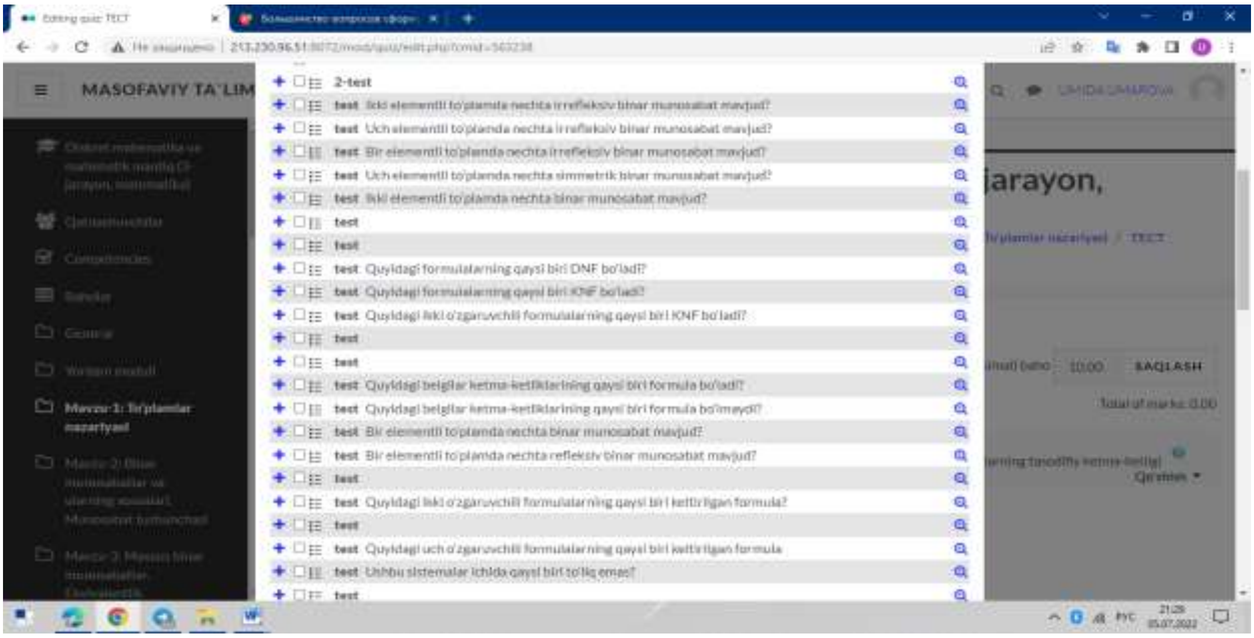
Analysis and results. The educational tasks correspond to the tasks of the future professional activity, the main of which include the collection and analysis of preliminary data for design, the use of modern tools in the development of software, programming in the development of an information system.

It is of great importance to control the skills of students in the conditions of learning with the use of Remote Technologies. The current control consists in checking the correctness of the work of the program written by the student through the system by the teacher (Figure 1).



1-picture. Checking the control work in distance education.

In order to control the development of students, computer tests are successfully used, the materials of the topics mentioned, their active use will help to maintain the necessary level of education of the students. For each section of the courses, a large bank of questions, which is kept in the system, is developed and is constantly replenished. Most of the questions are formed in an unconventional way, have a practice-oriented nature, so there are no ready-made answers to them. The teacher has the opportunity to create a test scenario at his own discretion, including the necessary number of questions from different subjects of science (Figure 2). If the student gets a percentage of the correct answers set by the teacher, then he will be admitted to the next stage of knowledge control.



2-picture. Test bank on science.

At the same time, the main components of practical development, which can be directly controlled by the teacher and allow students to formulate professional skills, are control and course work. The biggest impact in this case is given by the term documents. Course design is a complex type of independent work that requires creativity, which is associated with the implementation of various descriptions, part of the design and focuses on the development of thinking and professional qualities. In the process of implementation, students must use the entire course material so that they can identify gaps in their knowledge and eliminate them independently.

The mechanism of step-by-step execution of the course work gives the teacher the opportunity to observe the progress of the work, immediately make comments on the material sent for examination and, ultimately, objectively assess the level of formation of the professional competence of the student.

The teacher-head of the work can determine the desired number of stages for his subject, specify the periods of control for the execution of the stages and draw up a task for each stage.

All this information is included in the information system and is used when communicating with students. The standard topics of the course work include the development of a database scheme in accordance with an individual task and the creation of a software that allows you to view the database, navigate through tables, search for records based on the values of the specified area, enter, delete and modify database records.

In order to timely monitor the progress of the course project, the work is divided into several stages with a mandatory report on each of them in due time. With the help of a personal account, the student can ask the teacher questions about the course work and send the results of each stage. The teacher either reads the stage, or resends the results to the student for further review, indicating their shortcomings. The whole process of communication is recorded in the system, and the teacher can see the

protocol of interaction with each student at any time. Currently, the system introduces a step-by-step mechanism for the implementation of the final qualification work, which includes all stages of the student's course work, from the development of a technical task to the preparation of presentations and reports for protection [3].

Conclusion.

In our opinion, distance learning will be effective only if the following organizational and pedagogical conditions are met:

- The educational and methodological base prepared in full and with the highest quality, available to each participant in the educational process - both the teacher and the student.
- Specialized platforms will be introduced into the educational process of the university to integrate several technological trends in the educational process and make training in the chosen field of study extremely effective.
- While ensuring the simultaneous use of distance and contact forms of education.
- When organizing a full-fledged certification system and quality control of students' assimilation of educational material (with strict observance of teaching technologies by the teacher).
- Introduction of new educational trends into the existing learning process based on teachers-passionaries, i.e. teachers who are ready for changes in the organization and want to implement them. It is especially desirable to involve them in the development of the terms of reference of the educational platform, since they are its first users.
- Timely monitoring and updating of the information and technological content of the distance course will be carried out.
- A real system of industrial practical training has been organized within the framework of the bachelor's degree.
- Case-learning technologies will be used in the preparation of a training course in legal specialties.
- The inclusion of a motivational component in the educational process acting "as opposed to" distance learning, which reduces the motivation of the student.
- Universities will be provided with specially trained experienced professional consultants, both in matters of the labor market and psychological counseling. The professional consultant should be familiar with the latest developments in the field of career guidance, namely the latest multimedia web resources.
- Asynchronous learning in groups will be organized in order to exchange information, discuss issues that cause difficultis [4].

The use of distance learning technology will enhance students 'self-teaching activities, enhance the intensity and consistency of teaching work, regulate the control of students' learning activities during the semesters and increase the motivation of students towards learning instructional materials, which will ultimately lead to an increase in the quality of teaching and the formation of professional competences of instructional materials.

References:

[1]. Gotskaya I. B., Zhuchkov V. M., Korablev A.V. Analytical note "Choosing a distance learning system" // A. I. Herzen Russian State Pedagogical University. URL: http://ra-kurs.spb.ru/2/0/2/1/

[2]. Tarenko L. B. Practice-oriented approach in the development of students' intellectual skills in the field of computer science and computer engineering // Bulletin of "TISBI". Kazan: Publishing Center of the University of Management "TISBI", 2013. No. 1. pp. 74-83.

[3]. Tarenko L. B., Formation of professional competencies among students studying with the use of distance technologies // Bulletin of the Mari State University. 2016. Vol. 10, No. 1 (21). pp. 44-48.

[4]. Troitskaya E.A. Management model of the process of formation of professional competencies in the conditions of distance learning // Fundamental research. – 2017. – No. 11-1. – pp. 128-132

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ON GENERAL PROFESSIONAL SCIENCES ELECTRONIC SOFTWARE OF THE EDUCATIONAL PROCESS

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Аннотация. Мазкур ишда олий таълим муассасалари Ахборот тизимлари ва технологиялари таълим йўналиши талабаларини “Сонли усуллар” фанидан тайёрланган мобил дастур асосида ўқитишнинг электрон-дастурий ва методик таъминоти ҳақида сўз боради. Мобил дастур мукаммал электрон дидактик восита сифатида хизмат қилиши натижасида талабаларнинг билим ва кўникмаларининг ривожланиш даражаси ошириши илмий асосланган.

Калит сўзлар: рақамли таълим, мобил таълим, концепция, синхрон, мультимедиа, когнетив, метакогнетив, гиперматн.

Аннотация. В данной статье речь идет об электронном программно-методическом обеспечении обучения студентов высших учебных заведений в области информационных систем и технологий на базе мобильного приложения по предмету “Численные методы”. Научно обосновано, что мобильное приложение служит прекрасным электронным дидактическим средством для повышения уровня развития знаний и умений учащихся.

Ключевые слова: цифровое обучение, мобильное обучение, концепт, синхронный, мультимедиа, когнитивный, метакогнитивный, гипертекст.

Annotation. In this article, we are talking about electronic software and methodological support for teaching students of higher education institutions in the specialty of information systems and technology based on a mobile application on the subject “Numerical Methods”. It is scientifically based that the mobile application

serves as an excellent electronic didactic tool to increase the level of development of students 'knowledge and skills.

Key words: digital learning, mobile learning, concept, synchronous, multimedia, cognitive, metacognitive, hypertext.

Introduction. Innovative electronic didactic forms of education - taking into account the abilities and interests of learners. It is a system of interplay between tutor and learner contingent on general pedagogical, didactic and individual methodological procedures aimed at designing the educational content in compliance with the purpose of education and the application of pedagogical, digital technological methods, forms and teaching methods [1].

In general, the fact that the content of education meets the following requirements leads to the full student development according to the needs of the level of knowledge acquired:

- be a tool for developing students' knowledge;
- be the basis for the development of students' practical experience;
- formation of students' critical, independent, and creative abilities.

Depending on the level of content, goals and objectives of education, there is an opportunity to implement e-learning resources in the learning process.

Literature review. On the evolving mobile education of today, the British scientist S. Trongtortam in his scientific work gave a generalized description of mobile education. New methods of learning using mobile phones, smartphones, tablets and mobile devices have been introduced to help students develop and improve their methods in mobile education. Mobile learning technologies are intended to be used to facilitate, support and improve the learning process and teaching, which can be attractive to teachers and students [2].

Mobile learning helps students to actively participate individually on issues that are achievable, useful, relevant, and encouraging in solving system problems. Adaptation to mobile learning requires teachers working at all stages of education to master the software tools of modern technology in order to use mobile learning in the learning process. However, we know that even in societies with a good socio-economic environment, there are some problems in this process. These include issues such as lack of teaching aids and relevant manuals for teachers, as well as the lack of competence to use mobile learning [3].

In turn, it is necessary to study the requirements and principles of distance, mobile education, based on the requirements of today's educational process.

To date, it has been researched by several scholars to base the resource content used in digital education on the following principles:

- multimedia principle;
- the principle of continuity;
- the principle of comprehensibility;
- the principle of conformity;
- the principle of interactivity;
- the principle of communication between text and graphic data;

- the principle of focusing on creating a connection between media elements and cognitive structure.

Based on the above principles, digital education is prepared from audio, video, text data in the preparation of the order of educational material without departing from the level of normative documents of science. Simple, clear and concise information is provided in the topic context, based on the capacity of students to receive visual information. Having said that, it is essential to consider the continuity of science topics in the interaction between educational resources [4]. As digital education technologies evolve rapidly today, we will try to explore these changes as the above principles are self-updating.

Based on the above-mentioned principles of foreign scholars, we need to show that mobile education is based on the following principles:

- the ability to use a variety of methods to present information helps to reflect complex processes and events in a way that is unimaginable in real life;
- should be located on a single interface as much as possible in a format associated with a single concept element. This allows the user to learn the object (process, event) from different angles and different methods of manifestation;
- information such as audio, graphics and text should be used in an ordered synchronous view. This allows the user's perception not to work with overload, and also contributes to the multifaceted perception of the object (process, event);
- the form of mobile learning material should be relevant to the education content and the objective of the syllabus;
- it is vital to take into consideration the pedagogical and psychological approach to the simultaneous use of text, visual and audio forms of presentation for mobile educational material;
- complex concepts and processes are presented through a single medium, followed by two or more media outlets;
- take into account the knowledge and cognitive characteristics of students;
- facilities should be created so that students with a high level of metacognitive skills can easily find links and any information through hypertext.

Analysis and Results. Pedagogical experience from the principles of this mobile education shows that the digital technology usage in the teaching of general disciplines in the field of “Information Systems and Technologies (by industries and sectors)” in higher education plays a significant role in further improving the effectiveness of education. Mobile software training tools play a special role in this [5].

In this regard, it is important to further improve the quality of training teachers for innovative professional activities by developing software for the subject “Numerical Methods” in the general education block of the curriculum of higher education institutions 5330200 - Information Systems and Technologies (by sectors and industries).

In providing theoretical insights on the subject of “Numerical Methods”, the teacher in the introductory instructions, explains the requirements for the implementation of the task step by step, stating only the purpose of the task. Based on

the developed software-based sequence of tasks and practical instructions on how to perform them, students have to learn virtually independently. The advantage of this methodology is that the teacher has the opportunity to devote special time to students who have not mastered the topic and provide them with practical assistance. The result can be determined by observing how well the students are doing the tasks and how well they understand them. Methodological guidelines have been developed for the implementation of practical training tasks, which include: the purpose of the work, the necessary theoretical information about the work, the requirements for sample developed results, independent practical tasks and test tasks for control.

Brief theoretical information about the mobile application of the subject "Numerical methods"

The mobile application of digital science has been developed using innovative E-learning technology. Innovative technology of E-learning combines traditional education with distance learning. When you enter an application installed on your mobile phone, the application's main window will appear. The mobile application of the subject "Numerical methods" consists of the following content. The mobile application includes a homepage, application information, content, lectures, practical exercises, glossary, thematic and finally a complete science test bank, list of references, and a brief description of the author (see Figures 1 and 2).

Components of the mobile application of the subject "Numerical methods"

Figure 1. A summary of the mobile application of the science of numerical methods

Figure 2. View of the content of the mobile application of the science of numerical methods

The developed software includes all the content on the subject, the content of lectures and practical sessions, theoretical information for each lecture, glossary,

independent assignments, a bank of thematic tests, sample solutions for practical training, videos, virtual boards, list of references and brief information about the author.

The mobile application is radically different from other mobile applications in that it is easy to install, easy to understand, contains all the necessary information, tutorials and control tests are designed separately for each topic, and is designed for all android devices. In order to improve the capability of students to learn independently and develop individual performance skills in the subject “Numerical methods” in the general science block in the curriculum of 5330200 - Information systems and technologies (by industries and sectors), a mobile program, recommended for use by students and professionals, was developed and implemented. As a result, in the process of mastering the content of general professional subjects, students are not limited to traditional education, but also increase their knowledge, skills and abilities on the basis of software tools based on digital technologies.

Conclusion. In the process of teaching using a mobile application, the level of development of students is assessed objectively with automatic detection. The program is distinguished by the fact that methodological recommendations have been developed and put into practice, with the selection of indicators and criteria that allow to control in practice and use them as a tool for objective assessment. In the process of full mastery of theoretical materials, students develop practical skills. The resulting mobile application is intended to serve as a perfectly programmed electronic didactic tool for e-learning and methodological support of teaching.

References:

[1]. Inoyatov U.I, Zamonaviy uzluksiz ta'lim muammolari: innovasiya va istiqbollar. Xalqaro ilmiy konferensiya. 2018 y. -5 b.

[2]. Trongtortam, Suparawadee. A decision support model for mobile technology enhanced teaching. Diss. Liverpool John Moores University, 2019.104.

[3]. Irby T.L. Instructor Competencies Needed to Develop Instructional Strategies for Mobile Learning in Fields of Agricultural Education: Diss. – 2014.

[4]. Martina Brajković. Tools and Methodologies for Developing Interactive Electronic Books. ERASMUS program June 2014. P. 4-34-38.

[5]. Rasulova Z.D. Conditions and opportunities of organizing independent creative works of students of the field Technology in Higher Education. International Journal of Scientific & Technology Research. Vol. 9, no. 3, 2020. – P. 5061-5062.

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ETYMOLOGICAL ANALYSIS OF REDUPLICATIVE WORDS IN ENGLISH LANGUAGE.

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Annotasiya. Ushbu maqolada tildagi reduplikativ so‘zlarning etimologik tahlili yoritilgan. Tildan tashqarida so‘z yasovchi bog‘lanishlarni ham ifodalaydi. Bundan tashqari, maqolada qayd etilgan reduplikativ so'zlarning tarixiy o'zgarishlari. Quyidagi so‘zlarning yasalishi turli til o‘zgarishlarida uchraydi.

Kalit so‘zlar: reduplikatsiya, etimologiya, onomatopeyalar, cheklanmagan, so‘z yasovchi identifikatsiya, tabiiy til, birikma

Аннотация. В данной статье освещен этимологический анализ редупликативных слов в языке. Также выражает словообразовательные связи вне языка. Кроме того, исторические изменения редупликативных слов, упомянутых в статье. Образование следующих слов можно встретить в разных языковых вариациях.

Ключевые слова: редупликация, этимология, звукоподражания, безудержность, словообразовательная идентификация, естественный язык, сочетание.

Abstract. This article highlighted the etymological analysis of reduplicative words in the language. Also expresses word-building connections outside the language. Besides, historical changes reduplicative words mentioned in the article. The formation of the following words can be found in different language variations.

Key words: reduplication , etymology, onomatopoeias, unrestrained, word-building identification, natural language, combination

Introduction. Etymology (from the Greek "truth" and "concept, doctrine") - 1) a section of linguistics that studies the origin of words; 2) any hypothesis about the origin of a particular word (less often - a different language unit, such as a suffix or idiomatic expression). In this last understanding, “near etymology” is distinguished - the identification of word-building connections of a certain word with other words of the same language that have become obscured over time - and “distant etymology” - the identification of word connections outside the language under consideration.

The words of any natural language can be - according to their origin - divided into the following groups:

1. Native words, i.e. words inherited from the ancestor language (the largest group);
2. Words formed with the help of existing (or previously existing) word-building means in the language;
3. Words borrowed from other languages;
4. Artificially created words (a group not represented in all languages);
5. Words resulting from various "linguistic errors".

Words that are native in a given language could belong to any of the above groups in the ancestor language. For any word that is a derivative in a given language, one can find out from which word and with the help of what word-building means it is formed.

Materials and Methods. In this section, we will consider only some of the most interesting reduplicative words from the point of view of their origin.

The English word "flip-flop" (n.) has two meanings: 1) sandals or slippers; 2) trigger (therm.), electronic switching circuit. It was formed from interjections-onomatopoeia flip (clap) and flop (slap). The first mention of this word was recorded in 1920, but then it meant a lobe (earlobe - earlobe), but to our time it has not retained this meaning. Later it was used in various onomatopoeias. The word received its most common meaning (sandal) in the 1960s. In 1889, it appeared again, but this time it means the sound of footsteps. The phrase changed meaning drastically in 1992, when its general meaning was "somersault". To add to the confusion, 1935 introduced the name "flip-flop" to the electronic switching circuit.

The English reduplicative word "aye-aye" is a noun, translated as a lemur or Madagascar arm. This animal was discovered by a group of American scientists in 1812. One explorer heard exclamations of surprise and fear (“aiee!-aiee!”) from Malagasy (the tribe that encountered the animal). However, this name also exists in remote villages. Based on this, it is unlikely that it has European roots. Another hypothesis suggests that it comes from "hey-hey", which means "I don't know" in Malag. More precisely, the name could have come from Malagasy, who, when asked by Europeans about the animal, answered “I don’t know”, so as not to pronounce the name of a terrible magical animal.

Another example of reduplication appeared in the 1920s. Boogie-woogie has several meanings: 1) (n.) the name of a dance style or musical style; 2) (humorous slang) to dance in a fast and unrestrained style; move quickly, hurry up; leave or keep moving. The term is used jokingly in North America as a term meaning "let's hang out" (slang) or "let's move on". Unlike the expected "boogying", this word has not found wide acceptance in the English-speaking world. "Boogie-woogie" is a reduplication of "boogie" that appeared in Black English (African American English), possibly from the West African English word "bogi (dance) akin to Hausa buga (to the beat of drums)". The expression "Boogie-Woogie" entered colloquial usage in 1928 when Clarence Pineton Smith recorded Pinetop's Boogie-Woogie. These were fast guitar base chords with piano accompaniment. These rhythms were a direct precursor to the blues. Dancing to such music was fast and unrestrained, which determines the meaning of the word today.

Results. Having analyzed about the reduplicative words etymology we should highlight that, the reduplicant "nitty-gritty" currently has only one meaning (routine). But it is not the only one with which this word was previously used. It has been established that "nitty-gritty" is a pejorative reference to the 18th century English slave trade. The phrase is usually used with the prefix "getting down to" and there is a feeling that whatever nitty-gritty is, it is at the very bottom of something. It is believed that the phrase comes from the term denoting various garbage that remained at the bottom of the ship's hold after the transportation of slaves, and later the meaning of the phrase was extended to slaves. But, nevertheless, there is not enough evidence that "nitty-

gritty" has anything to do with the ships of the slavers. It may have originated with the US as an African-American expression, and that is not where its relationship to slavery ends. Until the 1950s, this phrase was not even seen in print, and none of the early reference books link it to slavery.

The following example of "prinkum-prankum" has three different meanings covering the period from the 1500s to the 1980s. The first meaning, which was rarely used even in its time, means prank, and the second means pillow dance (cushion-dance), but in fact it is quite a common dance. The Oxford English Dictionary defines it as a round dance, early danced at weddings, during which men and women take turns kneeling on pillows and kissing. Finally, "prinkum-prankum" means expensive clothes and jewelry. This reduplicant is formed from two non-replicated words: the verb prink (to shrink) and prank (prank).

The name of a small bird called “Chiff-chaff” (tinkovka) in English comes from a similar onomatopoeia. These birds make similar sounds during the mating season. There are similar names in some other European languages.

The term "claptrap" takes its name from the clap-net (net-traps), a device for catching larks. This reduplicant noun is derived from the noun "clap" (cotton) and the verb "trap" (to catch). According to other sources, "claptrap" was a rhyming rant used by dramatic poets to please the audience and "break" the applause. This reduplicant was first mentioned 150 years ago. In the future, this word began to be called signs that were written in advance and shown to fake viewers in order to receive applause at the right time for the director. This technique is very often used in comedy series, the so-called behind-the-scenes applause.

The word "yum-yum" (or "yum-yum-yum") became a slang sensation in 1875, although the first mention of it did not appear until 1870. The origin is still not clear, perhaps it came through a game or a song from London. In its early meaning, the term was used to describe an attractive girl. Derived from the ideophone "yum", which is used to express satisfaction, especially in relation to a meal. Food can be rated "yum-yum", "yummy", and even "yum-o". "Yum-yummy" (or "yummy yum") was already widely used in 1895. "Yumptious" (yummy+scrumptious) has been quoted since 1957. Famous London television chef Rachel Ray used "yum-o" from 2005 to 2006.

The word "yo-yo" appeared in 1915, most likely from the Filipino language. In 1932 registered as a trademark in the Canadian city of Vancouver. That same year saw the first yo-yo boom. In fact, the toy's age dates back to 1824, when it was known as baldalore. The very word “yo-yo” in a figurative sense means any movement up and down, which was first documented in 1932, as well as another meaning “stupid person”, which has been known since 1970 and is used in colloquial speech.

The name of the plant "ylang-ylang" (ylang-ylang) comes from the Tagalog word "ilang" (desert area), alluding to their habitats, or from "ylang-ilan", which means rare, indicating its exceptionally delicate aroma. The most common translation is "flower or flowers". The plant is native to the Philippines and Indonesia and is grown in Polynesia, Melanesia and Micronesia.

Outdoor games, commonly referred to as "seesaw" (children's swings), have a number of regional names. New England has the widest selection of titles in the smallest area. In New England, swings are called "tilt" or "titling board". In Massachusetts they are

called "teedle boards". In Naraganset Bay there is a term "dandle" or "dandle board". "Teeter" or "teeterboard" is mostly used in the northeastern United States, while the term "teeter-totter" is more common after "seesaw" and is used in the interior northern states and up the west coast. Both the words "seesaw" (from the verb saw) and "teeter-totter" (from the word "teeter" - to swing and "teeter on the edge" - to balance on the edge) indicate a language process called reduplication, when a word or syllable is doubled , often with vowel changes. Doubling is characteristic of words meaning a repeated action, such as swinging on a swing.

The English reduplicated word "go-go" has the following meanings: 1) modern youth dances; 2) (colloquial) active, active, enterprising. It was formed by doubling the stem "go". First mentioned in 1960 with the meaning "fashionable". The term "go-go" comes from the name of the Parisian dance cafe Whiskey à Gogo, which, in turn, is named after the French expression à gogo (in abundance, in abundance), derived from the old French word la gogue (joy, happiness). According to another version, the term go-go comes from the expression in English "go-go", which can be conditionally translated as "come on, come on." The expression “come on, come on” was common on the dance floors of Europe in the 70s of the XX century, thereby the dancers cheered on the artists, musicians (DJs) and themselves.

The name of the game "ping pong" is also formed by reduplication. For the first time, the name "ping pong" began to occur since 1901 (before that, names similar in intonation were in use: "flim-flam", "vif-vaf" and also "Gossima"). John Jaques registered the coined name. It came from a combination of two sounds: "ping" - the sound made by the ball when it hits the racket, and "pong" - when the ball bounces off the table. The name was subsequently sold to the Parker brothers. They used it as a trademark for tennis equipment. Later, in 1905, this word began to be used as a verb, and in 1952 in a figurative language.

The name of the Latin American dance "cha cha" is of Cuban origin. It was first performed to the music of the same name by the Cuban composer and violinist Enrico Giorrin in 1953. This rhythm was developed from the "danzón" on the fourth beat. This word is formed with the help of onomatopoeia, from the rhythm of "güiro" (drag) and the shuffling of feet.

The reduplicant word "blackjack" currently has a huge number of meanings. It was first mentioned at the beginning of the 16th century with the meaning "black leather covering for a jug of beer". Since that moment, the combination of the words “black” + “jack” has become widespread among slang expressions and such meanings as “sphalerite, zinc blende”, “pirate flag, black Jack” have appeared. In 1889, this was the name given to the type of weapon, and in 1900 to the card game, which in Russian sounds “twenty-one” or “point”. (But the traditional point game has slightly different rules.) This is one of the most popular card games in casinos around the world. The great popularity of the game is due to simple rules, the speed of the game and the simplest strategy in card counting. However, the popularity of the game won not immediately. The gambling houses of the United States had to stimulate interest in the game with various types of bonuses and a variety of blackjack rules. It is believed that the predecessor of this game was the card game "vingt-et-un" ("twenty-one"), which appeared in French gambling establishments around the 19th century.

Conclusion. It was initially established that reduplication as a way of word formation in English is much older than in other languages. The etymology of reduplicant words goes much deeper into history, and these words have more meanings.

The prevalence and frequency of reduplication varies from language to language. In those language systems where reduplication is a common type of word production, it is closely related to sound representation. This relationship is the motivating feature underlying the words that are the result of reduplication.

Reference:

[1]. Some semantic functions of reduplication in various languages. Anthropological Linguistics 7(3): 88−102.
[2]. Teliya V.N. The connotative aspect of the semantics of nominative units. –M.: Nauka, 1986.
[3]. Teliya V.N. Russian phraseology. Semantic pragmatic and linguoculturological aspects. -M.: School "Languages of Russian culture", 1996.
[4]. Truevtseva O.N. English language nomination features. Nauka, Leningrad, 1986.
[5]. Ulukhanov I.S. Components of the meaning of segmented words // Questions of Linguistics. - 1974, -№2- p.71-78.
[6]. Urinbaev Z.B. Linguistic and stylistic nature of reduplication in modern English: Abstract of the thesis. dis. cand. philol. Sciences. -T., 1982.

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THE DETAILED PRAGMATIC THEORIES AND ANALYSIS STEPPED FORWARD BY THOMAS C.SCOTT-PHILIPS; WEAK AND STRONG PRAGMATICS

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Annotatsiya. Pragmatika tillarning nolingvistik xususiyatlariga e'tiborni qaratadi, ular ham ma'no shakllanishida hal qiluvchi rol o'ynaydi. Gapning ma'nosini o'zgartirishi mumkin bo'lgan, lekin ko'pincha e'tibordan chetda qoladigan ba'zi jihatlar bo'lishi muqarrar. Tomas C.Skott-Filips odamlarning e'tiborini muloqotda pragmatikaning ahamiyatiga va pragmatikani bilish va bilmaslik xabarni tushunishga qanday ta'sir qilishiga qaratadi. Suhbat ishtirokchilari odatda kontekstni kodlaydilar va buni qulflash va dekodlash uchun yagona kalit pragmatikaga tegishli. Ijtimoiy ishonch va iqtisodiy asos ham Tomas C.Skott-Filips uni kuchli pragmatik deb atagan kontekstni tushunishda ba'zi o'zgarishlarga olib kelishi mumkin.

Kalit so'zlar: Pragmatika, Kuchli pragmatika, Kuchsiz pragmatika, kodlash, dekodlash, gap, kontekstlar, aloqa, shakllanish, tillarning xususiyatlari, tillarning jihatlari, pragmatikani bilmaslik, tilni tushunish, pragmatikani bilish, ma'noni fundamental intellektual qabul qilish

Аннотация. Прагматика обращает внимание на нелингвистические особенности языков, которые также играют решающую роль в формировании значения. Неизбежно, что есть некоторые аспекты, которые могут изменить смысл высказывания, но часто игнорируются. Томас С. Скотт-Филипс хочет привлечь внимание людей к важности прагматики в общении и к тому, как знание и незнание прагматики влияет на понимание сообщения. Участники разговора обычно кодируют контекст, и единственный ключ к его блокировке и расшифровке касается прагматики. Социальное доверие и экономический фон также могут внести некоторые изменения в понимание контекста, который Томас С. Скотт-Филипс называет сильной прагматикой.

Ключевые слова: Прагматика, сильная прагматика, слабая прагматика, кодировать, декодировать, высказывание, контексты, общение, формирование, особенности языков, аспекты языков, незнание прагматики, понимание языка, познание прагматики, фундаментальное интеллектуальное принятие значения

Abstract. Pragmatics draws attention to non-linguistic features of languages which also play a crucial role in the formation of meaning. It is inevitable that there are some aspects which can change the meaning of the utterance but are often ignored. Thomas C.Scott-Philips wants to get people's attention to the importance of pragmatics in the communication and how the cognition and ignorance of pragmatics affect the comprehension of the message. The participants of the conversation usually code the context and the only key to lock and decode this is concerning pragmatics. Social trust ad economic background also may make some alternations in understanding the context which Thomas C.Scott-Philips labels it as strong pragmatics

Key Words: Pragmatics, Strong Pragmatics, Weak Pragmatics, to code, to decode, the utterance, the contexts, the communication, the formation, the features of languages, the aspects of the languages, the ignorance of the pragmatics, the comprehension of the language, the cognition of the pragmatics, The fundamental intellectual acceptance of meaning

Introduction. Pragmatics is always stated as the evolution of language. According to Thomas C.Scott-Philips, there can exist strong and weak pragmatics in the language comprehension. The fundamental intellectual acceptance of meaning of a language usually lies in the govern of several categories and structural aspects of it. Number 1 category as it is traditionally understood as "Prominent parts of language" which can embrace 5 features : sound, phonems, words, phrases and literal meaning.
In the article "Pragmatics and the aims of language evolution", Thomas C.Scott-Philips stated:
Depending on one's specific questions, it can be productive to abstract away from the complications that pragmatics brings with it. Indeed, this is sometimes the most scientifically appropriate thing to do. All scientific investigation necessarily abstracts away from the issues at other levels of analysis. Many linguistic topics can be profitably pursued without any consideration of pragmatics. One consequence of this is that, despite common acknowledgement that it is important dimension of language and language use, pragmatics is kept at the margins of linguistics as a discipline. In short, the fact that it is connected with the boundary between language and the outside world, a major reason why pragmatics is kept on the periphery of the discipline itself.

Literature review .What it was going to be referred is in terms of the ignorance of the essence of pragmatics. Many scholars and linguists stick up to the authentically classic division of the language which creates the formation of the only language itself but the importance of the potential of the alteration concerning the meaning is often neglected.

Even if unintended, this marginalization of pragmatics affects the direction of research in linguistics, and language evolution is a case in point("Pragmatics and the aims of language evolution", Thomas C.Scott-Philips)

As it is told above, pragmatics can fall into two big classifications:

1. Weak Pragmatics
2. Strong Pragmatics

Research methodology .Weak pragmatics is the one which is produced in the correlation with behavior and it depends on the context. This sort of pragmatics is born, being influenced by outer behavior and the effects of this behavior are noticeable in the context. It does not limit its usage capacity with humans only but stretches its scope beyond them to other mammals.

Weak pragmatics is simply context dependence- that is, the observation that the effects of different communicative behaviors depend, at least in part, on the local circumstances in which the behavior is produced. This type of "pragmatics" is widespread in natural world. It may be particularly salient feature of human communication, but it s certainly not uniquely human. It is not even unique to mammals. Weak pragmatics is implicit in Fig.1, where it is effectively presented as one further level of linguistic analysis, in addition to semantics, syntax and the rest. It is also implicit in a significant proportion of research published in pragmatics itself.

Analysis and results. When it comes to strong pragmatics, its capacity is wider than the weak. The communication is produced in the form where the social features play a crucial role. This is not about only how the outer formation affects the behavior or how the speaker and listener behave, it is about how other features such as economic background, social cognition, social beliefs change the context:

In contrast, strong pragmatics is a capacity of mind, to communicate in a way that is fundamentally a matter of social cognition. More precisely, it is a capacity to communicate by expressing and recognizing intentions. This type of pragmatics commonly goes by labes "Gricean communication" and it is not only a further level of linguistics analysis. It is, rather, the social-cognitive basis of a type of communication that is not reducible to codes and context dependence (Carstin,002a,b; Levinson,2006; Origgi&SPerber,2000;Scott-Philips,2014;Sperber&Wilson,1995,2002,Tomasello,2008).

Strong type of pragmatics is only peculiar to humans as it is about the social backgrounds which are solely found in the human nature.

Conclusion/Recommendations .As Dan Sperber and Deirde Wilson in their article *Relevence: Communication and Cognition* brought a conception that linguistic communication occur with relation to others linguistic aspects and plus, non-linguistic features which pragmatics directs the focus. This non-linguistic features can be points, shrugs, implicits, hand mimics and gestures.

All the things summed up, one can deduce that pragmatics is the key factor to unlock decoded context. The ignorance of pragmatics may lead to the loss of the comprehension of the context and give rise to the misunderstanding of the speakers.

References.

[1]. Pragmatics (1983)- Stephen C.Levinson
[2]. Speech Acts:An Essay in the Philosophy of Language(Paperack)(1969)- John Rogers Searle
[3]. Understanding Pragmatics(1998)- Jef Verschueren
[4]. The Study of Language(1985)- George YuleThe
[5]. Information Structure and sentence form:Topic,Focus and the Mental Representations of Discourse Referents(1994)- Knud Lambrech
[6]. Presumptive Meanings: The Theory of Generalized Conversational Imlicature(1999)- Stephen C.Levinson
[7]. Cognitive Pragmatcs: The mental Processes of Communication (2010)- Bruno G.Bara
[8]. Thoughts and Utterances :The Pragmatics of Explicit Communication (2001)- Robyn Cartson
[9]. “Pragmatics and the aims of language evolution”, Thomas C.Scott-Philips

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ETYMOLOGICAL DICTIONARY OF THE UZBEK LANGUAGE – INFORMATION BASE OF CORPUS SEMANTIC EXPANSION

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Annotatsiya: Mazkur maqolada o'zbek tili leksik birliklari semantik kengaytmalarini ishlab chiqishda o'zbek tilining etimologik lug'ati axborot manbai sifatida xizmat qilishi bir qancha misollar orqali ochib berilgan. Shuningdek, so'z tilning tarixi, taraqqiyoti davomida mazmunan o'zgarmay, tovush jihatidan o'zgarishi, omonimiya hodisalari tahlilga tortilgan. “O'zbek tilining etimologik lug'ati”dan keng jamoatchilik foydalanishini ko'zda tutsak, sharhlar ommabop yo'sinda, ixcham tarzda bayon qilinganligi, bu esa semantik kengaytma izohlarini ishlab chiqishda qulaylik berishi ta'kidlanadi. Til korpusi yoki boshqa axborot qidiruv vositalaridan keng jamoatchilik foydalanadi. Bu esa semantik kengaytma uslubini soddalashtirishni taqozo etishi borasidagi mulohazalar bayon qilingan.

Kalit so'zlar: semantik kengaytma, etimologiya, leksikografiya, til korpuslari, axborot qidiruv vositalari, semantik sinkretizm, omonimiya.

Annotation: This article reveals through a number of examples that the etymological dictionary of the Uzbek language serves as an information source when developing semantic extensions of lexical units of the Uzbek language. Also, during the historical development of the word language, not changing in content, in terms of sound, the phenomena of homonymy were subjected to analysis. If we consider the use

of the"etymological dictionary of the Uzbek language" by the general public, it is noted that the reviews are explained in a popular way, in a compact way, which gives ease in the development of comments of a semantic extension. The language Corps or other information search tools are used by the general public. This explains the considerations regarding the need to simplify the semantic extension style.

Key words: semantic extension, etymology, lexicography, language corpora, information search tools, semantic syncretism, homonymy.

Аннотация: В данной статье этимологический словарь узбекского языка служит источником информации при разработке семантических расширений лексических единиц узбекского языка на нескольких примерах. Также в ходе исторического развития языка слово меняется не по содержанию, а по звучанию, анализируются явления омонимии. Учитывая широкое общественное использование «Этимологического словаря узбекского языка», отмечается, что комментарии изложены популярно, лаконично, что облегчает разработку смыслового расширения комментариев. Лингвистические корпуса или другие средства поиска информации используются широкой публикой. Говорят, что это требует упрощения метода семантического расширения.

Ключевые слова: семантическое расширение, этимология, лексикография, языковые корпуса, средства поиска информации, семантический синкретизм, омонимия.

Introduction. When interpreting the meaning of a word, it is extremely important to express its etymological properties. Therefore, when developing semantic extensions of lexical units of the Uzbek language, the etymological dictionary of the Uzbek language serves as an information source. It is known that although the experience of constructing an etymological dictionary in World lexicography has become widely popular, the work of compiling an etymological dictionary of the Uzbek language does not correspond to the first years of the development of Uzbek lexicography. Despite the fact that since the second half of the 20th century, various general and special linguistic dictionaries have been published, work on the etymological dictionary of the Uzbek language has been delayed.

Literature review. The author writes these words about Etymological Dictionary of the Uzbek language: "there were those who sought to make an etymological dictionary of the Uzbek language, but in scientific work did not go beyond historical and etymological interpretation of certain words. Look at Dahr's kajraftor, it was my responsibility to draw up such a dictionary. I agreed to this work only after the firm claim of Academician Turabek Dolimov, the vice-rector for scientific work of TashDU: "an etymological dictionary has been compiled on other languages, including Russian, why is such a dictionary not compiled on the Uzbek language?! Of course it is necessary to draw up. May it be short, simple, but start working on it". Having studied a number of sources I began to, more or less, understand the historical evolution of the vocabulary of the Uzbek language, I dared to do this rewarding work. The result of the work done was reflected in four books published in 1997-1999 under the name "short Etymological Dictionary of the Uzbek language". It turns out that the first Etymological Dictionary of the Uzbek language dates back to the last years of the XX century. The author noted that he compiled all the articles in

the dictionary directly himself. He recruited other specialists in order to test the work he did. Various linguists gathered different parts of dictionary - professor I. M.Mirtozhiev compiled the letters u, e, o', g, d, j, k, t; professor M.Kadyrov made up the dictionary letters like a, i. Sh.Rahmatullaev, on the other hand, compared the articles of these to the ones he compiled, using them in the formation of a dictionary article.

Analysis. The vocabulary in the 2000 edition is compiled according to the "Explanatory Dictionary of the Uzbek language". Due to the fact that initially the Uzbek literary language was intended to provide an etymological explanation to the Turkic layer in the vocabulary, words from other languages in this Explanatory Dictionary were not covered, while words made on the basis of words from other languages were not included in the vocabulary. The author notes that a very large part of the Turkic words allocated after such discounts do not need an etymological explanation. Etymological explanation should be given to a part of the words, while today there is no way to give such an explanation. So, after the above restrictions, more than 2,400 words were covered in this dictionary. This amount can be enriched at the expense of the words sheva, at the expense of the words made by adding an adverb from another language to the Turkic word. Relying on the above information, it can be said that when creating a semantic extension for the combination of 80,000 words and phrases in the Uzbek language, not all of them have an etymological description. Because the etymological description in the semantic extension (like other footnotes) is obtained only from the source of information, that is, from the etymological dictionary of the Uzbek language.

It is noted that the terms of linguistics are practically not used, providing for the use of the dictionary by the general public, reviews are expressed in a popular way, in a concise manner. This gives us convenience when developing semantic extension annotations. Because the language Corpus or other information search tools are used by the general public. This necessitates simplifying the semantic extension style.

Discussion. When a new word with an additional addition occurs, the word “yasalgan" is used, and if the grammatical form occurs, the word "hosil qilingan" is used. Between the base and the insert is the sign of the addition, between these and the derivative is the sign of the fold. Brackets were used to indicate the relationship between parts of a word. The previous and subsequent form of the word, which has changed in terms of sound, is indicated using the transition sign (>). We also prefer to keep the same characters in the semantic extension.

The etymological interpretation of words is usually given in two ways:

1) in terms of content;

2) in terms of form (sound).

It is difficult to give an interpretation in terms of content than in words that are considered to be substantive. The structure of an etymological dictionary article is as follows:

“AVAYLA”– “ehtiyot qil” – “*Seni avaylab o’stirdim”*. This verb is originally used independently in some Turkic languages, including Kyrgyz, and is made with the Abay suffix –la from the noun, which means "caution"; then in Uzbek, the consonant

b between the two vowels exchanged for the consonant v, and the vowels a exchanged for the vowels ä: ***abay+la = abayla > äbäylä.***

Or we will focus on another comment, the issuance of homonymous words:

ADASH I “исми бир хил (кишилар) (people with the same name)”. *Иккимиз адашмиз.* This word is made from the noun form of the word a:t, which means "name" in the ancient Turkic language –with the suffix Dash, which later exchanged the consonant t for the consonant d under the influence of the consonant d, and then one of the consonants dd was not pronounced; in Uzbek, the vowels: ***at-dash = atdash > addash > adash > ädäsh.***

ADASH II: ADASH BO’L - “oyoq kiyimining poyi boshqa bir oyoq kiyimining bir poyi bilan almashib qolishi”. *Kechagi yig’inda bir poy kalishim adash bo’lib qolibdi.* Bu so’z ***ädäsh-*** the verb is homonym of the old Uzbek language and is not used independently, ***ädäsh bol-*** comes in compound sentences.

ADASH III- “to’g’ri yo’lni yo’qot-”, “yanglish-”. *Qorong’i tushganidan keyin adashib qoldim.* This word is originally formed by the suffix - (a)sh, which means "lose the right path -" from the form a:D - of the verb A:z–, which means "a little" in the ancient Turkic language, later the stretch mark of the vowel a: is lost (KRS, 22); this word originally meant "deviate slightly from the right path -". In Uzbek, vowels a exchanged for vowels ä: (a:z - a:d -) ***+ash = a:dash- > adash- > ädäsh.***

The word may have changed in terms of sound, not changing in content throughout the historical development of the language. The dictionary articles describe how such sound changes were made from the ancient Turkic language to the current Uzbek language.

The author of the dictionary notes that when giving etymological interpretation of sound to words in the current Uzbek literary language, this sign, characteristic of vowels in the ancient Turkic language in terms of hardness and softness, is not taken into account in the literary language, although it partially retains its power in some dialects of the Uzbek language.

Also, Sh.Rahmatullaev draws our attention to the following issue: "in the ancient Turkic language (as well as in most of the current Turkic languages), the brevity of vowels also served to distinguish words among themselves. In the ancient Turkic language, the word a:t, which means "horse" was distinguished by the short/longness of the reciprocal vowel sound; from the hungry - verb, which means "kovla", the adjective a:ch, which means " bring to an open state -", from the ach - verb, which means"bring to an open state -".

One of the phenomena characteristic of the ancient Turkic language is the use of tag meaning as two words of the same base. It is correct to distinguish the phenomenon of the branching of meaning of such a basis as both a verb and a noun, and in part both a noun and an adjective, from homonyms, calling it semantic syncretism in relation to the ancient Turkic language (E.V.Sevartyan. Etymologicheskiy slovar tyurkskikh Yazikov. I, 40). As a result of various sound changes as originally homonyms, words are said to have accidentally remained the same form as a result of word assimilation. And the phenomenon in the ancient Turkic language is completely different in nature, equal to the meaning of two different categories with one basis. This phenomenon can only be considered a semantic homonym in conditional interpretation. For example, in

the ancient Turkic language, the word “or” meant both the meaning of "kovla-" and the meaning of "chuqur". Also, the meaning of "alanga ol -" was meant by the word o:t -, and the meaning of "alanga" was meant by the word o:t; the noun - verb of postponement is out of consumption, in the current Uzbek language there is only a noun.

Conclusion. In the above pairs, the tag meaning is the same, the two words arose as a result of the supposedly branching of this tag meaning; regardless of this, if the difference between vowels is not visible in the first pair, then in the second pair the vowels are distinguished in terms of their short-length. Well, at the heart of this phenomenon lies the development of meaning. As a result of the development of such a meaning, another category Word grows out of one category word. The development of such a meaning continues from the ancient Turkic language to the present day. In the etymological dictionary, an attempt was made to correctly reflect even such a process.

References:

[1]. Rahmatullaev Sh. O‘zbek tilining etimologik lug‘ati. (turkiy so‘zlar). – Toshkent: “Universitet”, 2000. – 600 b.
[2]. E.V.Sevortyan. Etimologicheskiy slovar' tyurkskix yazikov. I, 40
[3]. Kustova G.I., Lyashevskaya O.N., Paducheva Ye.V., Raxilina Ye.V. Semanticheskaya razmetka leksiki v nasional'nom korpuse russkogo yazika: prinsipi, problemi, perspektivi \\ (Elektron resurs): http://ruscorpora.ru/sbornik2005/10kustova.pdf;
[4]. Muhammedova S. Harakat fe'llari asosida komp'yuter dasturlari uchun lingvistik ta'min yaratish. Metodik qo‘llanma. – Toshkent, 2006.
[5]. Abduraxmonova N.Z. Inglizcha matnlarni o‘zbek tiliga tarjima qilish dasturining lingvistik ta'minoti (Sodda gaplar misolida). Filol. fan. bo‘yicha falsafa doktori (PhD)…dis. avtoref. – Toshkent, 2018. – 52 b.
[6]. Xamroeva Sh. O‘zbek tili mualliflik korpusini tuzishning lingvistik asoslari: Filol. fan. bo‘yicha falsafa doktori (PhD)…disser. – Qarshi, 2018. – 250 b.
[7]. Eshmo‘minov A.A. O‘zbek tili milliy korpusining sinonim so‘zlar bazasi: Filol.fan.bo‘yicha falsafa doktori (PhD)…disser. – Qarshi, 2019. – 140 b.
[8]. Axmedova D.B. Atov birliklarini o‘zbek tili korpuslari uchun leksik - semantik teglashning lingvistik asos va modellari: Filol. fan. bo‘yicha fal. doktori (PhD) dissertasiyasi. − Buxoro, 2020. − 247 b.
[9]. Begmatova G. O‘zbek milliy korpusida idiomalar bazasini yaratish. Filol. fan. bo‘yicha falsafa doktori (PhD) dis.avtoref. – Termiz, 2021. – 48 b.
[10].https://classes.ru/grammar/174.Akhmanova/source/worddocuments/_18.htm
[11]. Ne'matov H., Rasulov R. O‘zbek tili sistem leksikologiyasi asoslari. – Toshkent: O‘qituvchi, 1995.

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CULTURAL VOIDS, LACUNAE, IN THE TRANSLATION OF “O‘TKAN KUNLAR” BY CAROL ERMAKOVA AND MARK REESE

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Annotatsiya: Mazkur maqolada tarjima jarayonida har qanday tildan chet tiliga bir so‘z bilan tarjima qilib bo‘lmaydigan muqobilsiz leksikalarning mavjudligi va bunday so’zlar asosan mahalliy xalqqa xos pul, masofa va uzunlikni ifodalovchi o’lchov birliklari, ro‘zg‘or ashyolari, kiyim-kechak, yegulik-ichkilik kabi tushunchalarni anglatadigan so‘zlardan tarkib topganligi, aynan ushbu so’zlarning tarjimada muqobilini topishda muammolar vujudga kelishi va shunda tarjimada har doim lakuna hodisasi voqelanishi atroflicha yoritib berilgan. Olimlarning lakuna haqidagi fikrlari misollar orqali ko’rib chiqilgan va maqolada aynan Abdulla Qodiriyning ‘O’tkan kunlar’ romanining ingliz tiliga Kerol Yermakova va Mark Rizlar tomonidan qilingan tarjimalaridagi lakuna hodisasiga uchragan milliy koloritga ega bo’lgan til birliklari haqida fikr yuritilgan. Xulosa o‘rnida o’zbek tilidan ingliz tiliga tarjima qilinishi qiyin bo’lgan roman tarjimasidagi so’zlar ro’yxati jadval ko’rinishida shakllantirilgan.

Kalit so'zlar: asliyat matni, tarjima matni, tarjima metodlari, lakuna, madaniy bo'shliqlar, madaniyatlararo, ikki madaniyatli, ijtimoiy-madaniy.

Аннотация: В данной статье в процессе перевода выявлено наличие лексиконов, которые не могут быть переведены с какого-либо языка на иностранный одним словом, а такими словами в основном являются деньги местных жителей, единицы измерения, обозначающие расстояние и длину, предметы быта, одежда Подробно объясняется, что он состоит из слов, обозначающих такие понятия, как -ночь, еда и питье, возникают проблемы с поиском альтернативы этим словам в переводе, и тогда всегда возникает явление лакуны в переводе. На примерах рассматриваются мнения ученых о лакуне, а также в статье рассматриваются языковые единицы с национальным колоритом, столкнувшиеся с явлением лакуны в переводах романа Абдуллы Кадири «Минувшие дни» на английский язык Кэрол Ермаковой и Марка Риза. . В заключении в виде таблицы формируется список слов в переводе романа, труднопереводимых с узбекского на английский язык.

Ключевые слова: оригинальный текст, переводной текст, способы перевода, лакуна, культурные разрывы, интеркультурный, бикультурный, социокультурный.

Abstract: In this article, in the process of translation, the existence of lexicons that cannot be translated from any language to a foreign language with one word, and such words are mainly local people's money, units of measurement representing distance and length, household items, clothing It is explained in detail that it is made up of words meaning concepts such as -night, food and drink, problems arise in finding

an alternative to these words in translation, and then there is always a lacuna phenomenon in translation. The opinions of scientists about the lacuna are examined through examples, and the article discusses the language units with a national color that have encountered the phenomenon of lacuna in the translations of Abdulla Qadiri's novel "The Past Days" into English by Carol Yermakova and Mark Reese. In conclusion, a list of words in the translation of the novel that are difficult to translate from Uzbek to English is formed in the form of a table.

Key words: source text (ST), target text (TT), translation methods, lacunae, cultural void, cross-cultural (trans-cultural), bicultural, sociocultural

Introduction: Translation is one of the most interesting and amazing process. It is a privileged space where linguistic and social systems meet, intermix or come into conflict. [1] As we know culture is created by the people who live in a place and speak at one language. While translating one nation's culture into another language, translation problems appear within this process. And the main reason for that is various cultures of diffent countries. As a result, for solving this kind of translation problem linguculturology joins into the translation process. According to Zoya Proshina 'Translation and culture are inseparable. Translation could not have developed without culture. Literature, science, and philosophy influence translators' conceptualizations. On the other hand, culture could not have developed without translation, since translations enrich nations with the cultural values of other nations.' [2] And here a translator requires awareness of cultural difference.

Translation can be considered as a cross-cultural project that travels between languages and cultures. And for this reason translation can be misunderstandings too. As LeBaron has suggested, culture, being a sense-making, viewpoint-forming and behaviourdetermining system, can be defined as "a set of internalized understandings and ways of interacting with the world." [3]

Literature review: Snell-Hornby has rightfully contended that the concept of culture as a totality of knowledge, proficiency and perception is fundamental in our approach to translation. If language is an integral part of culture, the translator needs not only proficiency in two languages, he must also be at home in two cultures. In other words, he must be bilingual and bicultural. [4]

Translation is regarded as a process which offers studying cultural interaction. Translators and translations play an important role in shaping deeper understanding between cultures.

As Basil Hatim and Jeremy Munday mentioned, there are two methods of translating the texts which describe culture of the source language into the target one. [5] They are direct (literal) translation and oblique translation.

Direct translation procedure occurs when a target text is produced directly from the original source text. [6] Direct translation relies on such devices as introductions, notes or glossaries. They provide the full understanding of the source text.

Texts, which are considered as the products of the historical and social structure of a particular culture, are very difficult to translate. In some cases, it is impossible to translate them. Most of their examples are the texts which the target culture has no need. That means the texts have no counterparts in the other culture. In these cases, the textual situations are incompatible. The target text must be an oblique rendering of the

source here. And oblique translation method is used here. According to Vinay & Darbelnet, a term ‘oblique translation method’ is used to refer to various types of translation procedure designed to cope with situations where, because of structural or conceptual differences between ST and TT, some stylistic effects cannot be rendered satisfactorily without disturbing the syntactic or lexical order of the text. [7]

Research methodology: In some translation tasks translator can transpose the message of the source language into the target language element by element. But it maybe also possible that translators may also notice the gaps, or ‘lacunae’ while translating, mainly the culture of the source message. So, lacuna always occurs in places where a word of source language cannot find an appropriate or exact alternative one in the target language. In the dictionary of Translation Studies a lacuna is called ‘Voids or semantic voids, or lacunes (French), or blank spaces or gaps’ and defined by Dagut as the “non-existence in one language of a one-word equivalent for a designatory term found in another.’ [8]

Voids are found only at word level. Because larger source language units may always be expressed in target language. Dagut identifies four types of void. The first one is environmental voids. They arise from the untranslatability of natural phenomena. And they translate into the target language through transcription. Such transcribed forms are frequently accepted into TL as new words. Example can be Russian tundra. The second type is cultural void**.** Dagut divided it into the religious and the secular voids. English cream tea and Russian samovar all frequently give rise to voids of this type. As they all point to cultural phenomena which would almost certainly have no direct TL equivalent. Such voids can once again generally be most effectively filled in TL by means of transcription, if necessary with a footnote added. The third type is the lexical void and the last one is termed as syntactical voids. [9]

Analysis and Results: In the translation of “O‘tkan kunlar” one can see an effective use of the oblique translation method. Translators Carol Ermakova and Mark Reese add footnotes to cultural phenomena of the ST at the bottom of the page of TT that gives extra information about the cultural voids. While Carol Ermakova gives footnotes as “Translator’s notes” in her translation for providing reader with the full understanding of the source text, Mark Reese gives it as “Endnotes” at the end of the book. For instance, there are the words ‘kurpach’ and ‘adras’ in TT that show the cultural importance. [10; 6] In the process of translating these culture describing words translators have to add their footnotes by oblique method of translation. Carol Ermakova adds her footnotes as “Kurpach – a traditional quilted mattress stuffed with felt or soft cotton generally covered in silk or cotton, used not only on beds but also in seating areas” [11; 11] and “Adras – striped or monotone semi-silk fabrics with colourful designs” in her “Translator’s note” at the bottom of the page which they are given, while Mark Reese gives footnotes as “Adras is a silk-and-cotton-blend fabric. It retains the luster of silk but has a tougher weave to allow for more practical uses-i.e. Korpachalar-heavy quilted mattresses with a cotton filling. Central Asians use them to sit and sleep on. Every spring the ladies of the household will change out the cotton. These futons are part of the bride’s dowry gifted by the groom so they can begin a household” in his “Endnotes” at the end of the book. [12; 422] More examples of cultural voids of “O‘tkan kunlar” are given in the following table:

№	Cultural voids	Translators	Footnotes
1	Dasturxon [10; 9]	Carol Ermakova	Dastarkhan- a Persian word meaning ‘tablecloth’ or ‘great spread,’ widely used in Central Asia to refer to the meal setting as a whole. Translator’s note. [11; 14]
		Mark Reese	Tablecloth. [12; 28] Dasturkhon: a tablecloth one could consider the symbolic center of the household. Laying of the Dasturkhon is an important part of Central Asian hospitality. It is changed throughout the meal to keep the eating area clean. [12; 425]
2	Chopon [10; 22]	Carol Ermakova	Chapan – a kind of kaftan or long quilted coat, usually worn by men. [11; 26]
		Mark Reese	Chopan: A Chopan is a quilted robe worn by many Uzbek males. They range from simple designs showing regional affiliation with cotton cloth and filling to elaborate affairs made of silk or velvet with gold embroidery, s design common in Samarqand and Bukhara. Chopans are often handed out as gifts and as signs of patronage. [12; 434]
3	Atlas [10; 27]	Carol Ermakova	Atlas – a highly-prized silk spun from the threads of the atlas moth. [11; 31]
		Mark Reese	Atlas: Common in an Ikat design. Central Asia, especially Uzbekistan, is home to a wide array of silk production, Margilan being one of the great centers of silk weaving. Atlas is used for Korpacha, women’s clothing, and Chopans. [12; 436]
4	Nisholda [10; 50]	Carol Ermakova	Nishalda – a traditional dessert sometimes described as liquorice-flavoured meringue. [11; 54]
		Mark Reese	Nishaldah: Fresh marshmallow. Used either during lavish celebrations or during Razamazan. [12; 442]
5	Bosh-oyog’ kiyim [10; 52]	Carol Ermakova	Sarpa – a costume consisting of both garments and footwear, usually given at weddings or other grandiose ceremonies. [11; 55]
		Mark Reese	Sarpah or Bosh-Oyog: A full accoutrement of clothes for special occasions. Literally “head to toe.” [12; 442]
6	Paranji [10; 53]	Carol Ermakova	Paranja – a full body veil worn by girls and women to screen them completely from sight when they left their homes. [11; 56]
		Mark Reese	Paranji: A Central Asian paranji is basically a long-armed, thin robe placed over the head with a cloth or

			horsehair screen, or chachvan, held up by the hands to hide the face. [12; 443]
7	Yanga [10; 57]	Carol Ermakova	Yanga – female matchmakers. [11; 59]
		Mark Reese	Yanga: Translated as “sister-in-law” or “wife of an elder brother,” but here we could consider them also witnesses to the consummation of the marriage and protectors of tradition and values. [12; 442]
8	Isiriq [10; 57]	Carol Ermakova	Isryk – a herb burnt to purify and ward off the evil eye. [11; 60]
		Mark Reese	Isiriq – wild rue: burned in places of worship and public spaces usually by Multani asking for alms. Many believe it has a purifying role. [12; 445]

Conclusion: Direct translation method is used when it is possible to transpose the source language message element by element into the target language. And oblique translation method is used when certain stylistic effects cannot be transposed into the target language. Then ‘cultural void’ occurs in the translation process and causes some difficulties for the translator. And the various cultures of the different countries will be the main reason for existing lacunae in translation. To overcome a lacuna, corresponding elements must be filled while translating the source language message into the target language, so that the overall impression will become the same for the two messages. Except translating culture aspects of a nation, lacunae may happen because of structural or metalinguistic differences, certain stylistic effects cannot be transposed into the target language without upsetting the syntactic order, or even the lexis. In this case the more complex methods have to be used in the translation process. At first they may look unusual. But these methods can let translators to have a strict control over the reliability of their work. And these procedures are called oblique translation methods.

References

[1] Said Faiq. Cultural Encounters in Translation from Arabic (Library of Congress Cataloging in Publication Data Cultural Encounters in Translation from Arabic. 1st ed. Topics in Translation: - 26 p.
[2] Zoya Proshina. 12 p.
[3] LeBaron, Michelle. Bridging Cultural Conflicts: A New Approach for a Changing World. 2003. San Francisco: Jossey-Bass.42 p.
[4] Snell-Hornby, Mary. 2001. Translation Studies: An Integrated Approach. Shanghai: Shanghai Foreign Language Education Press. 42 p.
[5] Basil Hatim and Jeremy Munday. Translation an advanced resource book. 2004. Published in the USA and Canada, New York, NY 10016 - 148-151 p.
[6] Mark Shuttleworth & Moira Cowie. Dictionary of Translation Studies. London and New York. Published by Routledge. 2014. 40-42 p.
[7] Neubert, Albrecht. Shreve, Gregory M. Translation As Text Translation Studies. Unity and Difference in Translation Studies. 1992. 25-26 p.

[8] Dagut, Menachem. Hebrew-English Translation: A Linguistic Analysis of Some Semantic Problems. 1978. University of Haifa. 45 p.
[9] Rabin, C. “The Linguistics of Translation”, in A. H. Smith (ed.) Aspects of Translation (The Communication Research Centre, University College, London: Studies in Communication, Vol.5), 1958. London: Secker & Warburg, 127 p.
[10] Abdulla Qodiriy. O‘tkan kunlar. Roman. “Sharq” nashriyoti. Toshkent 2018. 6, 9, 22, 27, 50, 52, 53, 57, 57 p.
[11] Abdulla Qadiri. Days Gone By. Translated by Carol Ermakova. Karimov foundation. Nouveau Monde editions, 2018. Paris. 11, 14, 26, 31, 54, 55, 56, 59, 60 p.
[12] Abdullah Qodiriy. O‘tkan kunlar (Bygone Days). Translated by Mark Reese. Published by Muloqot Cultural Engagement Program. Nashville TN. 2018. 422, 425, 434, 436, 442, 442, 443, 442, 445 p.

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THE STEPPED FORWARD OUTLINES TO BE IMPOSED SO AS TO DEVELOP GLOBAL FRIENDSHIP WITH THE HELP OF THE SHANGHAI COOPERATION ORGANIZATION

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Annotatsiya. Xalqaro turizm mamlakatlarning bir-birlariga mehmondo'stlik ko'rsatishi va o'zini tutishida hal qiluvchi ahamiyatga ega. Shanxay Hamkorlik Tashkiloti xalqaro osoyishtalik va tinchlikni ta'minlash uchun bor kuchini sarflayotgan eng muhim va muhim tashkilotlardan biridir. Hamkorlik ro‘yxatidagi mamlakatlar do‘stligini mustahkamlash maqsadida bir qancha tadbirlar va qator loyihalarni amalga oshirdi. Ushbu jarayonni yaxshiroq va samaraliroq qilish uchun ushbu maqola bir nechta texnika va usullarni taklif qiladi

Kalit so'zlar. Hamma joyda, yaxshi yo‘lga qo‘yilgan hamkorlik, sug‘urta, xalqaro osoyishtalik, do‘stlikni mustahkamlash, xavfsizlikni ta’minlash, iqtisodiyot nuqtai nazaridan barqarorlikni ta’minlash, siyosat bilan birga xavfsizlik, uzoq muddatli tinchlik, hayotning bir qancha jabhalariga alohida e’tibor qaratilmoqda. , yordami bilan keng ko'lamli

Аннотация. Международный туризм имеет решающее значение в том, как страны действуют и проявляют гостеприимство друг к другу. Шанхайская организация сотрудничества — одна из самых важных и решающих организаций, делающих все возможное для обеспечения международного спокойствия и мира. Он запустил несколько мероприятий и ряд проектов, чтобы укрепить дружбу стран, включенных в список сотрудничества. Чтобы сделать этот процесс лучше и эффективнее, в этой статье предлагается несколько техник и способов их внедрения.

Ключевые слова. Вездесущность, хорошо налаженное сотрудничество, страхование, международное спокойствие, укрепление дружбы, обеспечение

безопасности, стабильность с точки зрения экономики, политики и безопасности, длительный мир, первостепенное внимание, несколько аспектов жизни , широкий охват с помощью

Annotation. International Tourism is crucial in the way countries act and show hospitality to each other. The Shanghai Cooperation Organization is one of the most important and crucial organizations which are doing the best to ensure the international tranquility and peace. It has launched several events and a range of projects in order to strengthen the friendship of the countries on the list of the cooperation. To make this process better and more effective, this article suggest a few techniques and ways to be introduced.

Key Words. The ubiquity, well-built cooperation's, the insurance, the international tranquility, to strengthen the friendship, the assurance of security, the stability in terms economy, politics together with safety, long-lasting peace, the paramount focus, several aspects of the life, the wide scope with the help

Introduction. The ubiquity of the well-built cooperation as well as friendship among the countries whose paramount focus is delivered to the assurance of security is being more pronounced over the years.

Being imposed since 2001, the Shanghai Cooperation Organization is the home of the stability in terms economy, politics together with safety. The sustainability offered by an array of countries, embracing several Asian parts namely Uzbekistan, Kazakhstan, Tajikistan has a paramount mutual role to play on the path of the reciprocal enrichment regarding several aspects of the life. Why do we still need to direct the focus to strengthening the tranquility between countries? To provide long-lasting peace? To guarantee the stability of the finance? To offer better education system? To make sure the people have high potential of better health conditions?

The assurance over the tranquility is needed just for a life. The life many used to dream about in the past years and the life many are dedicating the present to build their future within that life.

The Shanghai Cooperation Organization can be marked on the top of the list to help countries to build mutual bonds together towards the global friendship. So far, a set of reformations have been imposed in the wide scope with the help of The Shanghai Cooperation Organization. Take the case where the organization started solving boundary issues given rise by the terroristic actions in 2021 as a sensible illustration.

Literature review. To expand the activeness of the cooperation and to soar the possibility of future fulfillments, an array of future outlines can be drawn so as to obtain more efficiency as well as productivity. The prominent intention to be introduced might come in the form of Education on the ground that the young are the salient keys to open the door of international accomplishments. Once a country imposes programs which can create a chance for students to swop the atmosphere and taste a pinch of shift in the way of education system in neighboring countries, the host country tries to launch all the required facilities to welcome guests at the high levels which, in turn, can make feel the former one to witness the real actions attained concerning the global friendship. Secondly, being shoulder by shoulder with a person who belongs to another nation can cut the real distance in the origin, background and cultural difference. The youth themselves can accept each other, support each other, not following the social

segregation. On lighter note, the country is made up by people. If people themselves comprehend the real logic behind the peace-oriented projects, they can act accordingly and more effectively.

Research methodology. Another indispensable method towards more prosperous connection between countries is regarding international trade. International merchandise might offer an opportunity to expand the list of products in the local market. Additionally, to gain a wider quantity of the produce, countries can remove the boundary tolls or slash them to comfort the traders. With the help of this program, the locals can remove the monopoly, make the prices go down and enjoy the exported high quality products and countries take measures to hold this process stable over time.

Tourism can be counted as next inevitable factor to direct countries into more peaceful environment. As soon as a particular country shows genuine welcome to the out-comers of another by providing all the facilities as well as amenities, tourist agencies of the host country can release some series of tours by collaborating and coordinating. To make sure whether a neighboring country is catering more reliable and safe trips and to defend its populace who wants to discover more corners, the government tries to build bonds with the top and most frequent country to be visited by others.

Analysis and results .Launching cultural huts are also another source of tranquility. Once each country offers a small room near the bus station built in the way where a specific culture is displayed with all atmospheric decorations, clothes, jewelries as well as books , people can go into and study thoroughly about how nations are connected with each other, how a culture roots back and has evolved for years. Just reading about it at school in the subject History can seem a bit monotonous and finding yourself in the embrace of that environment being surrounded by all the relatable decors which remind you of the ancient times might help to form more prompt insight into nations.

Marking one specific Day on the Calendar to celebrate the global friendship of the countries included in The Shanghai Cooperation Organization might be the final method to be stepped forward. By providing once-in-a-time chances such as free health services to the foreigners who are beyond the boundaries of the home country, offering a list of cheaper or reasonably-priced products at the markets, wearing their own national dresses by portraying traditions which may be both engaging and beneficial asset to be put forward to expand the scope of the international friendship and make it stronger.

Conclusion/Recommendations .If we are really willing to compel the concepts evoked on the way of strengthening the global friendship raised by The Shanghai Cooperation Organization, we should set the mind to the realistic actions to make the projects work for benefits of the people of all nations who deserve the biggest happiness of the world by implementing the innovative reformations on education by the global exchange program, cultivating tourism, making the deep enrichment in terms of the international trade and introducing a special day by a range of services to subside the hardship the immigrants are going through.

Reference

[1]. The Shanghai Cooperation Organization and Eurasian Geopolitics: New Directions, Perspectives, and Challenges (Asia Insights, 2), Michael Fredholm
[2]. China's Energy Geopolitics. The Shanghai Cooperation Organization and Central Asia, *Thrassy N. Marketos*
[3]. The Shanghai Cooperation Organization Exploring New Horizons *Sergey Marochkin,Yury Bezborodov*
[4]. Shanghai Cooperation Organization Handbook Paperback – Import, 1 July 2013,by Inc. International Business Publications (Author)
[5]. The Shanghai Cooperation Organization: Origins and Implications Spiral-bound – January 1, 2003, Timothy Craig
[6]. STRATEGIC IMPLICATIONS OF THE EVOLVING SHANGHAI COOPERATION ORGANIZATION,Henry Plater-Zyberk and Andrew Monaghan

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HETEROPTERAN BUGS AND DEVELOPING PERIODS OF EURYGASTER INTEGRICEPS PUTON ON WHEAT CROP IN NORTH - WESTERN UZBEKISTAN

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Annotatsiya. Ushbu tadqiqot bug'doy ekinidagi qandalalar xilma-xilligini o'rganish uchun o'tkazildi; namunalar 2022-yil 15-fevraldan 15-iyungacha Chalish tumanidagi shaxsiy fermer xo‘jaligiga tegishli bug‘doy ekinlaridan yig‘ib olindi. Hozirgi tadqiqotda Hemiptera, Linnaeus 1758 turkumi bo‘yicha jami 5 ta zararkunanda qandalalar turi aniqlandi. Qandalalarning 3 ta turi Carpocoris pudicus (Poda, 1761), Carpocoris fuscispinus (Boheman, 1850), Eurydema ornate (Linnaeus, 1758) Pentatomidae Leach, 1815 oilasi, Pentatominae W.E.Leach, 1815 kenja oilasi va Podopini & Amyot 1815 tribasiga; 1 ta tur Eurygaster integriceps (Puton, 1881), Scutelleridae Leach 1815 oilasiga; 1 ta tur Graptostethus servus (Fabricius, 1787), Lygaeidae Schilling 1829 oilasi, Lygaeinae Schilling, 1829 kenja oilasiga tegishliligi aniqlandi.

Kalit so`zlar: Hemiptera, Pentatomoidea, Carpocoris pudicus, C. fuscispinus, Eurydema ornate, Eurygaster integriceps, Graptostethus servus, bug'doy, qandalalar, zararkunanda hasharotlar, fitofaglar.

Аннотация. Настоящее исследование было проведено для изучения истинного разнообразия клопов на посевах пшеницы; образцы были собраны с посевов пшеницы, примыкающих к частному хозяйству в Чалышском районе с 15 февраля по 15 июня 2022 года. Всего в настоящем исследовании обнаружено 5 видов насекомых-вредителей отряда Hemiptera, Linnaeus 1758. Настоящие клопы обнаружены у 3 видов Carpocoris pudicus (Poda, 1761), Carpocoris fuscispinus (Boheman, 1850), Eurydema ornate (Linnaeus, 1758) семейства Pentatomidae Leach, 1815, подсемейства Pentatominae WELeach, 1815 и трибы Podopini Amyot & Serville, 1843; один вид из семейства Scutelleridae Leach, 1815, Eurygaster integriceps (Puton, 1881); один вид из семейства Lygaeidae Schilling, 1829 и подсемейства в том числе; Lygaeinae Schilling, 1829 Graptostethus servus (Fabricius, 1787).

Ключевые слова: Hemiptera, Pentatomoidea, Carpocoris pudicus, C. fuscispinus, Eurydema ornate, Eurygaster integriceps, Graptostethus servus, пшеницы, клопы, насекомые-вредители, фитофаги.

Abstract. The present study was conducted to study the true bugs diversity on a wheat crop; the specimens were collected from wheat crop adjacent to the private farm at Chalish district 15th February to 15th of June 2022. In present study total 5 insect pest species were discovered under order of Hemiptera, Linnaeus 1758. True bugs were found with 3 species Carpocoris pudicus (Poda, 1761), Carpocoris fuscispinus (Boheman, 1850), Eurydema ornate (Linnaeus, 1758) family Pentatomidae Leach, 1815, subfamily Pentatominae W.E.Leach, 1815 and tribe Podopini Amyot & Serville, 1843; one species under family Scutelleridae Leach, 1815, Eurygaster integriceps (Puton, 1881); one species under family Lygaeidae Schilling, 1829 and subfamily including; Lygaeinae Schilling, 1829 Graptostethus servus (Fabricius, 1787).

Keywords: Hemiptera, Pentatomoidea, Carpocoris pudicus, C. fuscispinus, Eurydema ornate, Eurygaster integriceps, Graptostethus servus, wheat crop, bugs, insect pests, phytophagous.

Introduction. The wheat is an important grain crop which is being grown in Uzbekistan having scientific name *Triticum aestivum* in the country. It is cultivated during winter cropping season after cultivation of summer crops rice and cotton. Most provinces of Uzbekistan have been cultivating wheat, therefore country's name has been found in list of top 25 wheat producing states of the globe [6], but still there is problem to complete the grain requirement of increasing population of the country. The wheat crop has also many pests which damage the yield and quality of grains and are responsible for great reduction in yields. There are many species of insects which can cause damage to crop; including various kinds of diseases the weather conditions may also be responsible for yield losses in wheat. Various species of insects have been discovered feeding inside the stem or on the leaves of the plant. The changes in life called Biodiversity, but also presence of same kind of organisms in agroecosystem, generally called as biodiversity. When taking consideration of the biodiversitical effect, the things which are important to be considered are stability and productivity [11 p. 174-176]

Among the insect biocenosis that damage winter wheat agroecosystem, Heteropterans have a very important place. More than 95% of phytophagous true bug (Hemiptera: Heteroptera) species belong to four superfamilies: Miroidea (Cimicomorpha), Pentatomoidea, Coreoidea, and Lygaeoidea (all Pentatomomorpha). These iconic groups of highly diverse, overwhelmingly phytophagous insects include several economically prominent agricultural and silvicultural pest species, though their evolutionary history has not yet been well resolved. [5, p. 403-428] Most true bugs (*Carpocoris pudicus*, *Carpocoris fuscispinus*, *Eurydema ornate*, *Eurygaster integriceps*, *Graptostethus servus*) found on cereals and the first one is a vector for viruses [1, p. 181-185; 7, p. 113-138]. Naturally occurring carnivorous insects are responsible for the control of insect pests of wheat [9, p. 101-107].

Accurate identification of insects the process of evolution and extinction among and between various species. Proper identification of species can give a strong background to understand and to know the phylogenetic patterns, diversity and species permits for comparison or expansion of more ancient research works. Due to above mentioned wide range of insect pest problems invading wheat crop and causing losses in production, it was felt necessary to observe the current insect pest status on wheat

crop in Chalish district, the available knowledge will be helpful for the wheat growers to diagnose insect pests and find its solution to increase their crop yields.

Materials and methods. *Place of work:* For present studies adult specimens were collected from wheat crop adjacent to the private farm at Chalish district 15th February to 15th of June 2022. Further identification and examination were carried out at Entomology laboratory in Institute of Zoology Academy of Science of the Republic of Uzbekistan.

Method of collection: Collection was made through sweep net and pooter from selected wheat field.

Methods of killing and preserving: Specimens were killed in a jar containing ethanol 96 % and mounted through entomological pins, further specimens were labeled.

Methods of identification: To identify the specimen up to the species level, specimens were run through the keys for the region was collected from various publications.

Results. In present study total 5 species were discovered under order of Hemiptera. True bugs were found with 3 species *Carpocoris pudicus* (Poda, 1761), *Carpocoris fuscispinus* (Boheman, 1850), *Eurydema ornate* (Linnaeus, 1758) family Pentatomidae Leach, 1815, subfamily Pentatominae W.E.Leach, 1815 and tribe Podopini Amyot & Serville, 1843; one species under family Scutelleridae Leach, 1815, *Eurygaster integriceps* (Puton, 1881); one species under family Lygaeidae Schilling, 1829 and subfamily including; Lygaeinae Schilling, 1829 *Graptostethus servus* (Fabricius, 1787).

Discussion. Bugs are sometimes very notorious as an agricultural pest, their mouthparts are piercing and sucking, thereby make them capable of feeding directly on a crop and as a vector of plant diseases, the records in present study include; *Carpocoris pudicus* (Poda, 1761), *Carpocoris fuscispinus* (Boheman, 1850), *Eurydema ornate* (Linnaeus, 1758), *Eurygaster integriceps* (Puton, 1881), *Graptostethus servus* (Fabricius, 1787).

Insect biodiversity on wheat crop earlier was not considered as a harmful element, but due to the recent changes in climate and introduction of new varieties several insects are recorded on wheat crop in Chalish district of Khorezm region. *(Figure 1)*

Figure 1. Map of Study Area

Some insects are common visitors of wheat crop including aphids, but they usually been under check by their natural enemies as they voraciously fed by Coccinellids and Chrysoperla. In present study Phenological development of *Eurygaster integriceps* species were considered only. The crop has two critical periods of being attacked by insects' first Seedling and other is flowering phases. [4, p. 775-788]

In 2021-2022 years, the result of observations showed in Khorezm region, it was found that in the districts where grain is planted, bugs started to emerge from the first ten days of March-April. Egg lays proceed from the 2nd ten days of April to the 2nd ten days of May. The first larvae appeared in the 2nd-3rd ten days of April, and larvae were found until the middle of June (1-table).

1-Table. Phenology development of the Eurygaster integriceps at Chalish district in 2022

District	**March**			**April**			**May**			**June**		
	1	2	3	1	2	3	1	2	3	1	2	3
	G	G	S	T	T	H	H	A	A	GF		
Chalish	(+)	(+)	(+)	(+)	+	+	+					
				+		·	· (-)	· (-)	(-)	(-) +	(-) +	(-) (+)

Conditional characters of *Eurygaster integriceps*	**Development stages of wheat**	
(+) - a mature breed in the resting period + – flight of a mature breed · - egg period (-) – young larvae	G-Germination; S-Seedling Stages; T-Tillering; SE-Stem Elongation Stages;	H-Heading; A-Anthesis Stages; GF-Grain Filling Stage

In late summer/autumn (June-October), adult *E. integriceps* fly from the wheat fields at low altitudes (or other cereal based crops) to mountainous areas, to over-winter through subzero temperatures under low shrubs. In some regions the bugs can travel to altitudes as high as 2000 m above sea level [3, p. 271-287]. In the mountainous regions there may be two stages of over-wintering. At the end of the first stage (aestivation) in mid-October, the bugs migrate to lower altitudes to escape the colder temperatures, and begin the second stage. *E. integriceps* adults over-winter for up to 9 months in total. [10 p. 32-37]

If over-wintering sites such as dense forest or mountainous regions are unavailable (e.g. around Baghdad, some regions of Syria and Ukraine), then *E. integriceps* can over-winter in the surrounding soil near fields, and in weeds or litter under any available plant. [2, p. 445-514; 8, p, 19-30]

Conclusion. According to the true bugs identified in the North - Western of Uzbekistan, research showed that the 5 species were discovered on wheat crop which includes; *C. pudicus, C. fuscispinus, Eurydema ornate, Eurygaster integriceps, Graptostethus.* The study of developing periods of *Eurygaster integriceps* Puton

showed that this bug started to emerge from the first ten days of March-April on wheat crop. Egg lays proceed from the 2nd ten days of April to the 2nd ten days of May. The first larvae appeared in the 2nd-3rd ten days of April, and larvae were found until the middle of June. The adult forms fly from the wheat fields at low altitudes at the end of June.

References:

[1]. Bisztray G, Vacke J, Gaborjanyi R. Wheat dwarf virus in Hungary. Acta Phytopathologica et Entomologica Hungarica. 1991; 26: p.181-185

[2]. Brown, E.S., 1962. Researches on the ecology and biology of Eurygaster integriceps Puton (Hemiptera: Scutelleridae) in Middle East countries, with special reference to the over-wintering period. Bull. Entomol. Res. 53, 445–514.

[3]. Critchley, B.R., 1998. Literature review of Sunn Pest Eurygaster integriceps Put. (Hemiptera, Scutelleridae). Crop Prot. 17, 271–287

[4]. Freier BH, Möwes TH, Moll E. The potential of predators in natural control of aphids in wheat: Results of a ten-year field study in two German landscapes. Biological control. 2007; 52:775-788

[5]. F.Ye, P.Kment, D.Rédei, Q.Xie. Diversification of the phytophagous lineages of true bugs (Insecta: Hemiptera: Heteroptera) shortly after that of the flowering plants. Cladistics 2022 v.38 no.4 pp. 403-428

[6]. https://worldpopulationreview.com/country-rankings/wheat-production-by-country

[7]. Holzinger WE, Emeljanov AF, Kammerlander IZ. leafhoppers, planthoppers and cicadas. The family Cixiidae Spinola 1839 (Fulgoromorpha) a review. Denisia. 2002; 4: p.113-138.

[8]. Panafidin, K. A. (1976). Development of a chemical method of control of the noxious pentatomid in its hibernation sites. Zashchity Rastenii, 45, 19-30.

[9]. Sigsgaard L. A survey of aphids and aphid parasitoids in cereal fields in Denmark, and the parasitoids' role in biological control. Journal of Applied Entomology. 2002; 126: p.101-107.

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SYNTHESIS AND ANALYSIS OF COPPER(II) ION COORDINATION COMPOUND WITH KETOROLAC AND CARBAMIDE

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Annotatsiya: Hozirgi kunda dunyoda mavjud bo'lgan 3 o'lchamli metallar bilan biologik faol birikmalarning metallokompleks birikmalarini sintez qilish usullarini ishlab chiqish va ularning fizik-kimyoviy xossalarini aniqlashga bo'lgan qiziqish tobora ortib bormoqda. Ushbu birikmalar farmatsevtikada antibiotiklar va og'riq qoldiruvchi vositalar sifatida, tibbiyotda biologik faol moddalar sifatida va mikroorganizm hujayralari uchun bakteriyalarning ko'payishini inhibe qiluvchi antibakterial faol moddalar sifatida foydalanish uchun dolzarbdir [1]. (±)-5-benzoil-2,3-dihidro-1H-pirolizin-1-karboksilik kislota (2-amino-2-gidroksimetil-1,3-propandiol bilan birikma sifatida) (Ketorolak) kompleks birikmasini sintezi), aromatik karboksilik kislota hosilalaridan biri bo'lgan Cu2+ bilan o'rganildi. Xona sharoitida C32H32N6O8Cu kompleks birikmasining sinteziga ta'sir qiluvchi omillar ko'rsatildi. Xususan, reaksiya mahsuloti unumining vaqtga bog'liqligi, haroratning ta'siri, konsentratsiyaga bog'liqligi amaliyotda o'rganildi. Sintezlangan kompleks birikmaning fizik-kimyoviy tadqiqi IQ-Furye-spektroskopiya, elementar analiz, mass-spektrometriya, TG-DSK va rentgen strukturaviy analiz usullari yordamida o'rganilib, uning kimyoviy tuzilishi aniqlandi va bu yangi kompleks birikma ekanligi isbotlandi. termal va kimyoviy jihatdan barqaror**.**

Kalit so'zlar: ketorolak, mis sulfat, karbamid, kompleks birikma, metall kompleksi, rentgen strukturaviy tahlil, elementar tahlil, mikroblarga qarshi, monokristallar, Xirshfeld sirt tahlili.

Abstract: Nowadays, great amount of interest in the development of methods for the synthesis of metallocomplex compounds of biologically active compounds available in the world with 3d metals and in determining their physicochemical properties is steadily increasing. These compounds are actual for their use as antibiotics

and painkillers in pharmaceutics, as biologically active substances in medicine, and as antibacterial active substances that inhibit the growth of bacteria for microorganism cells [1]. The synthesis of the complex compound of (±)-5-benzoyl-2,3-dihydro-1H-pyrrolizine-1-carboxylic acid (as a compound with 2-amino-2-hydroxymethyl-1,3-propanediol) (Ketorolac), which is one of the aromatic carboxylic acid derivative, with Cu^{2+} was studied. Factors affecting the synthesis of $C_{32}H_{32}N_6O_8Cu$ complex compound under room conditions were shown. In particular, the dependence of the yield of the reaction product on time, the effect of temperature, and the dependence on concentration were studied in practice. Physico-chemical research of the synthesized complex compound was studied using IR-Fourier-spectroscopy, elemental analysis, mass spectrometry, TG-DSK and X-ray structural analysis methods, its chemical structure was determined, and it was proved that this new complex compound is thermally and chemically stable.

Key words: ketorolac, copper sulfate, carbamide, complex compound, metal complex, X-ray structural analysis, elemental analysis, antimicrobial, single crystals, Hirschfeld surface analysis.

Аннотация: В настоящее время неуклонно возрастает интерес к разработке методов синтеза металлокомплексных соединений биологически активных соединений, имеющихся в мире, с 3d-металлами и определению их физико-химических свойств. Эти соединения актуальны для использования в качестве антибиотиков и болеутоляющих средств в фармацевтике, биологически активных веществ в медицине, антибактериальных активных веществ, подавляющих рост бактерий для клеток микроорганизмов [1]. Синтез комплексного соединения (±)-5-бензоил-2,3-дигидро-1H-пирролизин-1-карбоновой кислоты (в виде соединения с 2-амино-2-гидроксиметил-1,3-пропандиолом) (кеторолак), который является одним из производных ароматических карбоновых кислот, с Cu2+. Показаны факторы, влияющие на синтез комплексного соединения C32H32N6O8Cu в комнатных условиях. В частности, на практике изучались зависимость выхода продукта реакции от времени, влияние температуры, зависимость от концентрации. Физико-химические исследования синтезированного комплексного соединения изучены методами ИК-Фурье-спектроскопии, элементного анализа, масс-спектрометрии, ТГ-ДСК и рентгеноструктурного анализа, определена его химическая структура и доказано, что это новое комплексное соединение термически и химически устойчив.

Ключевые слова: кеторолак, сульфат меди, карбамид, комплексное соединение, металлокомплекс, рентгеноструктурный анализ, элементный анализ, антимикробный препарат, монокристаллы, анализ поверхности по Гиршфельду.

Introduction. The study of coordination compounds allows to explain their main chemical properties, to form complexes, to determine the nature of chemical bonds between ligands, to determine the mechanisms of processes involving coordination compounds and changes in the reactivity of coordinated ligands using modern physical research. The obtained information is important for purposefully finding and synthesizing new chemical substances with predetermined specific

characteristics, composition and structure, as well as other important properties. This is especially necessary for substances with biologically active properties used in medicine[3]. Together with the staff of our laboratory, we tried to obtain a metal complex compound of such a bioactive ligand ketorolac. Ketorolac has a pronounced analgesic effect, and is used as an anti-inflammatory and moderate antipyretic agent. Inflammation and fever appear due to the entry of various disease-causing bacteria into the human body from the external environment. Ketorolac is one of the non-steroid substances used to eliminate this process, and in order to strengthen its effect, biometals such as Cu, Mn, Co, Zn, Mo, Fe were selected from 3d-metals and a metallocomplex compound was synthesized. When these new metallocomplex compounds are poisoned by microbes, they bind to them and try to remove them from the body faster or completely lose their effect [4].

Aim of the research consists of developing a methodology for synthesizing a complex combination of Cu^{2+} ion with ketorolac and studying the composition and structure of the synthesized complex using modern physico-chemical research methods.

Literature review. Scientific research aimed at determining the synthesis of complex compounds of (±)-5-benzoyl-2,3-dihydro-1H-pyrrolizine-1-carboxylic acid (as a compound with 2-amino-2-hydroxymethyl-1,3-propanediol) (Ketorolac), which is one of the aromatic carboxylic acid derivative, with biometals, their spatial structure, “bioactivity-structure” connection is being carried out in the world’s leading scientific centers and higher educational institutions, including Delhi Institute of Pharmaceutical Sciences and Research (India), Institute of Inorganic Chemistry of Aachen University (Germany), Institute of General and Inorganic Chemistry, Moscow State University (Russia), University of Tokyo (Japan), Royal Institute of London (England), Institute of Engineering and Technology (China), Jagiellonian University (Poland), Institute of General and Inorganic Chemistry (Uzbekistan) [5]

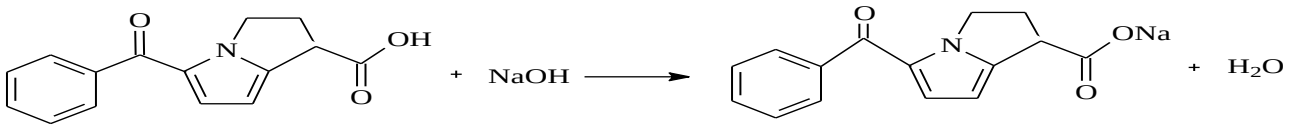
As a result of research conducted in the world on the structure of complexes of ketorolac with biometals and their biological activities, a number of scientific results were obtained, including the following: synthesis of chelated complexes of metals was carried out, their spatial structure and charge density were determined (Institute of Inorganic Chemistry of Aachen University, Germany); mixed-ligand coordination compounds involving carboxylates were synthesized (Institute of General and Inorganic Chemistry, Moscow State University, Russia); complexes based on biometals were synthesized, molecular and crystalline structures, as well as bioactivity were determined (Royal Institute of London, Great Britain); bi- and trihedral coordination compounds of ketorolac were obtained (Engineering-Technical Institute, China); complexes of metals with (±)-5-benzoyl-2,3-dihydro-1H-pyrrolizine-1-carboxylic acid derivatives were obtained and their mutual coordination types were determined (Jagiellonian University, Poland); on the basis of trace elements, cartbamide, ketorolac, drugs that leave pain in the human body and partially eliminate inflammation have been obtained and tested (Institute of General and Inorganic Chemistry, Uzbekistan). [6].

Scientific researches by Imanakunov B.I., Sulaymonkulov K.S., Tsivadze G.V., Tsintsadze G.V., Kharitonov Y.A., B.Kol, M.Kholt, Khamilton V.S., Kozlova

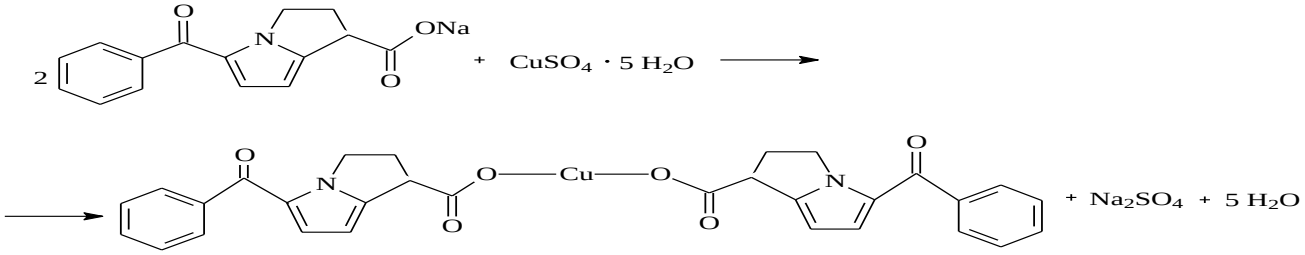
I.A., Savinkin Y.V., Kuzmin N.E., Palkin K.K., Penland R.B., Rau T.F., Dursun A.K and others were devoted to the synthesis of complex compounds of 3d metals and ketorolac in solutions and the study of physico-chemical research methods in the world [7].

Leading scientists of our country Parpiev N.A., Khodjaev O.F., Khakimov Kh.Kh., Ibragimov B.T., Sharipov Kh.T., Azizov T.A., Azizov M.A., Kadirova Sh.K., Kadirova Z.Ch., Daminova Sh.Sh. and their students have synthesized a number of biologically active coordination compounds that are used in medicine and other areas of the national economy. The technology of obtaining complex compounds of various salts of metals with bioactive organic ligands was developed, the processes of formation of coordination compounds in solutions and solid phases were studied. The physicochemical properties of the synthesized compounds were analyzed. Despite the fact that there are many experimental materials on the study of complexes of metal salts with substances containing the carboxyl group and amino group, the synthesis of metallocomplexes of Cu^{2+} mixed with ketorolac from these 3d-metal salts in solution has not been studied. In addition, there is no information about the structure of the coordination knot of compounds of this class [8].

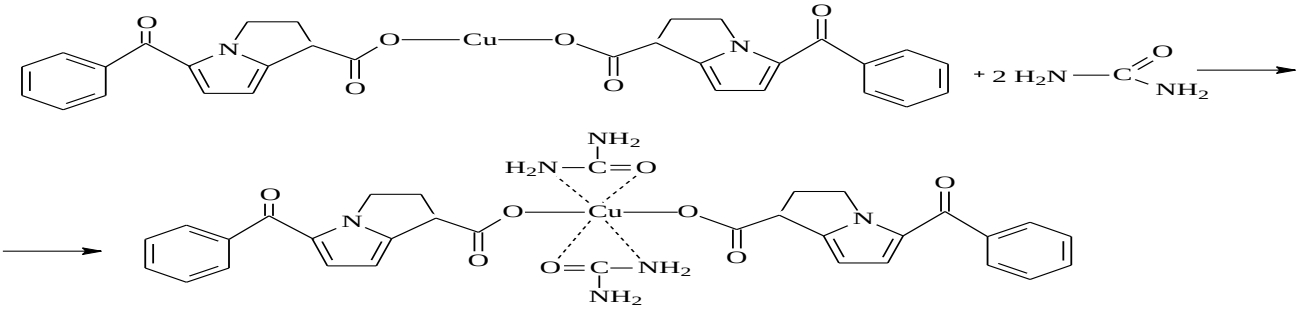
Research Methodology. In particular, the staff of our laboratory performed several reactions, trying to obtain complex combinations of the drug, known as a temporary pain reliever, 2-amino-2-hydroxymethyl-1,3-propanediol (Ketorolac) with 3d-metals and to strengthen the scope of action. The synthesis process was carried out as follows: aqueous solutions of 0.25 g (0.001 mol) of $CuSO_4 \cdot 5H_2O$ crystal hydrate salt and 0.510 g (0.002 mol) of ketorolac were prepared. At the first stage, in order to increase the reactivity of ketorolac, its sodium salt was obtained by reacting it with NaOH in a ratio of 1:1. At the second stage, ketorolac sodium salt and $CuSO_4 \cdot 5H_2O$ crystalline hydrate salt were mixed in a ratio of 2:1. Then, at the last stage, 1ml of the 0.1N solution of carbamide solution obtained as an auxiliary ligand was added dropwise to the complex salt solution. Then it was thoroughly mixed in a MS-H280-Pro magnetic stirrer at a temperature of 60°C for 40 minutes [9]. Then, the solution of the synthesized complex compound is left to slowly evaporate at room temperature. After five days, the obtained precipitates were filtered, washed with ethyl alcohol, then evaporated to a dry residue in a rotary evaporator at 60°C and dried. As a result, dark-green crystals of the complex compound were formed. The synthesis reaction can be expressed as follows:



Scheme 1: The reaction to obtain the sodium salt of ketorolac



Scheme 2: The reaction to obtain the copper salt of ketorolac



Scheme 3: Reaction of coordination compound of copper (II) ion with ketorolac and carbamide

Analysis and results. The complex formed by ketorolac with Cu(II) ion has a 6-coordinate, tetragonal (octahedral) geometric structure. The complex connection between Cu(II) ion and two molecules of ketorolac was formed as a result of binding of metal ion to carboxyl-O and amide group, N,O-atoms of carbamide containing oxygen atoms. The carbonyl group of ketorolac does not participate in complex formation, so the carbonyl group is still free in the ketorolac complex [10]. Elemental analysis was conducted on the complex compound $[Cu(HL)_2(Kar)_2]$.

The amount of metal in the synthesized complex compounds was determined using the Novaa 300 apparatus of Analytik Jena (Germany), and the analysis of carbon, hydrogen, nitrogen and oxygen elements was determined using the EA 1108 apparatus of Carlo-Erba (Italy) (Table 1).

Table 1

The result of the elemental analysis of the complex formed by the Cu(II) ion with ketorolac

The total formula of the synthesized complex compound	Cu, %		C, %		H, %		N, %	
	Obtained	Calculated	Obtained	Calculated	Obtained	Calculated	Obtained	Calculated
$C_{32}H_{32}N_6O_8Cu$	9,25	9,34	55,48	55,56	4,62	4,76	12,14	12,24

In order to better study the coordination number of the Cu atom and the geometric knot structure in this synthesized complex compound, IR-analysis of the synthesized complex compound was also carried out. In order to determine the binding properties of the coordination centers of the ligands to the central atom, the IR spectrum of the synthesized complex of 3d-metal salts with the ketorolac ligand was obtained [11]. C=O, C-N, OH, CH_2, CH functional groups in the ketorolac molecule show important valence vibrations in the IR spectrum. In the IR spectrum of the ligand, characteristic symmetric and antisymmetric valence vibrations of the -C-OH, -C=O- group were determined in the region of 1386-1432 cm^{-1}. Valence vibrations of the carboxyl group were manifested in the 3310 cm^{-1} region, and for the CH-group, they

were recorded in the 2980-3100 cm^{-1} region. When comparing the IR spectra of 3d metals, ketorolac and metal complexes with formate, acetate and carbamide, the absorption lines of the symmetric valence vibrations of the M-N bond and the =M-O= bond valence vibration in the ring undergo a sharp change, and the IR spectra of the complexes have a strong frequency compared to the ligand was observed to shift by ~20-40 cm^{-1} towards the field, and by ~30-40 cm^{-1} in the low-frequency field.

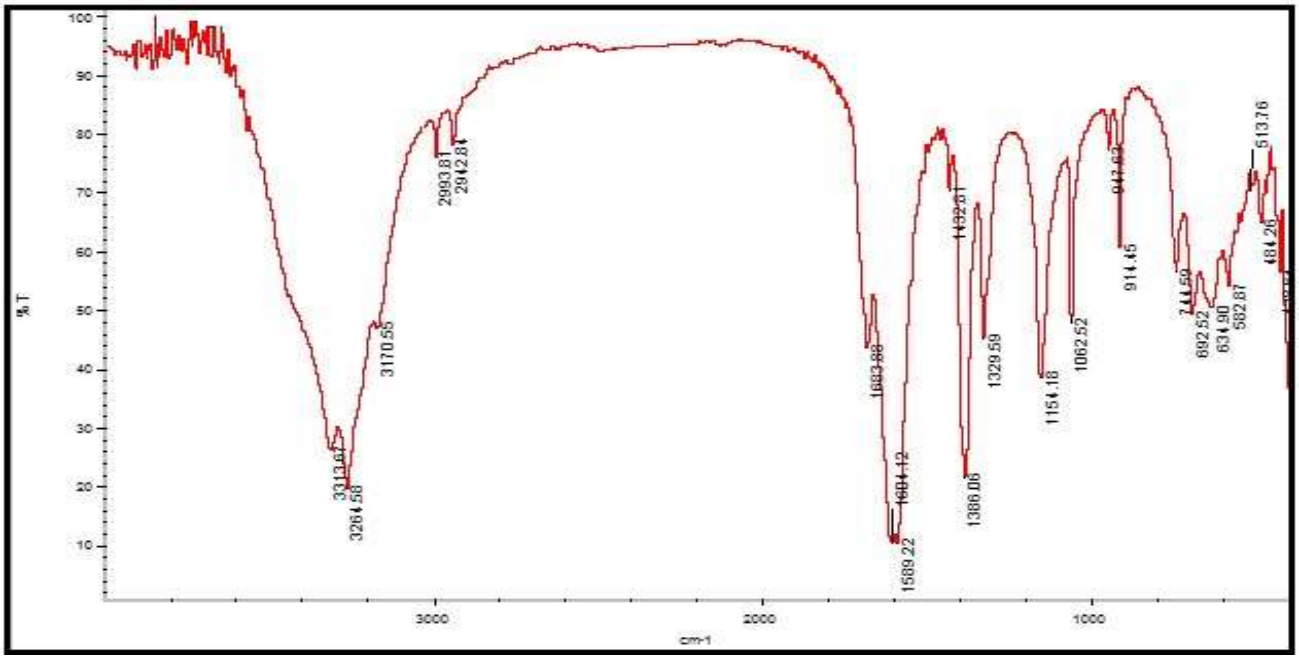


Figure 1. IR spectrum of ketorolac

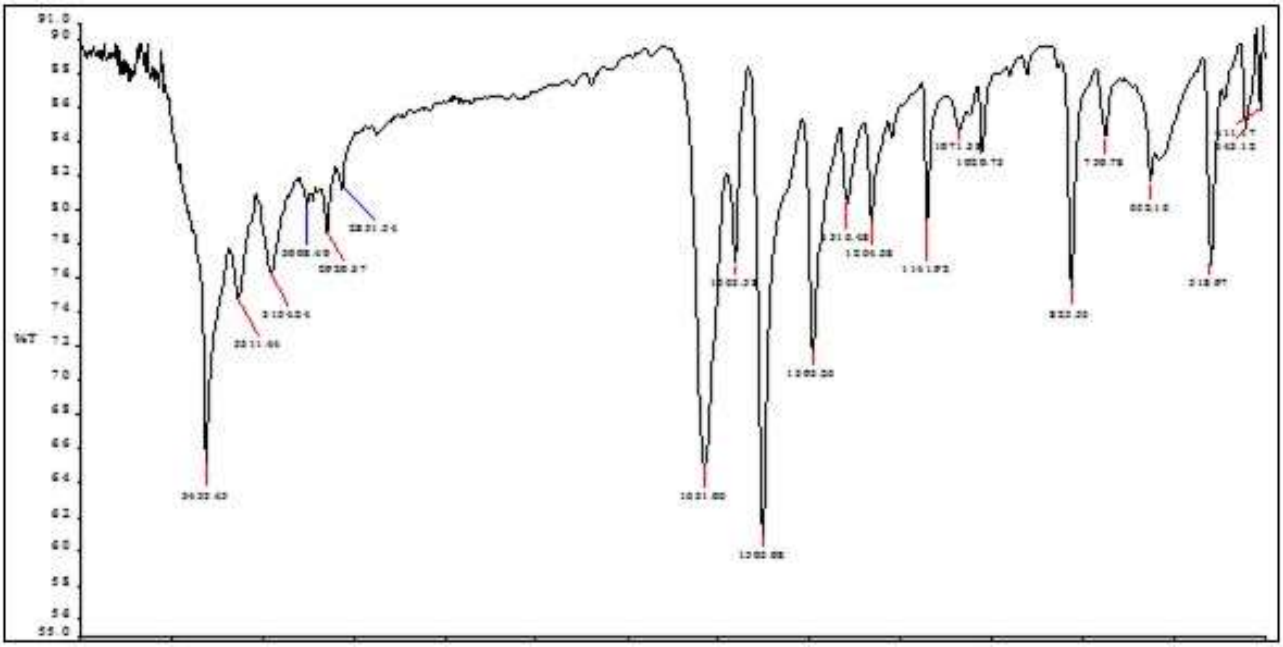


Figure 2. IR-spectrum of the coordination compound of Cu(II) with ketorolac and carbamide

In the spectra of the complexes, absorption lines were observed in the region of 412-452 cm^{-1} corresponding to M-N valence vibrations in the short wavelength range. Vibrations related to the -CH group of the benzene ring remained unchanged and appeared in the region of 2980-3100 cm^{-1}. The carbonyl group in the complexes

shifted to shorter wavelengths and was observed in the region of 3313-3264 cm^{-1}, which indicates that it is not involved in coordination. The X-ray structural analysis of the synthesized complex compound was also carried out and the parameters specific to the single crystal of the complex compound were determined.

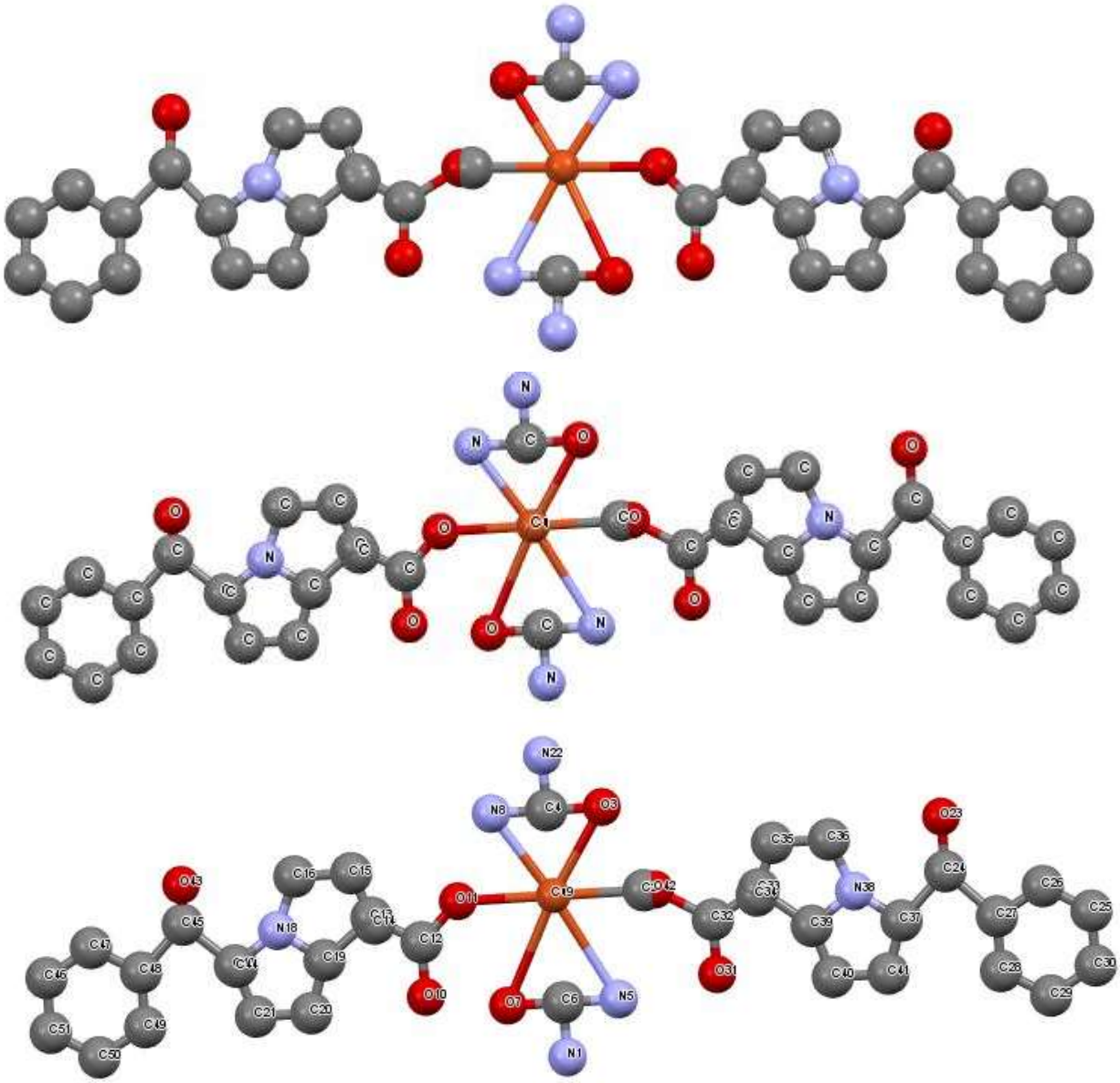


Figure 3. Illustration of Cu(II) coordination compound with ketorolac and carbamide

Table 2. Crystallographic data and parameters clarifying the structure of the Cu-complex compound.

	Cu-complex compound		
Formula	$C_{32}H_{32}CuN_6O_8$	Crystal size, [mm]	0.18×0.15×0.12
Molecular mass	692	T, °K	312
Syngonia	monoclinic	θ,°grad.	2,6; 52,4
Spatial group	$P2_1/n$	Interval h,k,l	999;-99 ; 999:-99 ; 999:-99
a, Å	31.26 (9)	Reflex	10281
b, Å	32.36 (9)	Refractive index	7137
c, Å	32.54 (13)	R_{int}	1672

α, β, γ, deg	90(7);90(7);90(6)	$F^2 \geq 2\sigma$ (F^2) criterion	0.71073
V, Å^3	30549.523	Parameter	3682
Z	4	Eligibility Criteria (F^2)	322
D_x, g cm^{-3}	0.165	R_1, $wR_2(I>2\sigma(I))$	1.04
μ(CuK_α), mm^{-1}	0.027		

Table 3

Bond lengths of a complex compound

Bond	d, Å	Bog‘	d, Å
Cu(1)-O(1)	2.2739	C(7)-C(8)	1.3412
Cu(1)-O(2)	2.2726	C(8)-C(9)	1.4696
Cu(1)-O(3)	2.2712	C(10)-C(11)	1.5650
Cu(1)-O(4)	2.2575	C(11)-C(12)	1.5332
O(2)-C(1)	1.3585	C(12)-C(13)	1.5332
O(3)-C(2)	1.2011	C(13)-C(14)	1.5325
O(4)-C(3)	1.3622	C(14)-C(15)	1.5359
O(5)-C(1)	1.2236	C(15)-C(16)	1.5440
O(6)-C(3)	1.2221	C(16)-C(17)	1.5252
N(1)-C(2)	1.3365	C(17)-C(18)	1.3554
O(1)-H(1)	0.9900	C(18)-C(19)	1.5150
O(1)-H(2)	0.9900	C(19)-C(20)	1.5360
N(2)-C(6)	1.4299	C(20)-C(21)	1.5334
N(2)-C(9)	1.2879	C(21)-C(22)	1.5338
N(1)-H(3)	1.0300	C(22)-C(23)	1.5335
N(1)-H(4)	1.0300	C(23)-C(24)	1.5336
C(2)-C(6)	1.3347	C(24)-C(25)	1.5316
C(2)-C(7)	1.4727	C(25)-C(26)	1.5229
C(3)-C(4)	1.5313	C(27)-C(28)	1.5569
C(4)-C(10)	1.5907	C(28)-C(29)	1.5367
C(5)-C(27)	1.6136	C(29) –C(30)	1.5388

Table 4.

Bond angles of a complex compound

Angle	ω, degree	Angle	ω, degree
O(1)-Cu(1)-O(2)	91.20	C(14)-C(15)-C(16)	113.27
O(1)-Cu(1)-O(3)	178.34	C(15)-C(16)-C(17)	114.93
O(1)-Cu(1)-O(4)	89.26	C(16)-C(17)-C(18)	118.12
O(2)-Cu(1)-O(3)	89.91	C(17)-C(18)-C(19)	116.41
O(2)-Cu(1)-O(4)	176.52	N(1)-C(2)-C(7)	108.01
O(3)-Cu(1)-O(4)	89.70	O(6)-C(3)-C(4)	118.22
Cu(1)-O(2)-C(1)	124.36	O(4)-C(3)-C(4)	123.33
Cu(1)-O(3)-C(2)	123.39	O(4)-C(3)-O(6)	118.31
Cu(1)-O(4)-C(3)	116.88	C(3)-C(4)-C(10)	113.35
H(1)-O(1)-H(2)	105.00	C(1)-C(5)-C(27)	117.67
Cu(1)-O(1)-H(1)	105.00	N(2)-C(6)-C(2)	123.55
Cu(1)-O(1)-H(2)	106.00	C(2)-C(7)-C(8)	123.30
C(6)-N(2)-C(9)	121.61	C(7)-C(8)-C(9)	118.10
O(2)-C(1)-O(5)	118.67	N(2)-C(9)-C(8)	119.28
O(2)-C(1)-C(5)	122.12	C(4)-C(10)-C(11)	119.02
O(5)-C(1)-C(5)	119.08	C(10)-C(11)-C(12)	110.59
H(3)-N(1)-H(4)	117.00	C(11)-C(12)-C(13)	111.31
C(2)-N(1)-H(3)	122.00	C(12)-C(13)-C(14)	110.50
C(2)-N(1)-H(4)	121.00	C(13)-C(14)-C(15)	111.13
O(3)-C(2)-N(1)	109.36	C(23)-C(24)-C(25)	111.01
O(3)-C(2)-C(7)	108.08	C(24)-C(25)-C(26)	110.72
N(1)-C(2)-C(6)	108.44	C(5)-C(27)-C(28)	118.58

Table 5

Hydrogen bonds in the crystal structure (A˚)

Bond D−H···A	Distance, Å			Angle D−H···A, grad.	Atomic coordinates, A
	D−H	N···A	D···A		
[$C_{32}H_{32}CuN_6O_8$]					
O(5)--H(5)…O(1)	1.1100	2.3400	3.2411(18)	138.00	-
O(6)--H(6)…O(2)	1.1000	2.3900	3.4445(17)	159.00	-

Also, differential thermal analysis was conducted in order to determine the properties of the obtained complex compounds. In the derivatograms of the studied compounds, endo- and exo-effects corresponding to various processes were observed: evaporation of crystallization water, phase transition and thermal oxidation and decomposition processes were observed. The analysis of the derivatograms of the complexes showed that the thermal decomposition of the organic part in all compounds ends in the temperature range of 100ºC-700ºC. In DTGA curves, this process is explained by endo- and exo-effects, which indicate the breaking of previous chemical bonds and the formation of new ones [12].

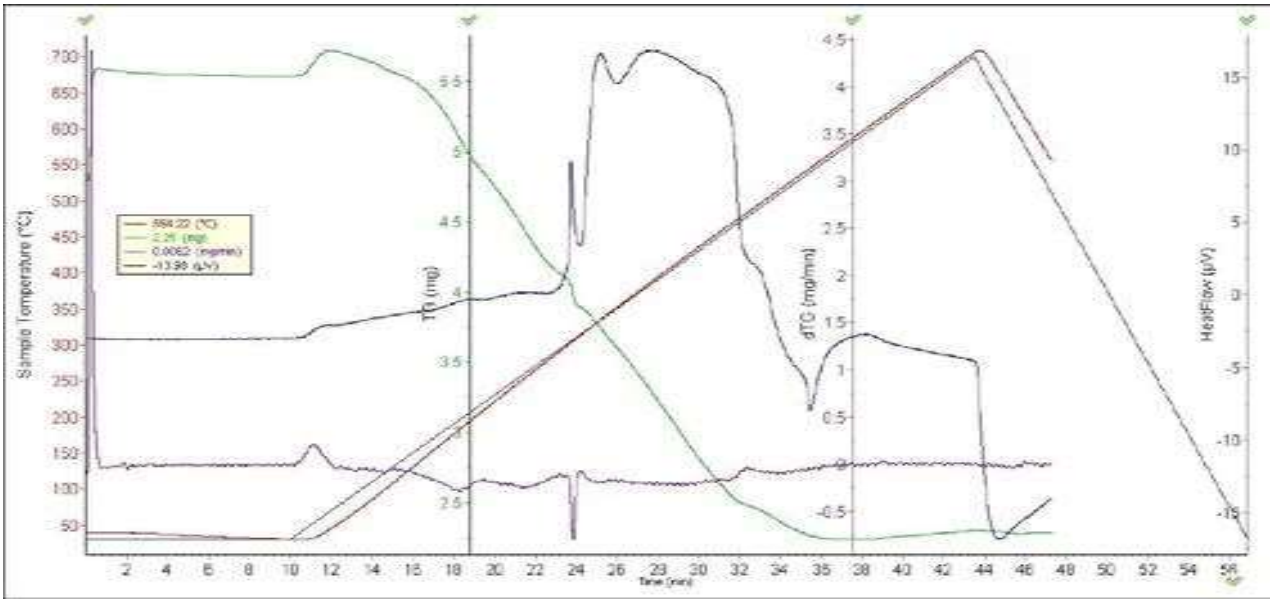


Figure 4. Derivatogram of a similar complex compound

A number of endothermic and exothermic effects were observed in the DTA curve of the [$Cu(HL)_2(Kar)_2$] complex. Above 100^0C, the endothermic effect refers to the decomposition of water of crystallization. As a result of the increase in temperature, the decomposition of the complex compound increases intensively. As a result, hydrazine begins to break down into components such as nitrogen oxides and carbon dioxide. Copper (II) oxide is formed as a thermolysis product. Based on the analysis of the research results, the thermal stability of the synthesized complex compounds is expressed by the nature of the central ion and the acid residue, as well as the absence of water molecules in the complex compounds. It was concluded that the complex compound synthesized on the basis of ketorolac is [$Cu(HL)_2(Kar)_2$] [13].

Conclusion. The complex $[Cu(HL)_2(Kar)_2]$ is a mixed-ligand complex of Cu(II), ketorolac, and carbamide with a 2:1 composition. The complex molecule contains O(5)--H(5)...O(1) and O(6)--H(6)...O(2) groups that can participate as donors in hydrogen bonds [6]. The fact that the synthesized ketorolac complex is important for temporary pain relief and anti-inflammatory use in all living organisms was shown by studying using physico-chemical research methods [14]. The solubility of the newly synthesized ketorolac complex is 25 times higher than that of ketorolac itself. It was determined by analyzing the Hirshfeld surface using the Crystall Explorer 17.5 program. According to it, the percentage of O···H/H···O interactions in the structure is higher than 36% on average and the share of H···H interactions was less than 26% [8]. Therefore, this result increased the solubility of the obtained compound [15].

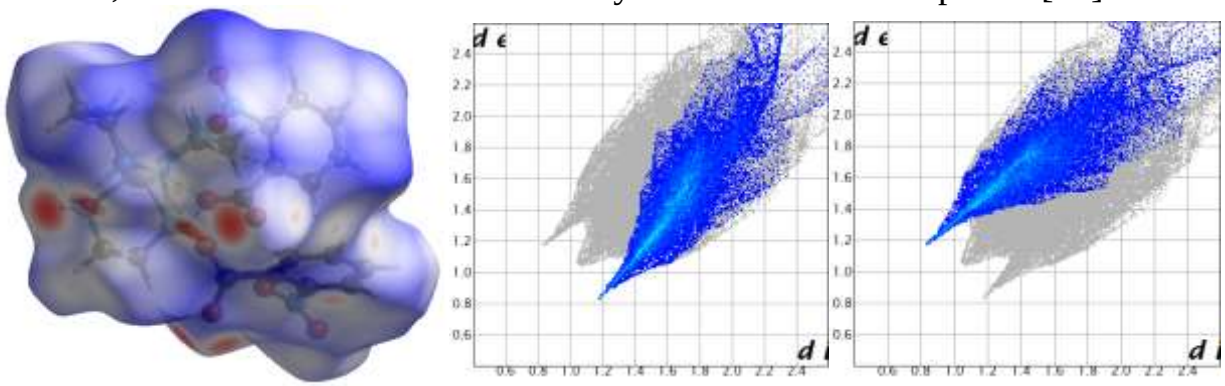


Figure 5. Hirschfeld surface analysis.

References

[1]. Jerry P., Jasinski., Ray J. Butcher., B. Narayana., M. T. Swamy., and H. S. Yathirajan. Crystal Structure of (±)-5-Benzoyl-2,3-dihydro-1*H*-pyrrolidine-1-carboxylic acid, Ketorolac // 2008 © The Japan Society for Analytical Chemistry. – 2008. – № 24. – p. 204-206.

[2]. Zeer G.M., Fomenko O.Y., Ledyaeva O.N. Application of scanning electron microscopy in solving actual problems of materials science // Journal of the Siberian Federal University. - 2009. - V.2. - No. 4. - P.287-293.

[3]. Kalmykov K.B., Dmitrieva N.E. Scanning electron microscopy and X-ray spectral analysis of inorganic materials. Methodological guide. Moscow, - 2017. - P.54.

[4]. Boyer KC, McDonald P, Zoetis T. A novel formulation of ketorolac tromethamine for intranasal administration: preclinical safety evaluation. Int J Toxicol. 2010;29:467–478.

[5]. Strom BL, Berlin JA, Kinman JL, et al. Parenteral ketorolac and risk of gastrointestinal and operative site bleeding. A postmarketing surveillance study.JAMA. 1996;275:376–382.

[6]. O.I.Khudoyberganov,Sh.B.Khasanov,B.T.Ibragimov,and… Synthesis, crystal structure and Hirshfeld surface analysis of the binuclear Cu(II) complex with 4-nitrobenzoic acid and triethanolamine.Chemical data collections.37(2022)100802

[7]. Litvak KM, McEvoy GK. Ketorolac, an injectable nonnarcotic analgesic. Clin Pharm. 1990;9:921–935.

[8]. Jamali F, Mehvar R, Pasutto FM. Enantioselective aspects of drug action and disposition: therapeutic pitfalls. J Pharm Sci. 1989;78:695–715.

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COMPLEX FORMATION IN THE SYSTEM POLYAMPHOLYTE - Ni^{2+}, Co^{2+}, Cu^{2+}, Zn^{2+}, Cr^{3+}-WATER

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Abstract. The complex-forming properties of polycomplexons including ions of amino and amino- phosphon groups obtained on the basis of local raw materials with Cu (II), Ni (II), Co (II), Zn (II) and Cr (III) were analyzed. The process of sorption of metal ions into ion exchangers was studied in the Pseudo-First-Order and Pseudo-Second-Order kinetic models, and it was determined by studying the absorption kinetics that the sorption process was the Pseudo-Second-Order Kinetic Model. The Langmuir and Freundlich constants of the isotherm of absorption of Zn (II) and Cr (III) ions into anion exchange resin and polyampholyte at different temperatures were calculated. Based on the results of the study, the thermodynamic parameters of the sorption process, the isothermal-isobaric potentials, the changes in the values of free energy (ΔG), enthalpy (ΔH) and entropy (ΔS) were found by calculating.

Keywords: polyvinylchloride, anion exchanger, polyampholyte, adsorption, chemisorption, kinetics, isotherm.

Introduction. Currently, there is an acute problem of protecting the environment from the negative consequences of the activities of industrial enterprises, as a result of which a large number of substances of various origins, both natural and anthropogenic, are released. Among them are substances of natural origin, the most dangerous toxic metal ions [1]. The sources of environmental pollution are mainly ferrous and non-ferrous metallurgy, mechanical engineering, and battery recycling plants. In recent years, a wide range of ion-exchange sorbents has been produced, including ion-exchange resins based on polymer materials with the properties of cation and anion-exchange and making complexes. The obtained ion-exchange resins allow us to

successfully solve environmental problems.[2] To date, in the world, polymer-metal alloys are being used for various purposes in various industries. A number of interesting research works have been carried out by scientists from the leading countries of the world on obtaining such polymer-metal alloys [3]. Polymeric-metal complexes can be synthesized mainly by interaction of synthetic polymers with metals, by sorption of metal ions to polycomplexons, by polymerization of monomers in which metal atoms are stored [4]. Synthesized polymer-metal ores have been widely used in various industries, including organic synthesis as a highly effective catalyst, purification of wastewater from harmful substances, sensors and other purposes [5].

Materials and methods. Analysis of applied materials and research results: In order to study the sorption of Zn (II) and Cr (III) ions into a bead-shaped ion exchange sorbent, it was studied in solutions of different concentrations. For the purpose of studying the sorption of metal ions into anion exchange resins, polyampholyte, the solutions of 0.001, 0.0025, 0.005, 0.0075, 0.01, 0.025, 0.05, 0.075 mole L-1 were prepared by using a solution with a concentration of 0.1 mole L-1 from water-soluble salts by the method of dilution. 0.2 g of the activated sorbent was put into conical glass flasks, then 100 ml of metal salts were placed on the solution, and the time dependence of the sorption was studied in each solution for 2, 4, 6, 8, 10 h. The analysis was carried out at temperatures of 303K, 313K and 323K based on these concentrations.

Since the colorless solution of the Zn (II) ion is water-soluble salts, it cannot be detected by a UV device. Zn (II) ions were found by using the complexometric titration method to change the concentration of the sorption process. Trilon B or NaHTr for short is used for titration. Trilon B forms stable internal complex compounds with many anions. In these compounds, the metal ion replaces the hydrogen atom in the carboxyl group and binds to nitrogen in the complex via coordination bonds. For this purpose, 0.05 N Trilon B solution is used. In order to shift the equilibrium towards the formation of a complex compound during titration, a buffer solution (pH-10) and the indicator “erichrome black T” were used to determine the equivalence point. It is possible to find out how much metal is absorbed from the difference in the pre- and post-concentration of the solutions of sorption process [6]. Based on the results obtained, the amount of absorbed metal ions in the sorbent PPE-1 and PPE-1-P was determined by using the following formula.

$$q_e = \frac{(C_0 - C_M)\cdot V}{m}$$

Here: q_e-the number of ions absorbed into ion exchanger mmol g^{-1}, C_0- the initial concentration Ce – the equilibrium concentration mmol L^{-1}; V the volume of solution l; m – the mass of dry sorbent (g).

Pseudo-First-Order Kinetic Model

It is represented by the equation (2) below

$$\log(q_e - q_t) = \log q_e - \frac{k_1}{2{,}303} t$$

In this equation: q_t and qe - the amount of sorption of metals of the sorbent at a given time and equilibrium (mg g^{-1}), k_1 - the rate of the firstorder sorption process (min^{-1}), and the angular value of the intersection slope in the line graph of $\log(q_e-q_t)$ and t time is equal to k1 /2,303 [7].

Pseudo-Second-Order Kinetic Model

It is represented by the equation (3) below

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^{\,2}} + (\frac{1}{q_e})t$$

The initial sorption rate (t = 0) is found as follows

$$h = k_2 q_e^{\,2}$$

In this equation, k_2-constant velocity, q_e – the amount of metal absorbed in the sorbent of a given mass (mg g^{-1}), t-time (minutes) [8]. Study of adsorption equilibrium: Adsorption isotherms are the most important thing for the analysis of equilibrium processes. Of the many models used to represent equilibrium processes in liquid and solid systems, the most widely used and most convenient are the Langmuir and Freundlich models [9].

Langmuir adsorption isotherm model: It is represented by the equation below.

$$q_e = q_{\max}\frac{K_L C_e}{1+K_L C_e}$$

Here: q_e - the amount of metal absorbed into the sorbent of a certain mass (mg g^{-1}), C_e – the equilibrium concentration of the solution (mg l^{-1}), q_{max} - the maximum amount of metal absorbed into the sorbent of a certain mass (mg g^{-1}).

In order to find the Langmuir constant (K_L), the Langmuir equation (2) can be converted to a linear form. The values of q_{max} and K_L can be determined from the C_e dependence graph of C_e/q_e.

$$\frac{C_e}{q_e} = \frac{1}{q_e K_L} + \frac{1}{q_{\max}}\cdot C_e$$

An important feature of the Langmuir isotherm parameters is that the separation coefficient "R_L" can be used to draw conclusions about the relationship between the adsorbent and the adsorbate.

$$R_L = \frac{1}{1+K_L \cdot C_0}$$

In this regard(4): It represents $0 < R_L < 1$ comfortable, $R_L > 1$ uncomfortable, $R_L = 1$ linear and $R_L = 0$ irreversible for the adsorption process [10].

Freundlich adsorption isotherm model It is represented by the equation (5) below.

$$q_e = K_F C_e^{\,1/n}$$

It is possible to study the sorption processes that take place in different (non-ideal) solutions by using the Freundlich isotherm equation [11]. The linear equation of this model can be expressed as follows:

$$\log q_e = \log K_F + \left(\frac{1}{n}\right)\log C_e$$

In this (5) equation: qe – the amount of metal absorbed into sorbent of a certain mass (mg mg l^{-1}), K_F- the Freundlich constant, Ce- the equilibrium concentration of the solution (mg l^{-1}), 1/n – the sorption intensity. The K_F and n (n≈1-10) values of the Freundlich constants are found by the angular value of the intersection slope on the log C_e with log q_e line graph [12].

Analysis of IR-spectroscopy of polymer-metal complexes

In the study, the laws of absorption and complex formation of intermediate metal ions Co (II), Zn (II), Ni (II), Cr (III) and Cu (II) from artificial solutions to polycomplexes under the same conditions were studied. Also, the stability, structure, composition and properties of the formed polymer-metal coordination compounds were studied using modern physicochemical research methods. In this regard, in order to determine the coordination center of sorbents, which were initially absorbed sorbents Cu^{2+}, Co^{2+}, Ni^{2+}, Cr^{3+}, Zn^{2+} ions, IR-spectroscopy analysis was taken [13; 14].

Table 1: IR spectra of complexes formed as a result of PPE-1 and sorption

Compound	υ (NH)	δ (NH)	υ (CH_2)	δ(CH_2)	Me-N	Me-O
PPE-1	3360	1635	1070	1456	-	-
$[CrL^1_3]Cl_3$	3281	1634	1070	1456	422	-
$[CoL^1_4]SO_4$	3350	1634	1072	1456	422	457
$[NiL^1_4]SO_4$	3348	1634	1070	1454	409	482
$[CuL^1_4]SO_4$	3340	1634	1072	1454	422	476
$[ZnL^1_4]SO_4$	3357	1634	1070	1447	419	467

Table 2: IR spectra of complexes formed as a result of PPE-1-P and sorption

Compound	υ (P=O)	υ (NH)	υ (OH)	δ(CH_2)	υ (CH_2)	Me-O
PPE-1-P	1298	3281	2120	1457	1072	-
$[CrL^2_3]Cl_3$	1290	3396	2162	1456	1072	470
$[CoL^2_4]SO_4$	1288	3338	2153	1455	1072	473
$[NiL^2_4]SO_4$	1291	3304	2127	1455	1077	474
$[CuL^2_4]SO_4$	1274	3305	2142	1458	1085	488
$[ZnL^2_4]SO_4$	1272	3354	2143	1456	1070	492

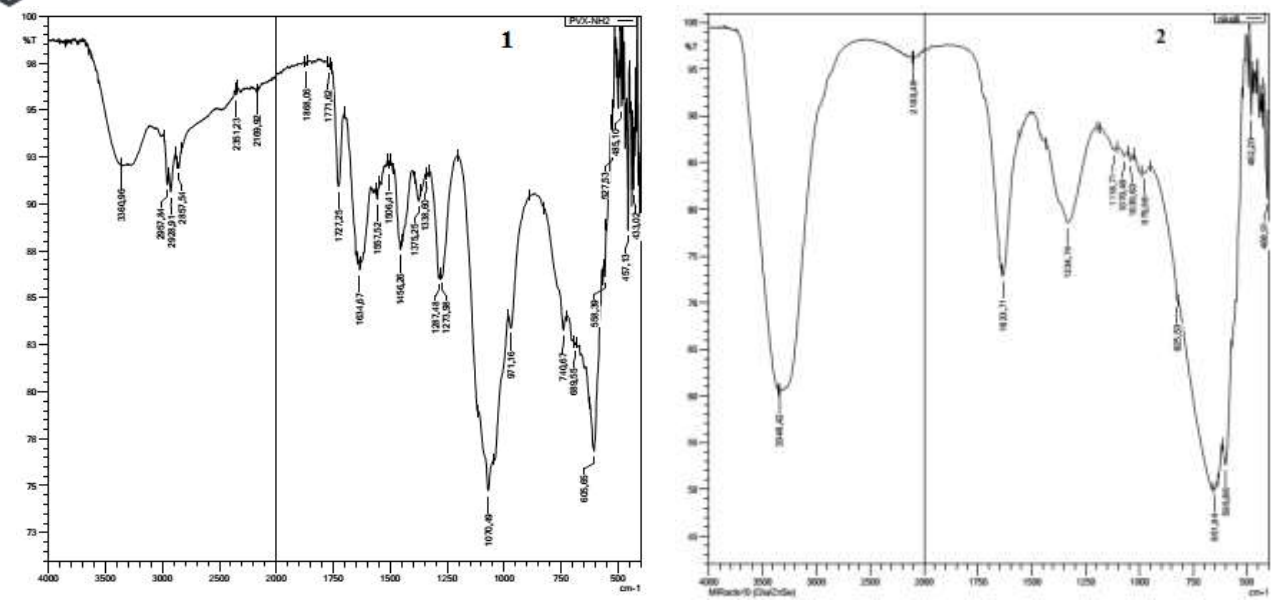

Figure 1. IR spectra of 1-PPE-1 and 2-$[NiL^1_4]SO_4$.

Quantum chemical calculation of energy and geometric parameters of sorption products. Based on the results of physicochemical analysis to determine the structure, geometric and energy parameters of the obtained molecules, the polymer complex formed by PPE-1 polymer with metals was quantum chemical and the spatial structure, geometric and energy parameters of the molecule were determined [15].

According to all the above methods of physicochemical analysis, the first Z-matrices of molecules were formed, taking into account the formation of coordination through Me-N bonds, and 6 coordination metal for chromium complexes: polymer =1:3, for copper, nickel, cobalt metals 1:4 and, zinc was estimated to be 1:2 for the metal and the energy and geometric parameters were calculated [16].

In the spatial structure found to be the most optimal for the chromium complex, the metal was bound by the secondary amine group nitrogen, and the chlorides in the metal chloride were found to be on one side and the polymer molecules on the other (Figure 1).

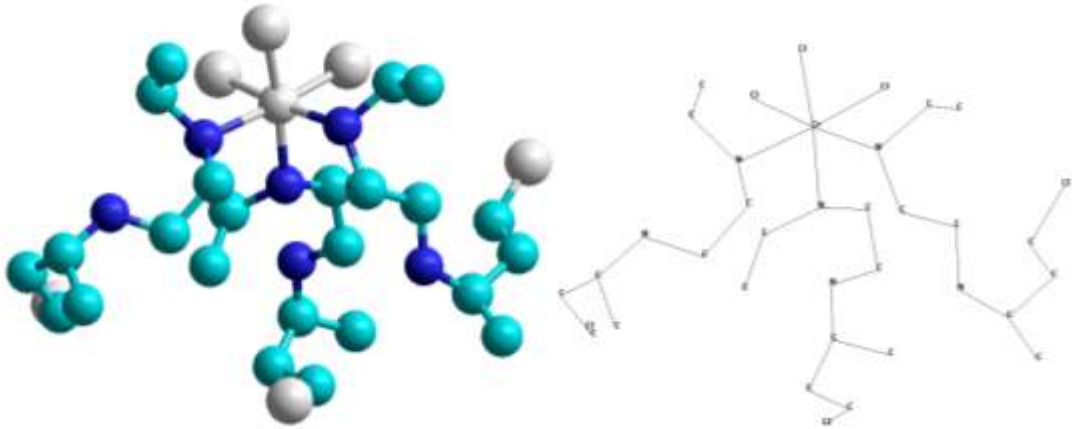

Figure 2. The spatial structure of the complex of $[CrL^1_3]Cl_3$

Conclusion. In this study, the process of sorption of Cu(II), Ni(II), Co(II), Zn(II), Cr(III) ions into PPE-1 anion exchange resin and PPE-1-P polyampholyte

containing amine and phosphite group preservatives, obtained on the basis of local raw materials, was studied in artificial solutions under static conditions. Factors that influence the sorption process, namely time dependence, temperature effect, concentration dependence, were studied. The process of sorption of metal ions into ion exchangers was studied in the Pseudo-First-Order and Pseudo-Second-Order kinetic models, and it was determined by studying the absorption kinetics that the sorption process was the Pseudo-Second-Order Kinetic Model. Sorption of the obtained ion exchangers in artificial solutions preserving Zn (II) and Cr (III) ions at different initial concentrations and temperatures showed that it is subject to the theory of Langmuir monomolecular and Freundlich adsorption.

It was determined that sorption of intermediate metals Cu (II), Ni (II), Co (II), Zn (II), Cr (III) ions of polycomplexes containing amino and phosphonic groups obtained on the basis of local raw materials, their copper (II) and chromium (III) ions were found to be highly selective. The study of polymer-metal complexes, which are sorption products using electronic spectra of IR-spectroscopy and diffuse reflectivity, made it possible to determine their structure, coordination centers and geometry.

References

[1]. Rustamov, M.K., Gafurova, D.A., Karimov, M.M., ...Bekchonov, D.Z., Mukhamediev, M.G. Application of ion-exchange materials with high specific surface area for solving environmental problems// Russian Journal of General Chemistry, 2014, 84(13), стр. 2545–2551

[2]. Gafurova, D.A., Khakimzhanov, B.S., Mukhamediev, M.G., Musaev, U.N. Sorption of Cr(VI) on the anion-exchange fibrous material based on nitron// Russian Journal of Applied Chemistry, 2002, 75(1), стр. 71–74.

[3]. Eishun Tsuchida and Hiroyuki Nishide. Polymer-Metal Complexes and Their Catalytic Activity// Monography. Japan. 2009. -pp. 2-75.

[4]. Rivas B.L., Seguel G.V., Ancatripai C. Polymer-metal complexes: Synthesis, characterization, and properties of poly(maleic acid) metal complexes with Cu(II), Co(II), Ni(II) and Zn(II)// Polymer Bulletin. 2000. –vol.44. -pp. 445–452.

[5]. Nurşen Sari, Ebru Kahraman, Beki˙r Sari & Ayli˙n Özgün. Synthesis of Some Polymer-Metal Complexes and Elucidation of their Structures// Journal of Macromolecular Science, Part A: Pure and Applied Chemistry. 2006. –vol.43, N 8. -pp. 1227-1235.

[6]. Smanova, Z.A., Gafurova, D.A., Savchkov, A.V. Disodium 1-(2-pyridylazo)-2-oxynaphthalene-3,6-disulfonate: An immobilized reagent for iron(III) determination// Russian Journal of General Chemistry, 2011, 81(4), стр. 739–742.

[7]. Foo, K.Y., Hameed B.H.: Insights into the modeling of adsorption isotherm systems, Chemical Engineering Journal, 2010, 156(1), 2-10;

[8]. Yuh-Shan Ho. Citation review of Lagergren kinetic rate equation on adsorption reactions// Scientometrics. 2004. -Vol. 59, No. 1 -pp.171-177.

[9]. Pam H Y Li, Roderick L Bruce, Malcolm D Hobday. A pseudo first order rate model for the adsorption of an organic adsorbate in aqueous solution// Journal of Chemical Technology & Biotechnology. 1999. -Vol. 74. -pp. 55-59.

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DETERMINATION OF THE COMPLEX OF AMIDO BLACK 10B DYE WITH LEAD (II) ION ON IMMOBILIZED FIBER

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Annotatsiya: Ushbu maqolada og'ir metallardan Pb (II) ionining azo kislotali bo'yoq - Amido Black 10B bilan ligand kompleksi orqali, yangi kislotali bo'yoq birikmasi olish va immobillangan tolada metal ionini sorbsion-spektroskopik aniqlash usulining tavsifi keltirilgan. Ligand va yangi azo kompleksining xususiyatlari FT/IQ spektroskopiyasi, UV-Vis spektroskopiyasi, nur qaytarish spektroskopiyasi tahlil qilindi. Tolaga immobillangan ligandning va yangi sintez qilingan qo'rg'oshin kompleksining tuzilishi yuqorida aytib o'tilgan barcha tahlil metodlari bilan tadqiq qilindi. Pb (II) bilan azo metal kompleksining hosil bo'lishi UV-Vis spektri bilan tasdiqlandi. Turli pH muhitlarda va spektral tahlillar bilan ushbu tolaga immobillangan kompleksning nisbati izomolyar seriyalar usulida ochib berdi. Organik ligandlarning sintetik polimer tolaga immobillanish mehanizmlari, optimal sharoitlari aniqlandi va suniy aralashmalarda sinovdan o'tkazildi.

Kalit so'zlar: og'ir metallar, buffer eritmalar, UV-Vis; IQ tahlil, rang tahlili, organic reagent.

Abstract: This article presents a description of the method of obtaining a new acidic dye compound and sorption-spectroscopic detection of the metal ion in the immobilized fiber through the ligand complex of Pb (II) ion from heavy metals with an azo acid dye - Amido Black 10B. The properties of the ligand and the new azo complex were analyzed by FT/IR spectroscopy, UV-Vis spectroscopy, and reflection

spectroscopy. The structure of the ligand immobilized on the fiber and the newly synthesized lead complex was studied by all the methods of analysis mentioned above. Formation of azo metal complex with Pb (II) was confirmed by UV-Vis spectrum. The proportion of the complex immobilized on this fiber in different pH environments and by spectral analysis was revealed by the method of isomolar series. Mechanisms of immobilization of organic ligands to synthetic polymer fiber, optimal conditions were determined and tested in artificial mixtures.

Key words: heavy metals, buffer solutions, UV-Vis; IR analysis, color analysis, organic reagent.

Аннотация: В данной статье представлено описание метода получения нового кислотного красящего соединения и сорбционно-спектроскопического обнаружения иона металла в иммобилизованном волокне через лигандный комплекс иона Pb(II) из тяжелых металлов с азокислотным красителем – амидо черный 10Б. Свойства лиганда и нового азокомплекса анализировали методами ИК спектроскопия с преобразованием Фурье, УФ-видимая спектроскопия и спектроскопии отражения. Строение лиганда, иммобилизованного на волокне, и вновь синтезированного комплекса свинца изучали всеми перечисленными выше методами анализа. Образование комплекса азометалла с Pb (II) было подтверждено спектром УФ- видимая области. Долю комплекса, иммобилизованного на этом волокне в различных pH средах и спектральным анализом, выявляли методом изомолярных рядов. Определены и испытаны на искусственных смесях механизмы иммобилизации органических лигандов к синтетическому полимерному волокну, оптимальные условия.

Ключевые слова: тяжелые металлы, буферные растворы, Ультрафиолетово-видимая спектроскопия; ИК-анализ, цветной анализ, органический реагент.

Introduction. Nowadays, the uncontrolled pollution of the environment as a result of the human factor and activity is one of the acute global problems of our time. Among them, pollution of natural waters is especially dangerous. The shortage of drinking water is becoming a major problem for the Central Asian region due to the scarcity of water resources. Reserves of fresh water suitable for drinking in the rivers and lakes of Uzbekistan are very limited. Scientists are promoting the idea that groundwater and glacial water will serve as a global solution to this problem, but these reserves have a tendency to accumulate toxic pollution. Thus, drinking water is truly becoming a “strategic resource of the 21st century”.

The aim of the work is to determine the structure of the complex using UV/Vis, IR, isomolar series method of sorption-spectrophotometric determination of lead using an organic reagent (OR) immobilized on a fibrous carrier of sodium 4-amino-5-hydroxy-3 diazoazo compounds with various spectroscopic methods. Because of its selectivity, this reagent has found use in the analysis of lead in the presence of many other metals. This article shows the advantage of sorption-spectrophotometric determination of lead (II) using an organic reagent immobilized on a polymer carrier over the photometric method.

Literature Review. Azo chemical compounds are still at the center of scientific research, particularly azo dyes, a class of synthetic, colored organic compounds containing one or more azo bonds (-N=N-) is a particularly noteworthy direction [1,2].

These azo groups form bridges between organic residues, at least one of which is usually an aromatic nucleus. Basically, the production of azo dyes is based on the coupling of diazonium compounds with phenols, naphthols, arylamines, pyrazolones or other suitable components, and focuses on the formation of hydroxyazo, aminoazo compounds or their tautomers. The chemistry of these dyes ranges from simple monoazo compounds to complex polyazo compounds with a molecular weight of 2000 or more [3]. Azo dyes are the most important class of organic dyes, and they are widely used in many fields: various fields (textiles, polymers, photography, printing and ceramics), optical fields (lasers, optical sensors, photochromic materials), in almost all food and cosmetics, drugs (pharmaceutical products, photodynamic therapy, antimicrobial activity), etc. [4-8]. Usually, metal complexes of azo dyes are formed by the reaction of intermediate metal ions with ligands, where the ortho positions close to the azo group contain groups that can form coordination with metal ions. Such groups include hydroxyl (-OH) carboxy (-COOH) amino (-NHR) and oxy-acetic (-OCH_2COOH) groups. These organic azo dyes with functional analytical active groups are used in sorption-spectroscopic determination of toxic metal ions in various water samples.

As a method of controlling the content of toxic elements, including lead ions in waste water, industrial water and natural water, it is possible to use the method of continuous monitoring and rapid control of elements.

Research on the creation of reagents immobilized on various polymer sorbents for the detection of heavy toxic metal ions is currently one of the actively developing areas of analytical chemistry [9-12]. As a rule, these studies are carried out at the intersection of several disciplines: organic, inorganic chemistry, chemistry of polymers, biology and medicine [13]. This method is carried out using sorbents using certain physico-chemical methods and analysis. As sorbents, polycrystalline films of chalcogenides and metal oxides with a thickness of 30-2000 nm are used, on which an inert fiber or solid base is applied, and they are also used as cellulose and its derivatives, glass, polymers and other materials. This new method applies to the management of waste, industrial water and natural water environment, and can be used (and intended) for continuous monitoring and rapid control of toxic and radioactive elements [7].

Research Methodology. Reagents and equipment. 1.598 g of Pb $(NO_3)_2$ measured on an analytical balance is placed in a 1 l measuring flask and dissolved in water, and the measuring flask is diluted to the mark “bi-distilled water”. 1 mg of Pb corresponds to 1 ml of the resulting solution [14].

A solution of a mixture of medium phosphoric acid, acetic and boric acids is prepared in a 1 l measuring flask. From each of them, the necessary amount of substances is measured to prepare a 0.04 M solution. The pH value of the resulting universal buffer solution is 1.81. The following volume of 0.2 N NaOH solution is added to 100 ml of this mixture to obtain a buffer solution with the desired pH value [15].

0.0154 g of amido black organic reagent measured on an analytical balance is placed in a 250 ml volumetric flask, dissolved in distilled water and diluted to the mark "bi-distilled water". Ready standard solution is $1x10^{-5}$M.

From synthetic polymer fibers with different composition: 0.2000 g of orange-colored ion exchange material (PPA) obtained by modifying polyacrylonitrile fiber with polyethylene polyamine; furthermore, 0.2000 g of polyacrylonitrile fiber modified with polyethylene polyamine and dichloroethane (PPD) fibers were measured on an analytical balance.

To record the diffuse reflectance spectra from a solid surface and study the dependence of the reflectance (R), the function of the reflectance F (R) on various factors, an X-Rite one pro recording spectrophotocolorimeter and a UV-ViS SPECORD 50 double-beam recording spectrophotometer were used [16].

pH optimum conditions of chemical reactions were controlled by METTLER TOLEDO pH meter.

Various fibrous materials (polyacrylonitrile type) containing various functional groups have been tested as a solid phase. The sorbent was used in the form of disks with a diameter of 20 mm and weighing 30–40 mg in a wet state, for which the disks were kept in a 0.1 M solution of hydrochloric acid, washed with distilled water, and then stored in Petri dishes [17].

FT/IR spectra of complex and immobilized azo dye ligand were analyzed using Perkin Elmer-Spectrum 100 spectrometer technique, and its value was recorded as 4000-400 cm^{-1}.

UV-Vis electronic absorption spectra of the complex in the solid phase and the ligand in water ($c=1.0x10^{-5}$ mol/dm^3) were studied on a SPECORD 50 spectrophotometer and its value was determined to be 490-620 nm.

The analytical signal was taken as the difference between the diffuse reflectance coefficients (ΔR) measured at 620 nm of the disks after the sorption of the element from the control and analyzed solutions and the reaction with the reagent on the solid phase.

The study was carried out in static and dynamic modes. In a static mode, 10.0 ml of reagent solution was injected into 50.0 ml flasks, and the carrier disk was lowered therein and stirred for 5-8 minutes. Holding the carrier with a glass rod, the reagents were decanted, the immobilized carrier was washed with distilled water, and it was immersed in the analyzed solution. In the dynamic mode, the analyzed solution was passed through the immobilized disk at a rate of 10 ml/min.

The degree of retention of amido-black (R%) on the carrier was calculated by the formula: $R=100 \cdot A/A_0$, where A is the optical density of the reagent after immobilization, A_0 is the optical density before immobilization.

Analysis And Results. The ligand of Amido Black 10B azo dye is shown in Figure 1, and it was complexed with Pb (II) ions using a metal: ligand ratio of u = 1:1 mol.

It is easy to see that only the atoms of the -OH functional group participate in the coordination reaction. The structure of the lead complex in the immobilized fiber is presented in Fig. 2.

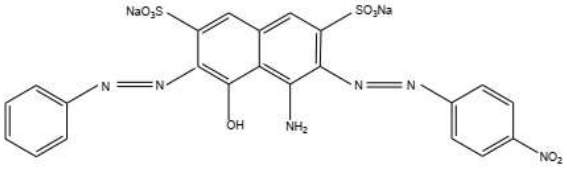

Figure 1. The structure of the ligand

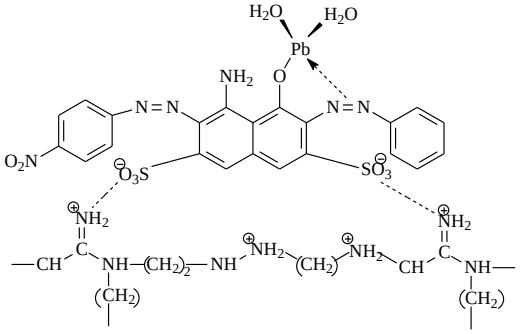

Figure 2. The structure of the complex

UV-Vis spectroscopy

The UV-Vis spectrum of the acidic azo dye (Figure 3) showed two lines from 263 nm to 368 nm. The first line may be due to the transition of **π-π*** in the aromatic ring, and the second line may be due to the **n-π*** transition of the N = N group [18]. Complex formation of azo reagent with Pb (II) ion was also confirmed by UV-Vis spectrum.

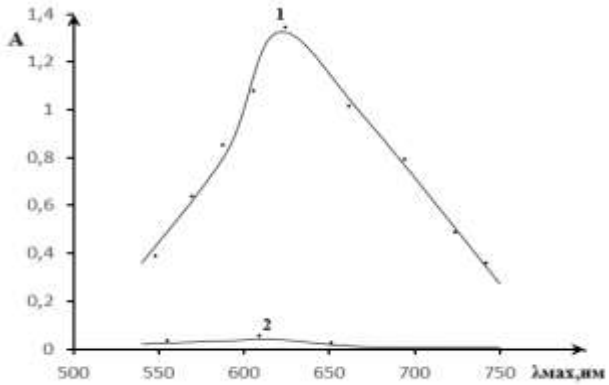

Figure 3. Absorption spectrum of organic amido black reagent immobilized on PPD-1 fiber (l=620 nm): before immobilization (1), after immobilization (2)

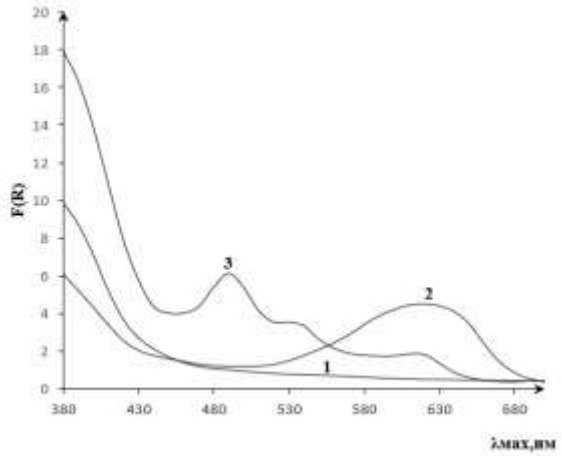

Figure 4. Reflectance spectra of fiber (1), immobilized reagent (2) complex with lead (II) ion (3) in universal buffer mixed media

It can be seen that λ max for the ligand is 620 nm. The complexation reaction is the main reason for the significant hypochromic shift in the region of π-π* and n-π* transitions, which reached a maximum of 490 nm in Fig. 4 [19].

Determination of the ratio of constituent moles of a complex compound.

In the determination of the ratio of moles of the components of a complex compound by the isomolar series method, selected solutions of the organic reagent AB with lead (II) ion immobilized are used.

Determination method: starting from 0.2000 g of PPD-1 chlorinated fibers selected for each reagent in separate cups, variable volumes of lead (II) ion solution (from 1.0 ml to 10, 0 ml and variable amounts of AB solution (from 1.0 ml to 10.0 ml) in 5 ml of universal buffer solution (pH=3.0-6.0) were added and sorbed for 4-5 min. Before and after immobilization the optical densities measured against the reference solution are presented in Table 1 and Figures 5.

Table 1

Determination of the ratio of moles of complex compounds by the method of isomolar series

PPD-1, $C_{AB}=1\cdot10^{-5}$ M, $\lambda_{max}=490$, l=1, t=10 min									
V_R, ml	1,0	2,0	3,0	4,0	5,0	6,0	7,0	8,0	9,0
$V_{ml\ Pb2+}$	9,0	8,0	7,0	6,0	5,0	4,0	3,0	2,0	1,0
A_{Pb2+}	0,002	0,025	0,12	0,33	0,5	0,35	0,25	0,15	0,015

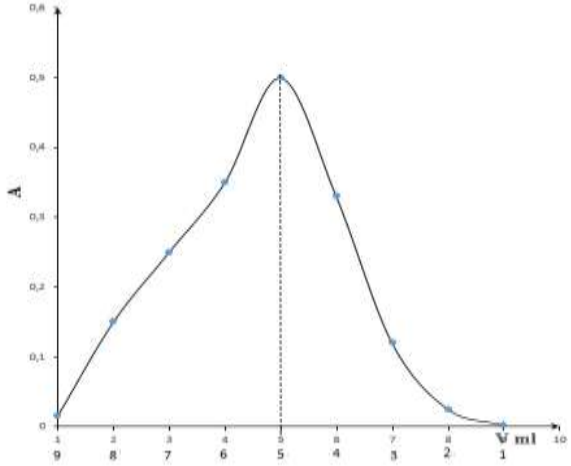

Figure 5. IMR:Me2+ ratio according to the isomolar series method. (for PPD-1 fiber)

The ratio between organic reagent and metal ions was proved to be 1:1 when immobilized amido black organic reagent was tested with lead(II) ion by isomolar series method.

FT/IB-UATR spectroscopy

Analysis of the FT/IR-UATR spectra of the ligand and the complex (Figure 6) highlights the following aspects: Amido black reagent: the absorption region at 3414 cm^{-1} is characteristic of the -OH group in the aromatic ring, the main amino group - NH_2 is in the absorption region at 3058 cm^{-1} will appear. The -N=N- group in the free ligand creates an absorption frequency in the region of 1487 cm^{-1}. The frequencies in

the 1455 cm^{-1}, 755-859 cm^{-1} absorption areas of the aromatic group held by the -OH group were evident. Absorption in 1606 cm^{-1}, 935-912 cm^{-1} regions was observed in the main ligand -C=C- in 2 or 3 substituted compounds in the ligand sample. -SO_2-O-R groups with 2 sulfonatium in the aromatic ring have absorption areas at 1283-1170 cm^{-1} and -O-Na bonds at 538 cm^{-1}. The main changes were observed in the absorption areas of 1455 - 1330 cm^{-1}, 859- 755 cm^{-1}, 643 cm^{-1}, 538 cm^{-1}.

Fiber: In the PPD-1 fiber IR-spectra, the absorption line of -CH acrylic groups in the absorption region of 2242 cm^{-1} is visible, the absorption lines in the region of 3345 cm^{-1} correspond to the valence and deformation vibrations of the -N-H group. Area changes at 3000-3400 cm^{-1}, i.e. expansion, indicate the presence of hydrated water molecules in the polymer, absorption lines at 1560 cm^{-1} belong to deformational vibrations of the >NH group, and absorption lines at 1662 cm^{-1} belong to valence vibrations of >C=N- bonds. The R-NH_2^+-R group in the fiber produced an absorption line in the region of 2927 cm^{-1}.

During the immobilization of the organic reagent AB on PPD fiber, a change in the R-NH_2^+-R group absorption area from 2927 cm^{-1} to 2946 cm^{-1} area was observed, and an increase in the >C=N-H group from 1662 cm^{-1} area to 1678 cm^{-1} area was observed. The immobilized organic reagent AB showed changes in the absorption areas of the aromatic group 2 sulfonatrium -SO_2-O-R groups at 1283 - 1170 cm^{-1} and -O-Na bonds at 538 cm^{-1} (Fig. 5).

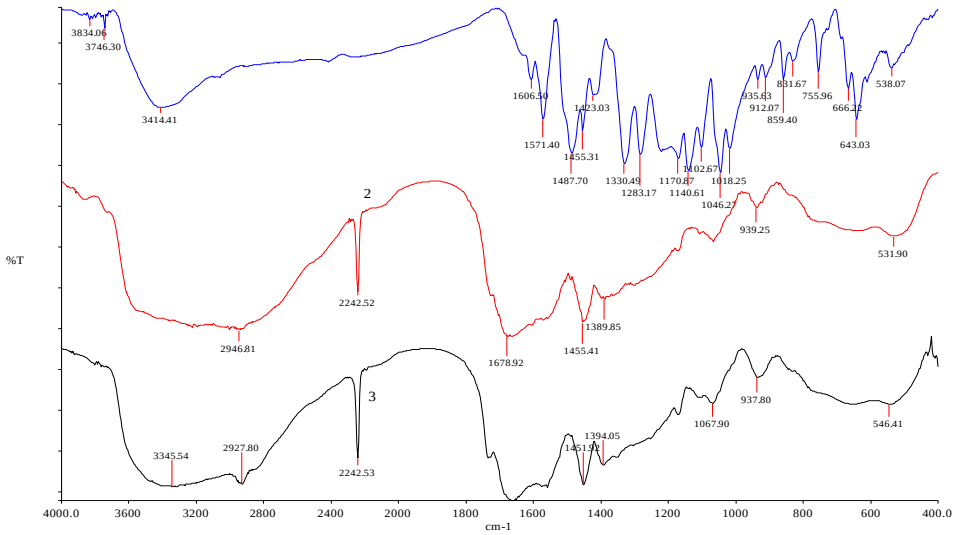

Figure 6. IR spectra of Amido black 10B (1), reagent immobilized on fiber (2), synthetic fiber (3).

The IR spectrum of the complex formed by the lead (II) ion with the organic reagent AB immobilized on the PPD fiber shows a broadening of the 3471 cm^{-1} area and a change in the absorption area of the -N=N- group at 1487 cm^{-1} due to the -OH group of the organic reagent and -N=N- indicates that the lead (II) ion forms a complex with groups. -O-Pb metal oxygen bond was observed in the absorption region of 415 cm^{-1} (Figure 6) [20].

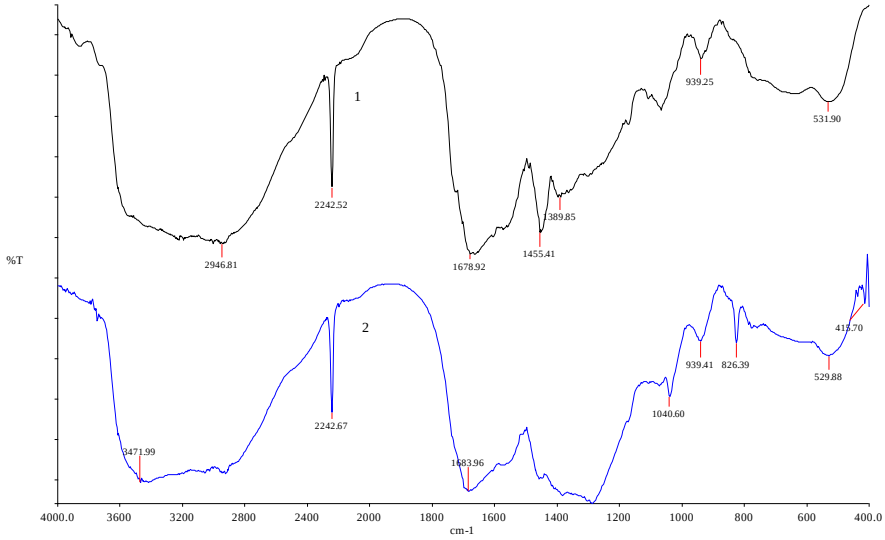

Figure 7. Reagent immobilized on fiber (1) and its complex with lead (2), IR spectra.

The difference between the color intensity of the immobilized reagent and the complex was higher at 600-830 nm, increasing the stability and saturation through complexation. Based on these analyses, the method of sorption-spectroscopic determination of lead (II) ion in artificial mixtures using the amido black reagent immobilized on synthetic fiber was tested (Table 2).

Table 2

Results of determination of lead (II) ion in artificial mixtures using IMAB organic reagent

[λ=490 nm, pH=4-6, P=0,95; n=5]

Composition of the analyzed mixture, μg	Found Pb^{2+}, mkg $\overline{X} \pm \Delta\overline{X}$	S	S_r
Pb(10)+Cd(2,0)	9,95 ± 0,18	0,160	0,016
Pb(20)+Co(5,0)+Ni(5,0)	19,89 ± 0,22	0,188	0,009
Pb(20)+Fe(10,0)+Ni(10,0)	19,87 ± 0,23	0,199	0,010
Pb(20)+Cd(20,0)+Mn(5,0)+Cu(10,0)	19,82 ± 0,36	0,316	0,016
Pb(25)+Cu(20,0)+Mn(10,0)+Fe(15,0)	24,91 ± 0,25	0,217	0,009
Pb(40)+Cr(50,0)+Hg(1,0)+Cd(30,0)	39,83 ± 0,24	0,205	0,005
Pb(50)+Ni(30,0)+Cu(1,5)+Zn(10,0)+Cd(5,0)	49,84 ± 0,19	0,163	0,003

As can be seen from Table 2, the developed sorption-spectroscopic detection method was used to detect lead (II) ion in binary, ternary and complex model mixtures, the relative standard deviation (Sr) does not exceed 0.016, which indicates the accuracy and reproducibility of the developed method.

Conclusion. The Pb (II) ion, which is considered one of the heavy metals, was used for sorption-spectroscopic detection using the amido black 10B organic reagent immobilized on the fiber. The structure of the metal complex was determined by the following physicochemical methods: FT / IR, UV-Vis spectroscopy. UV-Vis spectra of the ligand and the complex confirmed the formation of a 1:1 complex with Pb (II), which has high nitrogen stability. The sorption-spectroscopic method for the determination of lead (II) ion in primary, secondary and complex mixtures of artificial

mixtures was tested. The relative standard deviation (Sr) does not exceed 0.016, which proves the accuracy and reproducibility of the developed method.

References:

[1]. Zollinger, H., Color Chemistry: Synthesis, Properties and Application of Organic Dyes and Pigments, Wiley-VCH, Weinheim, 2003, p.161.
[2]. Maynard, C.W., Riegel's Handbook of Industrial Chemistry, Van Nostard Reinhold, New York, 1983, p. 145.
[3]. Venkataraman, K.,The Analytical Chemistry of Synthetic Dyes, Wiley Interscience, New York, 1977, p. 403.
[4]. Hassan, M.M., Bhagvandas, M., Journal of Cleaner Production, 152, 2017, p. 464. DOI.ORG/10.1016/J.JCLEPRO.2017.03.139.
[5]. Grad, M.E., Simu, G.M., Muntean, S.G., Ilia, G, Jornal of Iranian Chemical Society, 10, no.4, 2013, p. 807. doi.org/10.1007/s13738-012-0216-y.
[6]. Motiei, H., Jafari, A., Naderali, r., Optic& Laser Technology, 88, 2017, p. 68. doi.org/10.1016/j.optlastec.2016.09.011.
[7]. Yamjala, K., Nainar, M.S., Ramisetti, N.R., Food Chemistry, 192, 2016, p. 813. doi.org 10.1016/j.foodchem.2015.07.085.
[8]. Harisha, S., Keshavayya, J., Kumara Swamy, B.E., Viswanath, C.C., Dyes and pigments, 136, 2017, p. 742. doi.org/10.1016/j.dyepig.2016.09.004.
[9]. Zolotov Y.A. Sorption preconcentration of microcomponents from solutions: application in inorganic analysis // M.: Nauka, 2007. 320 p.
[10]. Savvin S.B., Dedkova V.P., Shvoeva O.P. Sorption-spectroscopic and test methods for the determination of metal ions on the solid phase of ion-exchange materials. Achievements of chemistry. 2000. V. 69, No. 3. pp. 203-217.
[11]. Ivanov V.M., Kuznetsova O.V. Chemical colorimetry: the possibilities of the method, areas of application and prospects // Achievements of chemistry. 2001. V. 70, No. 5. pp. 411-427.
[12]. Rustamov, M.K., Gafurova, D.A., Karimov, M.M., Bekchonov, D.Z., Mukhamediev, M.G. Application of ion-exchange materials with high specific surface area for solving environmental problems //Russian Journal of General Chemistry, 2014, 84(13), pp. 2545–2551.
[13]. Smanova Z.A., Gafurova D.A., Savchkov A.V. Disodium 1-(2-Pyridylazo)-2-oxynaphthalene-3,6-disulfonate: An Immobilized Reagent for Iron (III) Determination // Russian Journal of General chemistry. 2011.- Vol.81. - №4. -P.739-742.
[14]. P. P. Korostelev Preparation of solutions for chemical analytical work. // M., Science - 1964. - 269 p.
[15]. Lurie Y.Y. Analytical Chemistry Handbook. // M., Chemistry 1989 p. 267-275.
[16]. Ashirov M.A, Smanova Z. A, Shakhidova D.N. Sorption-photometric determination of lead (II) ions by immobilized sodium 4-amino-5-hydroxy-3 - ((e) -(4-nitrophenyl) diazenyl) - 6 - ((e) -phenyldiazenyl) naphthalene-2,7-disulfonate. // Electronic journal. Actual problems of modern science, education and training (УрДУ электрон журнали), - 2021.- vol XI. -p. 97-102. http://khorezmscience.uz.
[17] Ashirov M.A., Khalilova L.M., Smanova Z.A. Immobilized amidoblack reagent for the determination of lead ions. // Uzbek chemical journal. -2021. Number 3. - pp.

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PROMISING COTTON VARIETY “KHURMA”

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Annotasiya. Ushbu maqolada Xorazm viloyati tuproq-iqlim sharoitiga moslashgan IV va V turdagi tolali, yangi, ertapishar, serhosil, turli kasallik va zararkunandalarga chidamli, istiqbolli “Xurma” paxta navining qimmatli iqtisodiy xususiyati haqida ma’lumotlar berilgan.

Kalit so‘zlar: g‘o‘zaning istiqbolli navlari, Xorazm viloyatining tuproq-iqlim sharoiti, tola sifatining texnologik ko‘rsatkichlari, mikroneyr, tola bir xillik ko‘rsatkichi.

Аннотация. В статье приведены сведения о ценных хозяйственных качествах нового, скороспелого, высокоурожайного, устойчивого к различным болезням и вредителям, перспективного сорта хлопчатника «Хурма» с типом волокна IV и V, адаптированного к почвенно-климатическим условиям Хорезмской области.

Ключевые слова: перспективные сорта хлопчатника, почвенно-климатические условия Хорезмской области, технологические показатели качества волокна, микроне, индекс однородности волокна.

Abstract. This article provides information about the valuable economic character of the new, early ripening, high yielding, resistant to various diseases and pests, promising variety of cotton "Khurma” with fiber type IV and V, which is adapted to the soil and climatic conditions of Khorezm region.

Keywords: promising varieties of cotton, soil and climatic conditions of Khorezm region, technological indicators of fiber quality, micronaire, fiber uniformity index

Introduction. The most valuable of technical crops is cotton. It is grown mainly for fiber. Cotton fiber is the most widely used fiber in the textile industry, accounting for about half of the world’s fiber. Cotton is considered as the source of income for about 1 billion people and more than 250 million of them are directly engaged in cotton growing, as well as more than 100 million farms are specialized in cotton growing. Mainly two types of cotton, *Gossypium hirsutum* and *Gossypium Barbadense* are grown worldwide, accounting for more than 95% of total cotton production.

China and India are the leaders in the production of raw cotton (about 23% of world production). They are followed by the United States (about 16.5%) and Brazil (about 8%). Uzbekistan produces about 3% of the world's cotton.

Cotton production is declining around the world due to unfavorable weather conditions, water shortages and pest problems. This, in turn, is having an impact on the cotton sector, which, along with cotton growing, has also seen a decline in demand for cotton fiber. This situation is likely to continue until 2025. In this situation, the selection and creation of new varieties resistant to soil salinity, water scarcity, various pests and diseases, as well as to various adverse weather conditions will remain one of the main tasks for breeders around the world.

Breeding is a continuous process, and with the development of agriculture and the requirements of the textile industry, responsibility of breeders increase for regular improvement of cotton varieties and control of the quality of the varieties. One of the main issues in the selection of cotton is the creation and implementation into manufacture of varieties that are early ripening, high yielding, high fiber yield and quality, resistant to various adverse environmental conditions, as well as diseases and pests.

With the purpose of fundamental modernization of agricultural seed production, expansion of production of high-quality and competitive seed products, formation of surplus value chains in seed production, digitalization of the industry, integration and development of cooperation of science, education and manufacture resolution of the President of the Republic of Uzbekistan No. PK-106 dated 28.01.2022 was adopted.

Additional measures on further development of agricultural seed production are provided in the resolution, and tasks are assigned to develop measures on increasing the yield of cotton to 50 centners per hectare by expanding the area of new varieties in the country in 2022-2025.

It is known, that the area under cotton in our country is shrinking from year to year. In 2016-2017 93.5 thousand, in 2018 134.5 thousand, in 2019 37.5 thousand and in 2020 33 thousand hectares were reduced, and the last years the reduction of cotton growing areas exceeded more than 300 thousand hectares. According to the Ministry of Economy, at the end of 2017, the average income from 1 hectare of cotton grown on low-yielding lands was only 0.9 million sums. The reduction of the allocated areas for cotton growing must not lead to the reduction in annual cotton production. In the resolution No. PK-106, dated 28.01.2022, the tasks to develop measures to increase cotton yield to 50 centners in 2022-2025 by expanding the area of new varieties were provided.

Specialists of the field in collaboration with breeders are required to create early ripening, high yielding cotton varieties with high fiber output and quality and resistant to various adverse conditions, diseases and pests, as well as to develop agrotechnical measurements particular for each region.

New varieties of cotton, which are being created in the country in recent years, with early maturation, cotton color, fiber length, maturity and micronaire indicators meet the international standards. These are the main characteristics that determine the purchase of fiber in the global market. At present, it is important to pay attention to the creation of new varieties of cotton, which are highly profitable, competitive and meet the requirements of the world cotton market on fiber quality. A number of scientific researches, based on modern methods and technologies, are being carried out in the country to increase productivity without expanding the area under cotton. Due to

increase of soil salinity, water scarcity, environmental problems, global warming and other causes, creation of new cotton varieties, which are resistant to various adverse conditions of environment, diseases and pests, became one of the main tasks in present days.

Recently, a lot of work has been done in the field of cotton growing in our country, a number of scientific developments have been created and implemented by breeders. In recent years, scientists of the Khorezm Mamun academy have created a number of new varieties of cotton that are highly profitable, competitive and meet the requirements of the world cotton market in terms of fiber quality. Among them, “Khurma” and “Niyat” varieties have their own characteristics and are adapted to the extreme conditions of Khorezm region (saline soils, mineralized groundwater, water scarcity and very high temperatures), with fiber type IV, and meet the requirements of the standards of textile industry.

Systematic measures are being taken to select high yielding cotton varieties that are resistant to adverse conditions, show valuable economic characteristics, with high technological quality indicators of fiber, as well as to implement optimal agrotechnical methods of breeding. As a result of selection of the new cotton varieties with the high potential properties for every region, and the improvement of the cultivation agrotechnology, it became possible to grow a high quality and high yield cotton crop in our republic in the last year.

Accelerated development of agricultural production is directly related to the indicators of seed quality. Therefore, high quality seed cultivation is essential for cotton crop capacity and high fiber quality. Preliminary study of the seed quality of cotton varieties created by selectionists, searching and implementation of methods to increase it became one of the important and reliable factors. At present, the amount of fulfilled work on the development and implementation of various methods to increase the quality and efficiency of seed is not sufficient. Consequently, global climate change, the emergence of new strains of the causative agents of the diseases, and pests show the importance of creation of new cotton varieties resistant to stress factors.

Since the last century, there has been an abrupt development in cotton production. The development of various agrotechnology and agricultural machinery in the cultivation of cotton has led to the rise of this industry to a higher level. The research work on cotton selection and seed production is also important. Previously, fiber quality indicators did not play an important role in cotton selection. Due to the development in the field of gathering in the harvest, separating fiber from seeds and fiber processing, as well as to the increase of requirements on fiber quality in textile industry, there appeared a particular approach on fiber quality, and main attention is paid to cotton varieties with high fiber quality in selection.

Nowadays, it is important to take into account not only the quality of the fiber, but also environmental factors when creating new varieties of cotton. Creation of early ripening, high yielding, qualitative varieties, suitable to the climatic conditions of the region and resistant to various diseases and pests became an important task before breeders. Scientists from around the world have done a lot of research in this area, improved traditional methods of selection, and created new methods and technologies, such as markers assisted selection.

According to the researches carried out on increasing crop yield and fiber quality in the field of cotton cultivation in global scale the following results were achieved:

- Influences of mineral fertilizers and irrigation norms on crop capacity and indicators of micronaire (mic) of cotton varieties with medium and thin fiber cotton were determined (United States Department of Agriculture (USDA) , Texas A&M University);
- Number of recommendations were developed on irrigation norms and water consume of cotton varieties in the regions with various depth of ground water level (Institute of Cotton Research (ICR, CAAS), Chinese Academy of Agricultural Sciences);
- Influences of sowing dates and depth on timely germination of seeds and cotton growth and development were determined (Indian Central Institute for Cotton Research, Indian Agricultural Research Institute);
- Influence of plant density on opening of cotton bolls, technological indicators of fiber and branching of plants were studied (Australian Cotton Research Institute, Cotton Research Institute in Multan and Islamabad, Central Cotton Research Institute).

Scientists in the world in the field of cotton selection have conducted great number of researches in order to study the effectiveness of different methods of crossing. In particular, as a result of application of various methods of crossing in selection by Harlan H.V., Martini M.L., Briggs F.N., Johnson G., Dudley I., Allard R.W., Griffing, B.J. Hayman B.J., Kadapa S.N., Mac Key, Boroevich S. and others new enriched forms and varieties of cotton were created. Varieties with 10% or higher crop capacity were created (S.N.Kadapa, India). Based on completed crossbreeding on 16 varieties by U.S. scientists (H.V. Harlan and M.L. Martini), F_1 hybrids with eight parental genes were created. In the result of scientific researches of Uzbek breeders (Sh. Namazov, P. Ibragimov, G. Kholmurodova, B. Urozov and others), selection materials and varieties with rich genotypes have been created through complex crossing methods.

Newly created varieties are objectively evaluated after studies in the system of state seed-trial grounds, and the varieties, which showed relatively higher results than the control variety, are implemented into the production. At present, interspecific hybrids, obtained using wild and half-wild forms with different genotypes, are considered as an important initial raw material in practical selection in the creation of new varieties of cotton. Therefore, well-known scientists as Kammacher P., Polsson C.; Wendel, J.F., R.C. Cronn; Endriziy I.E. and others studied the creation of new genotypes of cotton, based on the existing wild and half-wild forms and introduction of species into interspecific hybridization. And Uzbek scientists as Artuyunova L.G., Muratov A., Sodiqov H.R., Namozov Sh.E., Boboyev S.G. and others carried out fundamental and practical researches in this sphere as well. Despite the fact that great achievements have been made in this regard, they are rarely used in practical selection. This is due to the fact, that wild and half-wild forms of cotton are difficult to intersect with cultural variety, and often appearance of afetal progeny in the F_1.

Among the Uzbek scientists Maksudov Z.Y., Mirakhmedov S.M., Avtonomov V.A., Kahkhorov I.T. achieved important data based on long-term researches on the

development of the crossing methods of geographically far forms in creating new varieties.

By studying the composition of medium fiber cotton varieties and using the methods of crossing and selection of varieties and forms, Mirakhmedov S.M. created early ripening variety “Tashkent”, Jalilov O.J. – “Yulduz”, “Mehnat”, Avtanomov A. – “C-6524”, “Namangan-77”, Batalov A. – “Bukhoro-6”, Sodiqov S. – “AN-Boyovut-2”, Namazov Sh. – “Sulton”.

Sodikov S. (1972), Senoedov V.P. (1972), Ibragimov Sh.I. (1986), Jalilov O.J. (1993, 1997), Egamberdiev A. (1993, 1994), Avtonomov V.A. (2010, 2012), Namozov Sh. (2014, 2017), Kahkhorov I.T. (1990, 1996, 2000, 20015, 2018) and others widely used the methods of interspecific hybridization in analyzing theoretical and practical aspects of cotton genetics and selection. As a result, they determined the potentials of genetics and selection of cotton varieties. Based on the conducted researches, donor characteristics of many initial forms, genotypic composition of cotton and signs of adaptability were revealed.

The process of formation, stability and preservation of the indicators of morphological economic characters in progenies of “L-15” line were studied. The line was created by targeted reselection, conducted on the extracted populations with the method of double crossing of intraspecific forms of *G.hirsutum L.* The adaptability of the new, perspective cotton variety “Khurma” was studied on the extreme soil-climatic conditions of Khorezm region, high-quality seed materials were produced and economic efficiency has been achieved by realizing the variety into production.

Based on the studies, assessment and selection of the indicators of morphological economic characters of intraspecific forms of *G.hirsutum L.* selection materials with high fiber output and quality were created.

By hybridization of intraspecific forms of *G.hirsutum L.*, a promising new cotton variety “Khurma” with high indicators of valuable economic characters was created. When the newly created cotton variety “Khurma” was grown in the extreme soil and climatic conditions of Khorezm region, higher indicators of crop yield were achieved comparing the standard varieties.

Created variety “Khurma” in the Khorezm Mamun academy, by using the method of targeted reselecting of L-15 line for many years, selected from the hybrid populations of regionalized varieties “An-510” and “Qirgiz-3” belonging to the *G.hirsutum L.* type of cotton, was included into the list of the Decree of the President of the Republic of Uzbekistan PQ-3855 “On additional measures to increase commercial efficiency of the results of scientific and scientific-technical activities” dated December 14, 2018 and the Order of the Ministry of Agriculture December №125 dated 29, 2018, and recognized as perspective variety in Khorezm region and the Republic of Qaraqalpakstan.

Brief description of cotton variety “Khurma”: Plant height 115-120 cm, green stem, medium hairy. Monopodial branches 0-1 ha. Sympodial branches belong to the 1.0-1.5 type, and the first branches are located in joints 4-5. The stem is thick and does not lie down. The leaves are of medium size, less hairy, green. The flowers and pollen are white-yellow, the weight bolls is 6.0-6.5 grams, medium oval shaped, pointless,

green, with 4-5 boll segments, opens freely when ripe, the seeds are medium-sized, ovoid, medium-haired, gray; cotton does not spill.

The fiber is white, fiber output 38-42%, fiber length 35.2-35.6 mm, fiber strength 4.4 g.s., fiber fineness 6100-6400 mn, breaking length of fiber 33.6 g.s./tex, micronaire 4.6 mic, the average inch length of fiber is 1.22. The seeds are of medium size, oval in shape, weight of 1000 seeds is 120-126 grams.

The superiority and economical effectiveness of the variety "Khurma". The variety adapted to the extreme soil-climatic conditions of the Khorezm region (saline soils, mineralized groundwater, water scarcity, high temperatures). This variety belongs to fiber type IV and meets the requirements of world standards due to its industrial value.

The average crop yield was 39-40 centners per hectare, 3-4 centners more than the standard variation, and the economic efficiency made up an additional 2-2.5 million sums.

Prospective variety "Khurma" has a higher yield (38.2-40.0 ts / ha) than the standard varieties, longer staple length of fiber (34.5-35.0 mm), softness of micronaire (4.3-4.5), higher fiber output (38-40%) compared to the standard and other varieties, as well as the fiber belongs to type IV.

According to the results of the study, cotton has high valuable economic characters and indicators, ripens 2-3 days earlier than the standard variety "Khorezm-127", high crop productivity, with fiber quality of type IV, high fiber output3 (38-40%). It has been determined, that the variety "Khurma" yielded 38.7-40.0 centners per hectare. Nowadays the variety "Khurma" is cultivated in the irrigated fields of diversified agricultural farms in Khonqa, Urgench and Khiva districts of Khorezm region. Introduction of the variety "Khurma" is of great importance in solutions of problems connected with production of high quality seed materials, preserving morphological and valuable economic characters, as well as, with creation and implementation of medium staple cotton varieties, with fiber quality of type IV, more than 40% of fiber output, which is peculiar to new cotton varieties.

Average indicators of valuable economic characters of the new, promising variety "Khurma" cultivated in the experimental base of Khorezm Mamun academy, 2019 - 2021

Table 1

№	Years	Economic characters								
		Weight of cotton in one boll, gr			Fiber output %			Fiber length, mm		
		X ± m	**σ**	**v**	**X ± m**	**σ**	**v**	**X ± m**	**σ**	**V**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
2	2018	6,1±0,10	0.81	13.44	39.1±0.41	2.64	7.08	35,29±0.24	1,91	2,91
3	2019	6,3±0,13	0.7	11.21	40.0±0.67	3.82	11.85	35,5±0,31	1,82	3,24
4	2020	6,1±0,09	0.63	12.05	39.0±0.62	2.97	8.01	34,41±0,22	1,25	2,52
5	Average	6,33±0,11	0.73	12.62	39.3±0.56	3.33	8.28	34,66±0,14	0,92	2,67

According to the data in Table 1, the weight of cotton in a boll of the variety "Khurma" is 6.0 g in 2018, 6.3 g in 2019 and 6.1 g in 2020. As it is revealed, that in 2020, compared to 2018, the average indicator of this sign fluctuated around 0.3 g.

Three-year data on fiber output showed average 39.1%. Over the research years, the indicators of this sign fluctuated between 40.0 and 39.0%. Hence, this indicator mean the preservation of stability in the genotypes of the variety.

The fluctuation of the indicator of fiber length between 35.1 and 35.5 mm. This means, that abrupt changes weren't observed and stability was achieved on this indicator.

The stem of the variety "Khurma" has a compact form and have been practically identified to be effective when planted in double furrow in different soil-climatic conditions of Khorezm region.

It has been proved, that the "Khurma" variety of cotton can be used as a initial material in future in scientific researches on creation of new cotton lines and varieties suitable for soil and climatic conditions of Khorezm region and suitable for double furrow planting.

References:

[1]. Fashion United. World statistics of the fashion industry. https://fashionunited.com/global-fashion-industrystatistics/, 2019
[2]. https://review.uz/post/xlopkovaya-konyunktura
[3]. Vura V., Larrea K., Bermudez S. World Market Report: Cotton. Series of platforms for sustainable goods, 2019
[4]. https://xs.uz/uzkr/post/pakhta-majdonlari-215-ming-gektar-qisqartirildi-nega
[5]. Linghe Z. et al. History and current research on the USDA-ARS cotton breeding program in Stoneville, Massachusetts. Breeding and genetics. Cotton Science Journal. 2018. S. 24-35.
[6]. Kammacher P., Polsson C. Surla chromosome conjugation guea'un Gossypium tetraploide synthetigue // C. R. Asad. So. Paris, 1966. -V. 262, -№ 16. - S. 1718-1720
[7]. Wendel J.F. and R.K. Kron. Polyploidy and the evolutionary history of cotton. Add. Agron. 78. 2003. -p.139-186.
[8]. Endriziy I.E., Turkotte E.L., Kokhel R.I. Genetics, Cytology and Evolution of Gossipium // Advances in Genetics, 1985.-V.23.- P.271-365.
[9]. Arutyunova L.G. Interspecific hybridization in the genus Gossypium L. Issues of genetics, selection and seed production of cotton. - Tashkent, 1960. -67-70 p.; Arutyunova L.G. Pulatov M. Interspecific hybridization is a source of creating initial material for selection and replenishment of the cotton gene pool // Genetics, breeding and seed production of cotton and alfalfa. Tashkent, 1989. -S. 43-50. (Russian)
[10]. Muratov A., Sodikov H.R. Correlation of changes of number of chromosomes and crossing ability interspecific hybrids of cotton // Journal of cotton and grain growing. Tashkent, 1999. - No. 4. - B. 26-27. (Uzbek)
[11]. Namozov Sh.E., Babaev S.G. The effectiveness of intensive interspecific hybridization in cotton breeding. - Tashkent: "Nison-Noshir", 2014.- 56-179 p. 7. (Russian).

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CHOOSING OF WIRELESS TECHNOLOGY AMONG THE INTERNET OF THINGS TO IMPROVE THE ORGANIZATION OF THE TRANSPORTATION PROCESS IN RAILWAY TRANSPORT

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Annotatsiya: Ushbu maqolada narsalar interneti (IoT) texnologiyasi asosida, tashishlarni operativ boshqarish samaradorligini oshirish maqsadida, harakat tarkibi dislokatsiyasi texnologiyasi va holatini monitoringi imkoniyatlari tahlil qilindi. Narsalar internetining olti turdagi simsiz tarmog'ining imkoniyatlari tahlil qilingan. Ularning har birining asosiy xususiyatlari va turli yo'nalishlarda qo'llash imkoniyatlari tavsiflangan.

Kalit so'zlar : tashishlarni tashkil etish , lokomotiv , vagon , narsalar Interneti , LoRaWAN , SigFOX , NB-IOT, Zigbee, Uyali aloqa , WiFi , RFID.

Аннотация: В этой статье проанализированы возможности совершенствования технологии дислокации и контроля состояния подвижных составов, с целью улучшить эффективность оперативного управления перевозками на основе технологии интернета вещей (IoT). Сделан анализ возможностей шести видов беспроводной сети интернета вещей. Описаны ключевые возможностей каждого из них и возможности применения в разных направлениях.

Ключевые слова: организация перевозок, локомотив, вагон, Интернет вещей, LoRaWAN, SigFOX, NB-IOT, Zigbee, Сотовая связь, WiFi, RFID.

Abstract: This article analyzes the possibilities of improving the technology of deployment and monitoring the condition of rolling stock in order to improve the efficiency of operational management of transportation based on the technology of the Internet of things (IoT). An analysis of the capabilities of six types of wireless network

of the Internet of things is made. The key features of each of them and the possibilities of application in different directions are described.

Key words: organization of transportation, locomotive, wagon, Internet of things, LoRaWAN , SigFOX , NB-IOT, Zigbee, Cellular communication, WiFi , RFID.

Introduction. The possibilities of advanced technologies depending on certain factors (innovation, lower prices for spare parts and chips) increase over time. Trends change and at the right time you should be aware of new technologies in order to use the advantages to your favor.

Railway transport by its specifics is a transport mainly for the transportation of mass cargo. The planning of cargo transportation for the year is based precisely on these mass cargoes, which will be formed on the basis of requests from shippers. In addition to planning for the annual period, there are monthly plans and additional plans. Consignors, in accordance with the Rule of Railway Transport, can apply for transportation of the appropriate type.

The provision of conditions for transportation specified in long-term, monthly and additional applications is carried out by dispatching personnel for the operational management of transportation. Operational management is based on information about the location and condition of cargo, rolling stock and the train as a whole. Currently in "Uzbekistan temir yullari" JSC, these information are provided through the Automated System for Operational Transportation Management (ASOTM). The work of ASOTM is a human-machine system, where all primary information about the rolling stock is collected manually. The scale of this system is great, as it operates in almost all CIS countries.

In this work, the author will analyze the possibilities of improving the technology of deployment and the state of rolling stock in order to improve the efficiency of operational management of transportation. To solve the problems of identifying the state of the rolling stock, the best option is the technology of the Internet of Things (Internet of Thinngs , IoT).

Internet of things (Internet of Things , IoT) is a network of physical objects equipped with technologies for interacting with each other and the external environment. There are many definitions for this term. The above definition is one of the shortest and most capacious. The keywords in it are network, technology, interaction, and the key point is that the presence of a person in this interaction is generally not necessary.[1]

Most likely the term Internet of Things was first used by Kevin Ashton (Kevin Ashton) in 1999. Kevin Ashton was an Assistant Brand Manager at Procter & Gamble in 1997 when he became interested in using RFID (Radio Frequency) technology. identification - radio frequency identification) for supply chain management. The IoT term was reborn at the suggestion of Cisco analysts, who considered that in the period from 2008 to 2009 the number of devices connected to the global network exceeded the population of the Earth, thus the "Internet of People" became the "Internet of Things". In the summer of 2013, Cisco launched the Connections Counter , a counter of devices connected to the Internet, on which you could see the number of connected devices in real time[2].

The Internet of Things includes technologies that have been created to solve certain problems or improve existing ones, which distinguishes them from others by their feature. One of the main objectives of this work is to select the most suitable IoT technology for improving the management of railway transport.

Literature review. The choice of IoT technology and applications in the transport industry were considered in their works by Rakhmangulov A.N. [3] and Kupriyanovskaya Yu.V. [4]. In the work of Rakhmangulov A.N. comparisons were made between different types of rolling stock identification technology in the conditions of metallurgical enterprises, and as a result, radio frequency identification (RFID) turned out to be the most acceptable type. Kupryanovskaya Yu.V. in her work, the features of the use of IoT technologies for a smart container.

In works [5-8], the problems of using the Internet of things in the field of logistics were considered. Taking into account the specifics of the transportation of goods, depending on the type of transport, solutions are proposed to reduce the delivery time of goods. Articles [9-11] provide technical characteristics of the types of the Internet of things for comparison. The issues of using one or another wireless network are discussed based on the results of the comparison.

Research methodology. In this article, the object of study is the main railway of the Republic of Uzbekistan. It should be noted that at present, GPS trackers and fuel sensors are being actively installed on locomotives based on the cellular technologies of the Internet of things to control the management of the locomotive fleet. But the wagons are controlled based on the information sent by the operators, receiving agents or commodity cashiers. The reason for this is the power supply. The locomotives have their own power sources to charge the sensors, unfortunately, the wagons are not equipped with autonomous power supply.

This reason is not a big problem, since other suitable IoT technologies can be used to remotely monitor the positions and states of the wagons.

The main and popular IoT technologies are:

1. Low Power Wide Area Networks (LPWAN).
2. Cellular communication (2G, 3G, 4G, 5G).
3. Zigbee .
4. Bluetooth and BLE.
5. Wi Fi _
6. RFID.

Key features of the systems

1. Low Power Wide Area Networks (LPWAN) .

This technology provides long-distance communication (up to 15 km) and low power consumption for sent and incoming information. This technology is quite new, but is already being used worldwide for asset tracking, environmental monitoring, facility management, presence detection, consumables monitoring.

LPWAN is suitable for use cases that do not require high bandwidth and to some extent do not take into account instantaneous alerts.

2. Cellular (3G/4G/5G)

Mobile communication has been used by society for a long time, having proven itself to be a reliable type of communication. The main advantages are the range and

the amount of transmitted information. Since the range of action and the amount of transmitted information is greater compared to other technologies, there are correspondingly more operating costs and energy costs.

Cellular communications in most cases are not suitable for systems where self-powered sensors are required. They are well suited for monitoring cars and other self-propelled rolling stock.

3. Zigbee and other network protocols

Zigbee is a type of medium range wireless communication (<100m). It is currently being used effectively for home automation, smart lighting, energy management and home sensors.

4.Bluetooth and BLE

BLE is a well-known type of wireless network that operates over short distances. It is a Low -Energy communication type designed for small consumer IoT applications. The BLE network is mainly used in combination with electronic means as an additional function of this device.

5. WiFi

Another among the popular wireless technologies with high-speed data transfer. Used to connect gadgets, sensors for smart home and for internet distribution. Differs in big energy consumption and smaller coverage of action.

6. RFID

Radio frequency identification consists of two main elements - a tag and a reader of information from tags. Reading distances up to 10 meters. Aptly attached to the object of identification, thereby the identification of objects by location is carried out. Applications for this technology include smart shelves, supply chain management and smart warehouse.

Analysis and results. Each of the presented types of network is designed to solve a certain type of problem in a certain field of activity. Over time, this area has constantly expanded and IoT technologies have become popular. When choosing a particular technology, you will need to choose priority opportunities. It is possible to combine these features of these networks for the best effect.

Railway transport has its own specifics, since the industry as a system has its own subsystems, and individual requirements are also different. For example, it is convenient to use cellular networks for geolocation of locomotives in the city, but not in distant parts of the country. This is due to the placement of antennas of cellular enterprises.

The wagon, unlike the locomotive, does not have an autonomous power supply and there is also more critical information regarding the wagons. When choosing types of communication, we should include among the priority opportunities: energy efficiency - the ability of sensors to work for a long time; range - for remote control; costs for installation and operation.

LPWAN becomes the best option, which can provide dispatch personnel with information for making decisions on traffic management. The next step in the selection is the selection of a specific type of network related to LPWAN. LPWAN includes wireless networks: LoRaWAN, Sigfox and NB - IoT.

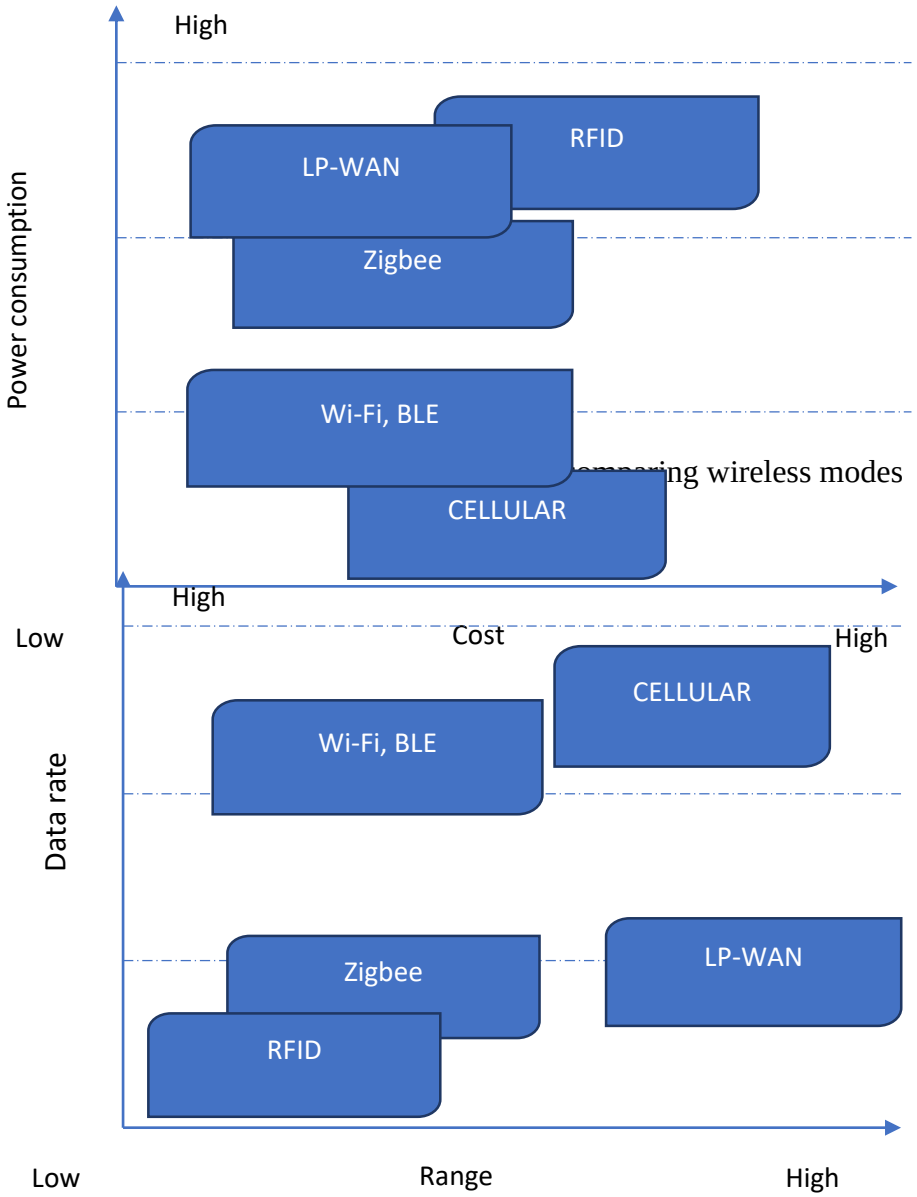

Figure. 2. Diagram comparing wireless types of communication

It should be weighed from the point of view of the specifics of rail transport management. Let 's do a SWOT analysis to better understand the network's strengths and weaknesses.

LoRaWAN or Long Range Wide Area Network was introduced as an energy efficient network technology by IBM Research and Semtech . Technology based on Semtech LoRa (™) PHY chip [2]. In terms of technical capabilities, it can satisfy the requirements for information support in transportation processes. The main advantages include low power consumption, relatively inexpensive deployment cost and availability, autonomous ownership of the entire infrastructure (independent of cellular networks) and a wide range of applications (Fig. 3).

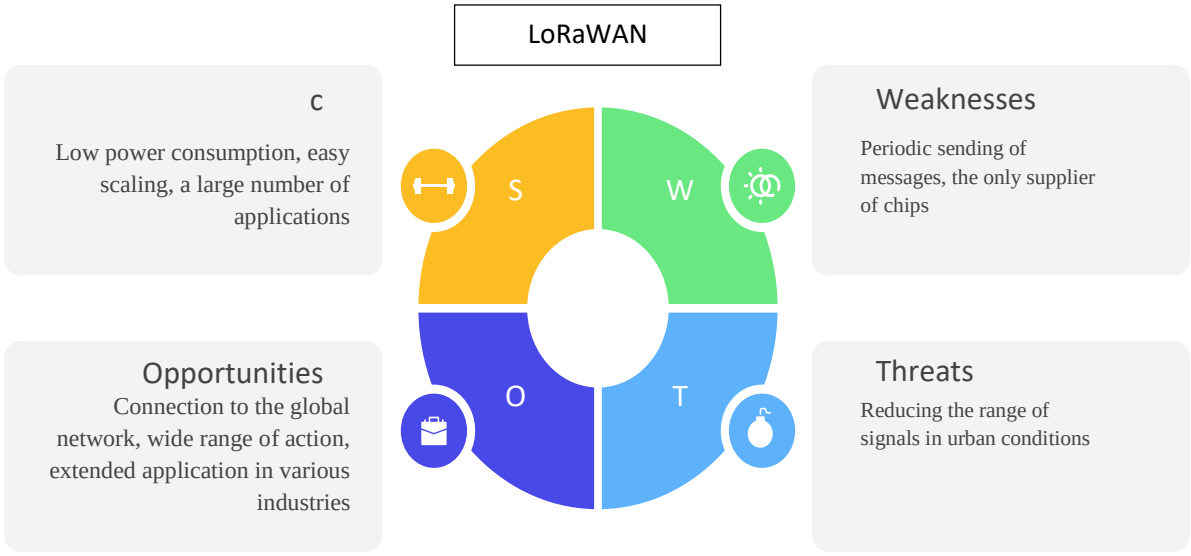

Figure.3 - SWOT analysis of the Lorawan wireless network

SigFox is built by the company of the same name, founded in France in 2009. It uses Ultra Narrow Band (UNB) technology, the same technology used for submarine-to-submarine communications during World War II [2]. This technology was originally designed for communication at low data rates. The main advantages of the system are ultra-low power consumption, low cost. It should be noted that the principle of operation is almost the same as LoRaWAN , but the technical capabilities and the level of global coverage are different (Fig. 4).

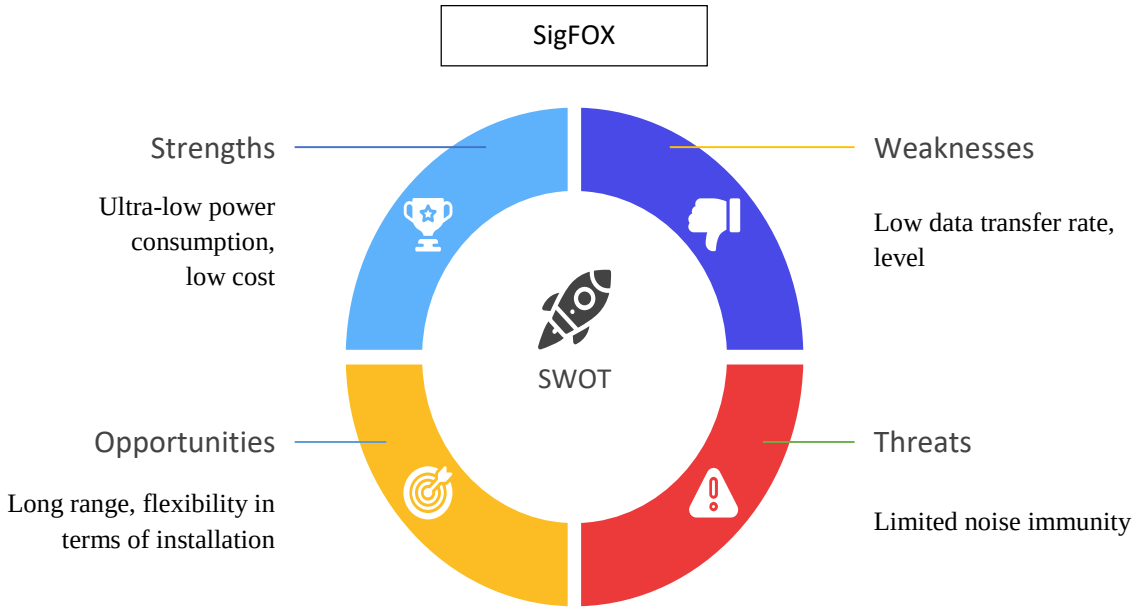

Figure 4 - SWOT analysis of the SIGFOX wireless network

NB - IoT is purpose-built for the IoT, so it takes into account specific needs such as improved sensitivity to signal modulation to connect hundreds of thousands of devices. Also, to work with NB - IoT , you do not need a SIM card and a fairly low power of the transceiver, that is, IoT devices can work for many years from one battery. The strong side is the large bandwidth and data security (Fig. 5).

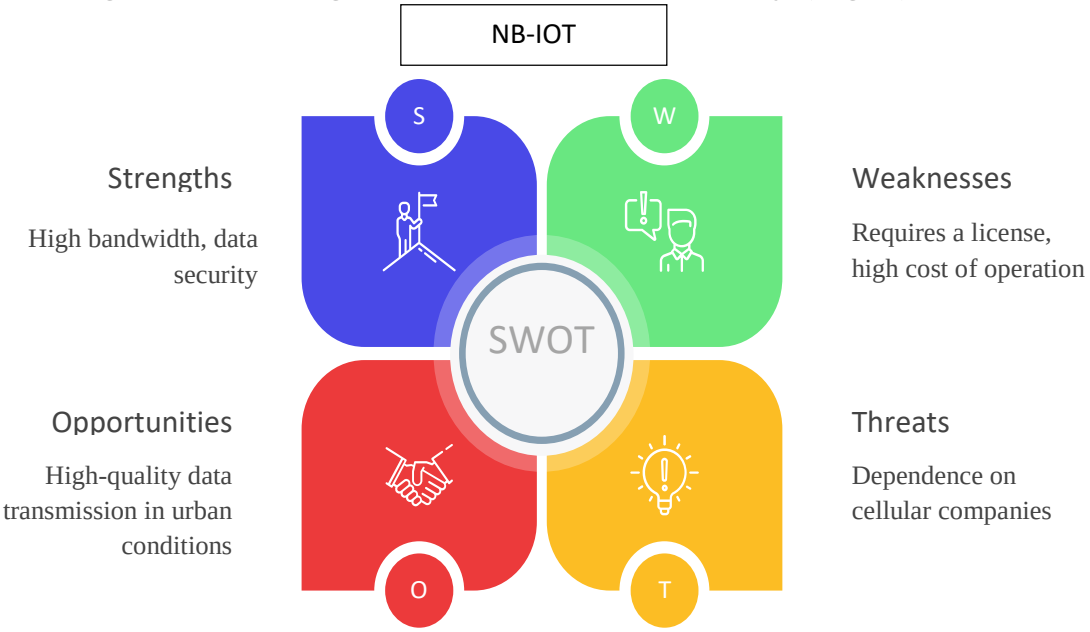

Figure.5 - SWOT analysis of the wireless network NB - IOT

According to specific features, you can choose one or another system. To manage the transportation process on the railway, you should choose the LoRaWAN system. Here are the reasons for this choice:

1. LoRaWAN has no limit on the number of messages sent per day, compared to SigFox which can send 140 messages per day.
2. LoRaWAN has a larger payload size (payload) of 100 bytes compared to SigFox which has only 12 bytes.
3. LoRaWAN has open LoRa Alliance with global public network coverage. Compared to SigFox, a significantly larger coverage area.
4. LoRaWAN has the ability to independently deploy at the expense of a non-licensed frequency. NB - IoT does not have such capabilities, since the frequency that it works requires a license, and the use of ready-made cellular networks makes it dependent on cellular companies and requires additional costs.
5. LoRaWAN has the ability to install equipment in any hard-to-reach regions. Basically, the railway infrastructure is located in the extreme parts of cities and regions in which cellular communications do not work well. The use of NB - IoT with the help of existing cellular companies makes the quality of the transmitted data very low and at present this technology is not supported by cellular companies operating in Uzbekistan.
6. Low prices when deploying LoRaWAN compared to NB- IoT. NB - IoT technology is one of the mos t modern, but the equipment is expensive.

c In this work, technological and technical comparisons between IoT types are made. Once again, it should be noted that the capabilities of the systems cover a

separate area of activity. By their nature, they are irreplaceable. You can, of course, combine and use positive abilities.

With regard to rail transport, a comparison of the three technologies showed the obvious advantage of the LoRaWAN network, which is more suitable for monitoring and controlling rolling stock.

Suggestions based on the results of the study:

1.LoRaWAN should be used to track wagons.

2. In urban areas, cellular technology should be used to track locomotives.

3. It is advisable to use the capabilities of combined systems, including BLE , WiFi and LoRaWAN for larger tasks of monitoring railway assets.

References

[1]. 131 ssilka pro IoT: kak bit' v kurse Interneta veshey https://habr.com/ru/post/388897/ (Date: 02.08.2022).

[2]. Kak vibrat' standart svyazi dlya seti IoT https://habr.com/ru/company/commandspot/blog/390825/(Date: 02.08.2022).

[3]. Raxmangulov A.N. Vibor ustroystv identifikasii i pozisionirovaniya jeleznodorojnogo podvijnogo sostava dlya usloviy metallurgicheskix predpriyatiy / Raxmangulov A.N., Kornilov S.N., Antonov A.N. // Sovremennie problemi transportnogo kompleksa Rossii/ Magnitogorskiy gosudarstvenniy texnicheskiy universitet im. G. I. Nosova – 2014.–Tom4.№1.– S.16-20

[4]. Yu.V. Kupriyanovskaya. Umniy konteyner, umniy port, BIM, Internet Veshey i blokcheyn v sifrovoy sisteme mirovoy torgovli/ Yu.V. Kupriyanovskaya, V.P. Kupriyanovskiy, A.A. Klimov, D.E. Namiot, A.V. Dolbnev, S.A. Sinyagov, Yu.P. Lipunsov, A.G. Arsenyan, S.N. Yevtushenko, O.N. Larin//International Journal of Open Information Technologies ISSN: 2307-8162 vol. 6, no.3, 2018

[5]. Swarali Karmalkar, Himali Patil, Sharmeen Patel , Divya Pund , Bushra Quazi "IoT Based Asset Tracking And Monitoring System", International Journal of NovelResearch and Development (www.ijnrd.org), ISSN:2456-4184, Vol.3, Issue 2, page no.4-7, February-2018

[6]. Yangke Ding, Mingzhou Jin, Sen Li & Dingzhong Feng (2021) Smart logistics based on the internet of things technology: an overview, International Journal of Logistics Research and Applications, 24:4, 323-345, DOI: 10.1080/13675567.2020.1757053

[7]. Xu, W., Rong, M. Research on Optimization of Expressway Logistics Path Based on the Advantages of Multimodal Transport in the Environment of Internet of Things. Wireless Pers Commun (2021). https://doi.org/10.1007/s11277-021-08755-y

[8]. I. F. Priyanta, F. Golatowski, T. Schulz and D. Timmermann, "Evaluation of LoRa Technology for Vehicle and Asset Tracking in Smart Harbors," *IECON 2019 - 45th Annual Conference of the IEEE Industrial Electronics Society*, 2019, pp. 4221-4228, doi: 10.1109/IECON.2019.8927566.

[9]. Kais Mekki, Eddy Bajic, Frederic Chaxel, Fernand Meyer. A comparative study of LPWAN technologies for large-scale IoT deployment. ICT Express, Volume 5, Issue 1, 2019, Pages 1-7, ISSN 2405-9595, https://doi.org/10.1016/j.icte.2017.12.005.

UDC 656.225.073

DEVELOPMENT OF THE INFRASTRUCTURE OF THE LORAWAN NETWORK FOR THE ORGANIZATION OF TRANSPORTATION MANAGEMENT IN RAILWAY TRANSPORT

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Annotatsiya: Ushbu maqolada temir yo'l transportida tashishlarni tashkil etish uchun LoRaWAN tarmog'ining infratuzilmasini yaratish bo'yicha tadqiqotlar natijalari keltirilgan. Tarmoq serverlaridan foydalanishning imkoniyatlri, shlyuzlar va sensorlar turlari o'rganildi. Qiyosiy tahlil o'tkazildi va tadbiq etish uchun tegishli variantlar tanlandi.

Kalit so'zlar: LoRaWAN, tarmoq serveri, shlyuz, sensor, vagon, transportni tashkil qilish, temir yo'l transporti

Аннотация: В этой статье описаны результаты исследований по созданию инфраструктуры сети LoRaWAN, для организации управления перевозками на железнодорожном транспорте. Исследованы возможные варианты использования сетевых серверов, виды шлюзов и датчиков. Сделан сравнительный анализ и выбраны соответствующие варианты для установки.

Ключевые слова: LoRaWAN, сетевой сервер, шлюз, датчик, вагон, организация перевозок, железнодорожный транспорт

Annotation: This article describes the results of research on the creation of the LoRaWAN network infrastructure for the organization of transportation management on rail transport. The possible use cases of network servers, types of gateways and sensors are investigated. A comparative analysis was made and the appropriate options for installation were selected.

Keywords: LoRaWAN, network server, gateway, sensor, wagon, transportation organization, railway transport

Introduction. The operational management of transportation in railway transport is based on primary information, which is generated mainly at railway stations. By means of an automated system for the operational management of

transportation, operations occurring at the stations are recorded by operational workers in a single database. It is proposed to use the Internet of Things (IoT) technology, namely the LoRaWAN wireless type of communication, to improve the reliability and quality of information related to rolling stock. With the help of LoRaWAN technology, it is possible to achieve automatic identification of rolling stock without the participation of personnel and improve the process of operational transportation management.

Lo RaWAN or Long Range Wide Area Network was introduced as an energy efficient network technology by IBM Research and Semtech . Technology based on Semtech LoRa (™) PHY chip. In terms of technical capabilities, it can satisfy the requirements for information support in transportation processes. The main advantages include low power consumption, relatively inexpensive deployment cost and availability, autonomous ownership of the entire infrastructure (independent of cellular networks) and a wide range of applications.

Literature review. In papers [1-4], the problems of using the Internet of Things in smart cities were considered. Opportunities and effective directions of implementation are revealed. Taking into account the specifics of the operation of this network, the consistent introduction into urban infrastructures is described in detail. Articles [5-7] provide the technical characteristics and architecture of building a LoRaWAN network to develop a specific asset monitoring system. The issues of using one or another wireless network are discussed based on the results of the comparison.

Research methodology. Consider the architecture of the LoRaWAN system . The system can be conditionally divided into 4 blocks. The first block contains sensors, the second block contains special antennas (gateway) for sending and receiving signals. The third, perhaps the most basic, is the network server, which receives data and processes it in the right order and transfers it to the appropriate applications.

The fourth block includes ready-made applications where the processed data will be stored and this data will be visually presented. This conditional division can be supplemented by auxiliary elements.

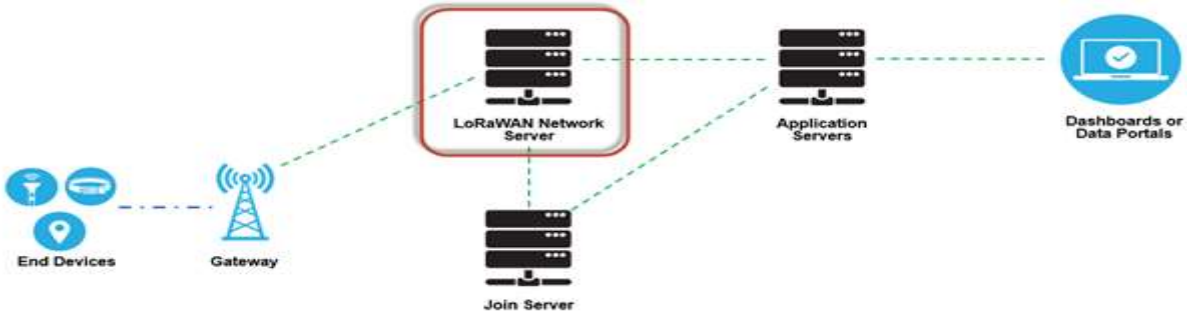

Figure 1. LoRaWAN Network Architecture

Formation of LoRaWAN infrastructure for solving operational transportation management tasks.

Since the network server is the main element of the LoRaWAN architecture , let's start by choosing the most suitable network server for the conditions of Uzbekistan. The use of Lo R a WAN can be done in two ways. The first is connection to a public network, which provides for installed antennas around all perimeters and ready-made network servers. In this case, there will be no capital investments, except

for sensors that will be installed on rolling stock. The second method involves connecting to a network server as a private network. In a private network, the entire infrastructure will be created by the user, while connected to a single network server.

Lo RaWAN network providers have not installed their infrastructures in the Republic of Uzbekistan to date. This indicates that it is not yet possible to connect to the public network. You need to choose the second connection method, namely a private connection.

There are many global companies that provide services for connecting to network servers and supporting their subscribers. Consider several network server companies and compare according to certain criteria. We will use the following criteria for comparing:

1. Price
2. Support for equipments released in the LoRaWAN market
3. Level of coverage
4. Level of service

We will choose from the list of private network servers recommended by Semtech:

1. Actility - offers a network server called ThingPark. This software infrastructure is used by a large number of telecom operators. ThingPark allows you to connect antennas (gateway) from such large manufacturers as Kerlink , Cisco , Browan , Melisight or Multitech . In addition, Actility has its own GPS subsidiary. tracker called Abeeway . _ These trackers are accompanied by the Abeeway App device management , which allows you to manage and control your devices.
2. Everynet is a global LoRaWAN ® network operator and provides carrier class networks in Asia, Europe and America. Everynet 's neutral host network model makes IoT accessible to any industry, enabling enterprise-grade solutions, and is deployed using LoRaWAN® technology, the globally accepted open IoT connectivity standard [8].
3. LORIOT is a global IoT company founded in Switzerland in 2015 with a mission to ensure long-term deployment of IoT solutions in every corner of the globe (and even in space!). The main product is software for scalable, distributed, fault-tolerant operation of LoRaWAN networks and end-to-end applications, which are offered within various business models [9].
4. Orbiwise, founded in 2014 in Geneva, develops advanced technologies for the Internet of Things (IoT) industry. In addition to Sampols , OrbiWise's offering consists of OrbiWAN , a carrier-class LoRaWAN ® network server, and OrbiWAN -Edge, a LoRaWAN network server running on a single server [10].
5. The Things Network - Offers software for managing private LoRaWAN networks. Its global customer base includes over 300 enterprises with 20,000 long-range wide area network (LoRaWAN) gateways and over 700,000 devices, enabling options from industrial IoT to supply chain monitoring and asset tracking. The Things Network is used to manage and monitor large remote devices and gateways using a sophisticated set of tools [11].

Analysis and results. Out of the five candidates Actility and The Thing Network are the leaders in all criteria. It is advisable to compare the servers of these companies(fig.2-3). The author investigated the operation of these two systems-a connected gateway and sensors of different types.

Figure 2. Actility network server console

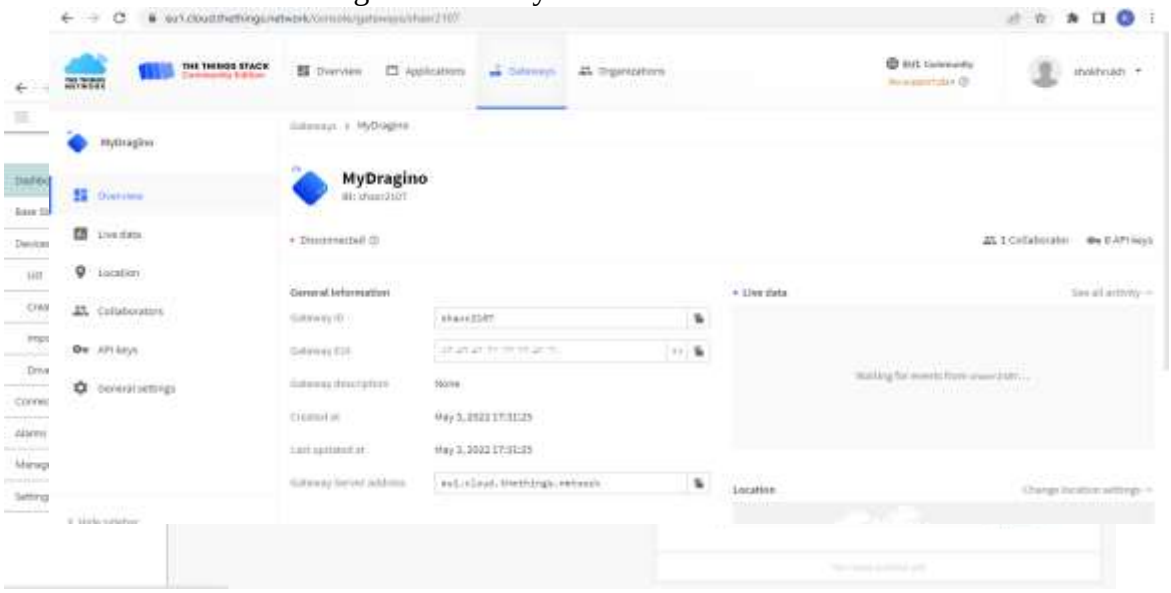

Figure 3. The Things Stack network server console window

Based on the results of testing, we can draw the following conclusions:

1. The pricing policy of both servers is focused on the number of connected sensors. The services provided by companies include technical support, cloud connectivity, and so on. Actility 's services turned out to be more expensive than The Things network .

2. Actility and The Things Network are in a leading position, manufacturers of gateways, sensors and other third-party software are trying to be partners with these companies. Providing them with drivers for their equipment. Both servers have drivers for popular hardware installed, and if not, you can manually configure connections to these devices.

Since the main purpose of using network servers is to determine the location and state of the rolling stock, several trackers from different manufacturers (Semtech, Abeeway , Digital matter). There were a lot of difficulties in decrypting the sent data on both servers. But Abeeway trackers work without any problems with the Actility server. A special software makes it easy to manage and control sensors. For this reason, Actility is more suitable as a network server for deploying assets.

3. Both network servers have two modes public and private. To scale up the system in the future, a public connection method can be used, which involves the use of a common infrastructure for data transmission. To compare the coverage level of networks, we can use Fig.4 and Fig.5.

Figure 4. Coverage level of Actility network servers

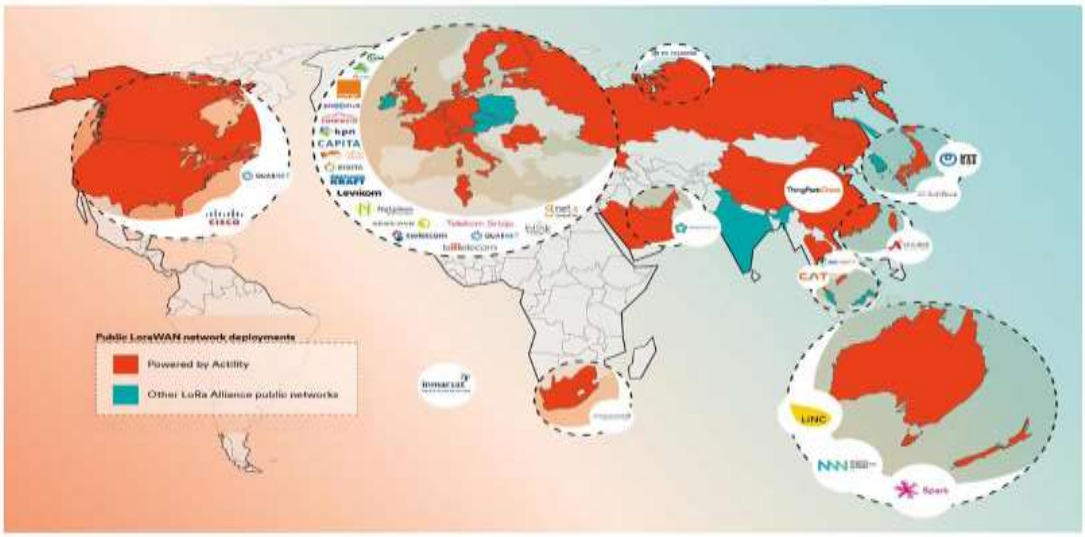

Figure 5. The Things Network server coverage

On the map, you can see that the Republic of Uzbekistan is not covered by network servers. For the same reason, at the top we talked about using only the private connection mode. But for the future, the level of coverage matters. In this regard, Actility is also in the lead , because it covers more countries with which Uzbekistan has a transit flow on rail transport.

4. The level of user support varies greatly. When testing network servers, Actility's customer service level is much higher than The Things network . Actility has created a community to discuss various issues and individual ticketing requests. Ticket service for users works at a good level, they respond within 24 hours. The _ Things Network individual support is conducted only in a paid mode of operation.

Based on the results of testing, it is advisable to choose a network server from Actility. Most of the criteria in favor of this company. Only the annual license is relatively expensive than the competitor. Summarizing the results, we will use the Actility network server to create the LoRaWAN network infrastructure .

The next step in creating the infrastructure is the selection of the gateway that will be installed at the stations for transmitting data from sensors. The gateway is divided into two types: internal and external. In the case of rail transport, we will choose only external gateways. There are many LoRaWAN gateway manufacturers in the IoT technology market. To test the capabilities of LoRaWAN, the author tested two internal UfiSpace gateways Pico Cell "Enterprise" - ThingPark Ready V1.5 Indoor and Dragino LPS8. But for deployment on the railway, it is advisable to choose the following gateways, since they are optimal in terms of price and capabilities.

Figure -6. Kerlink Wirnet iStation V1.5

Key Features of Kerlink Wirnet iStation v1.5:

- **4G Worldwide module** with 3G/2G fallback and Ethernet (RJ45) for backhaul connectivity,
- **Fully integrated and internal antennas** GPS, 4G, LoRa (peak gain=2,6dBi) : no external antenna installation required (external LoRa antenna 3dBi or 6dBi still possible as an option),"
- Carrier-grade casing (IP67) for industrial use,
- 8ch RX (125 kHz, multi Spreading Factor) + 1ch RX (250KHz or 500kHz, mono Spreading Factor) + 1ch RX (FSK) to get 10ch RX + 1ch TX,
- Mounting kit allowing simple and quick installation **without opening the casing**,
- Built-in high-rejection filters for co-localization with other radio devices and enabling strong interference resistance for better data transmission and permanent high availability.
- Powered by:
  - PoE injector (15W or 30W),
  - +48VDC or DC -48VDC over RJ45 (isolated power),
- Highly secured device relying on software and hardware architecture such as Prove & Run SecureBoot and SecureStorage,
- Convenient and straightforward configuration, management, monitoring, control, and update via Kerlink Wanesy Management Center.

Figure 7. Browan Micro 16CH V1. 5 3G / 4G

Main Features Browan Micro 16CH V1.53G/4GG

- Compliance to LoRaWAN 1.0.2
- **8 concurrent channels** for LoRa transmission
- 3G/4G backhaul supported
- Option support wide frequency range from 470MHz to 928MHz
- Long-range over 15 kilometers radius
- 1 LAN port (10/100Mbps) with PoE
- Downlink LBT
- Cloud service to support easy deployment
- Patented repeater mode for last-mile coverage
- Thousands to millions of devices depending on the data model
- Cost-effective for providing full redundancy coverage
- IP67 waterproof

Building the infrastructure of the Internet of things is based on sensors that transmit information about the state of objects. There are a lot of types of sensors, depending on the purpose. For the organization of transportation by rail transport, the location of wagons and their condition (empty or loaded) can be considered critical information. The temperature and humidity in the car body is also important information for perishable goods.

The author tested several types of sensors that provide information about the location of the wagons, as well as the temperature and humidity inside the car body.

Lora edge Tracker (Fig. 8) is the release of the founder of the LoRaWAN network of the company Semtech . The tracker was connected to both network servers, which we considered at the top. Has a separate app for smartphones for configuration via Bluetooth . But when sending information, there was a problem with the location, that is, the tracker sent data that could not be decoded by network servers. Customer support was also unable to help in solving the problem.

Figure 8. Lora Edge Tracker

Abeeway Compact Tracker (Fig. 9) is manufactured by Abeeway , which in turn is a subsidiary of Actility . A web application called Abeeway is used to remotely configure the tracker . device manager . Through this application, you can not only set up trackers , but also visually view locations on the world map and the charging status. At the moment it is connected and working and sends data every 10 minutes.

Figure 9. Abeeway Compact Tracker

Yabby edge Tracker (Fig. 10) manufactured by Digital Matter which is geared towards the release of GPS trackers for different types of wireless network. Service Life of Digital Sensors Matter is distinguished from others by its durability. Yabby Edge connects to network servers via an OEM server and works with that server. However, setting up and connecting this device also did not give a good result.

10-Figure. Yabby Edge Tracker

Oyster 3 Lorawan is also a product of Digital Matter. Sensors are configured with special equipment that is connected to a computer via USB . Remote configuration is not provided. This tracker does not require connection to an OEM server, it can be connected directly to network servers. The complex tuning process did not give good results.

11-Figure. Oyster 3 Lorawan

Sentrius RS1xx manufactured by Laird Connectivity for the production of food cooling equipment. This sensor was also connected to both network servers. The sensor is easily adjusted via a smartphone, connected by Bluetooth. Displays both temperature and humidity simultaneously. There are additional devices called "samples" for better temperature detection.

12-Drawing. Sentrius RS1xx

Netvox R718J2 is used to determine the state of the wagon, empty or loaded. Two cables with dry contacts are connected to the sensor. There is a button for sending data and a message transmission indicator. The sensor is fixed in a certain section of the car by connecting it to special equipment of the brake system. The device has been tested and today also works and periodically sends messages.

10-Figure. Netvox R718J2

Conclusion. LoRaWAN wireless network infrastructure, experimental checks of network servers and devices were carried out. Based on the research results, we will use the Actility company server as a network server. It is advisable to choose gateways for transmitting data from sensors to network servers, manufactured by Kerlink and Browan . To track the location, temperature and status (empty or loaded) of the wagon, use Abeeway accordingly Compact Tracker, Sentrius RS 1 xx and Netvox R718J2.

References

[1]. J. Fox, A. Donnellan and L. Doumen, "The deployment of an IoT network infrastructure, as a localised regional service," *2019 IEEE 5th World Forum on Internet of Things (WF-IoT)*, 2019, pp. 319-324, doi: 10.1109/WF-IoT.2019.8767188.

[2]. Basford, Philip & Bulot, Florentin & Apetroaie-Cristea, Mihaela & Cox, Simon & Ossont, Steven. (2020). LoRaWAN for smart city IoT deployments: A long term evaluation. Sensors. 20. 648. 10.3390/s20030648.

[3]. G. Wibisono, S. G. Permata, A. Awaludin and P. Suhasfan, "Development of advanced metering infrastructure based on LoRaWAN in PLN Bali toward Bali Eco smart grid," *2017 Saudi Arabia Smart Grid (SASG)*, 2017, pp. 1-4, doi: 10.1109/SASG.2017.8356496.

[4]. Poluektov, Dmitry & Polovov, Michail & Kharin, Petr & Štůsek, Martin & Zeman, Krystof & Masek, Pavel & Kochetkova, Irina & Hosek, Jiri & Samouylov, Konstantin. (2019). On the Performance of LoRaWAN in Smart City: End-Device Design and Communication Coverage. 10.1007/978-3-030-36614-8_2.

[5]. Fujdiak, Radek & Mikhaylov, Konstantin & Pospíšil, Jan & Povalac, Ales & Misurec, Jiri. (2022). Insights into the Issue of Deploying a Private LoRaWAN. Sensors. 22. 2042. 10.3390/s22052042.

[6]. Fraga-Lamas, Paula & Celaya-Echarri, Mikel & Lopez Iturri, Peio & Castedo, Luis & Azpilicueta, Leyre & Aguirre, Erik & Suárez-Albela, Manuel & Falcone, Francisco & Fernández-Caramés, Tiago. (2019). Design and Experimental Validation of a LoRaWAN Fog Computing Based Architecture for IoT Enabled Smart Campus Applications. Sensors. 19. 3287. 10.3390/s19153287.

[7]. Baldo, David & Mecocci, Alessandro & Parrino, Stefano & Peruzzi, Giacomo & Pozzebon, Alessandro. (2021). A Multi-Layer LoRaWAN Infrastructure for Smart Waste Management. Sensors. 21. 10.3390/s21082600.
[8]. Everynet Launches LoRaWAN® Service in Seven More Major Metropolitan Areas. https://www.dutchnews.nl/news/businesswire/everynet-launches-lorawan-service-in-seven-more-major-metropolitan-areas/. (Дата обращения: 02.08.2022).
[9]. Build your carrier-grade LoRaWAN® network with LORIOT and unleash the power of IoT. https://www.loriot.io/. (Date: 02.08.2022).
[10]. Orbiwise – About. https://orbiwise.com/about/. (Date: 02.08.2022).
[11]. The Things Enterprise Stack Enterprise LoRaWAN Network Server. https://aws.amazon.com/ru/iot/solutions/thingsindustries/. (Date: 02.08.2022).

ACTUAL PROBLEMS OF MATHEMATICS, PHYSICS AND MECHANICS

UDC 34L25

INTEGRATION OF THE KAUP-BOUSSINESQ TYPE SYSTEM VIA INVERSE SCATTERING METHOD.

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Annotatsiya. Ushbu maqolada Kaup-Boussinesq turidagi sistema qaraladi. Sistemaning to'la integrallanuvchi ekanligi ko'rsatiladi. Aynan, Shturm Liuvill operatorlari kvadratik dastasi uchun spektral berilganlarning vaqt bo'yicha evolyutsiyasi topiladi. Olingan tengliklar ixtiyoriy t larda sochilish nazariyasining berilganlarini to'la aniqlaydi va Kaup-Boussinesq turidagi systemaga qo'yilgan Koshi masalasini teskari spektral masala usulini qo'llab yechishga imkon beradi.

Kalit so`zlar. Kaup-Boussinesq turidagi sistema; Shturm Liuvill operatorlari kvadratik dastasi; teskari spektral masala.

Аннотация. В статье рассматриваются система типа Каупа-Буссинеска. Показано, что система является полностью интегрируемой системой. А именно, найдена временная эволюция данных рассеяния для квадратичного пучка операторов Штурма-Лиувилля. Полученные равенства полностью определяют данные рассеяния при любом t, что позволяет применить метод обратной задачи рассеяния для решения задачи Коши для системы типа Каупа-Буссинеска.

Ключевые слова. Система типа Каупа-Буссинеска; квадратичный пучок операторов Штурма-Лиувилля; метод обратной задачи рассеяния.

Abstract. The article considered the Kaup-Boussinesq type system. It is shown that the system is a fully integrable system. Exactly, the time evolution of the scattering data for a quadratic pencil of Sturm-Liouville operator is founded. The obtained equalities completely determine the scattering data for any t, which makes it possible to apply the method of the inverse scattering problem to solve the Cauchy problem for the Kaup-Boussinesq type system .

Keywords: Kaup-Boussinesq type system; quadratic pencil of Sturm-Liouville operator; method of the inverse scattering problem.

Introduction.

Nonlinear evolution equations are widely used as models to describe complex physical phenomena in various fields of sciences, especially in fluid mechanics, solid-state physics, plasma physics and biology. The Kaup-Boussinesq system was first studied in the paper [1, 2]. In [3], multisoliton solutions were found, and the asymptotic behavior of these solutions was investigated. In papers [4,5], real finite-zone regular solutions of the Kaup-Boussinesq system are studied.

In this work, we consider the following Kaup-Boussinesq type system

$$\begin{cases} v_t - v_{xxx} - 6uu_{xxx} - 18u_x u_{xx} + 6vv_x + 24vuu_x + 6v_x u^2 = 0, \\ u_t - u_{xxx} + 6vu_x + 6v_x u + 30u_x u^2 = 0, \quad x \in \mathbb{R}, \ t > 0 \end{cases} \tag{1}$$

under initial condition

$$v(x,t)\big|_{t=0} = v_0(x),\ u(x,t)\big|_{t=0} = u_0(x),\ x \in \mathbb{R}\ . \tag{2}$$

The functions $v_0(x),\ u_0(x)$ satisfy the following conditions:

(i) $u_0(x)$ is absolutely continuous on each finite segment $[\alpha,\beta] \subset (-\infty,\infty)$ and the inequalities hold

$$\int_{-\infty}^{\infty} |u_0(x)|\,dx < \infty,\quad \int_{-\infty}^{\infty} (1+|x|)[|v_0(x)|+|u_0'(x)|]dx < \infty, \tag{3}$$

(ii) the operator generated by the differential expression

$$T(0,k) := -\frac{d^2}{dx^2} + v_0(x) + 2ku_0(x) - k^2$$

has exactly $2N$ simple eigenvalues $k_1(0), k_2(0), ..., k_{2N}(0)$.

The main aim of this work is to derive representations for the solutions $v(x,t)$ and $u(x,t)$ of the Cauchy problem (1)–(3) within the inverse scattering method for the quadratic pencil of Sturm-Liouville operators:

$$T(t,k)y := -y'' + v(x,t)y + 2ku(x,t)y - k^2 y = 0,\ x \in \mathbb{R}\ . \tag{4}$$

The inverse scattering problem for the quadratic pencil of Sturm-Liouville operators in the class of "rapidly decreasing" functions was solved in the works [6,7], with periodical potential in [8,9].

The basic facts from scattering problem

In this section we give basic information about the scattering theory for the Sturm–Liouville equation with an energy-dependent potential.

Consider the following quadratic pencil of Sturm-Liouville equatins

$$T(0,k)y := -y'' + v(x)y + 2ku(x)y - k^2 y = 0,\ x \in \mathbb{R} \tag{5}$$

where $u(x)$ and $v(x)$ are real functions, moreover, $u(x)$ is absolutely continuous on each finite segment $[\alpha,\beta] \subset (-\infty,\infty)$ and the inequalities hold

$$\int_{-\infty}^{\infty} |u(x)|\,dx < \infty,\quad \int_{-\infty}^{\infty} (1+|x|)[v(x)+|u'(x)|]dx < \infty. \tag{6}$$

Under condition (6), Eq. (5) has solutions $f_+(x,k),\ f_-(x,k)$ regular in the half-plane $\operatorname{Im} k > 0$ and the asymptotic formulas hold

$$f_+(x,k) = e^{ikx}[1+o(1)],\ x \to +\infty, \tag{7}$$

$$f_-(x,k) = e^{-ikx}[1+o(1)],\ x \to -\infty. \tag{8}$$

For real $k \neq 0$, the pairs $f_+(x,k),\ f_-(x,k)$ and $f_-(x,k),\ \overline{f}_-(x,k)$ (the bar over the function here and below denotes complex conjugation) form two fundamental systems of solutions to equation (5). The following relations hold

$$f_+(x,k) = b(k) f_-(x,k) + a(k)\overline{f}_-(x,k), \tag{9}$$

$$f_-(x,k) = -\overline{b}(k) f_+(x,k) + a(k)\overline{f}_+(x,k). \tag{10}$$

The functions $a(k)$ and $b(k)$ are defined for all $k \in R^* = (-\infty,\infty)\setminus\{0\}$ and the following equality is fulfilled

$$a(k)=-\frac{1}{2ik}W\{f_+, f_-\},\ \ b(k)=\frac{1}{2ik}W\{f_+, \overline{f}_-\},$$
$$|a(k)|^2-|b(k)|^2=1,\ k\in R^*.$$

Moreover, the function $a(k)$ admits an analytic continuation to the half-plane $\mathrm{Im}\,k>0$ and can have at most a finite number of zeros $k_1,k_2,...,k_N$, besides, at $k=k_n$, $n=1,2,...,N$ the following equality holds:

$$f_{\mp}(x,k_n)=B_n^{\pm}f_{\pm}(x,k_n), \tag{11}$$

where the quantities $B_n^{\pm}$ are independent of x. The corresponding functions $f_{\pm}(x,k_n)$ are the only $L^2(R)$ solutions of (5) for $\mathrm{Im}\,k>0$ and are the 'bound states'.

The set of the quantities

$$\left\{r_-(k)=\frac{b(k)}{a(k)},\ k\in R,\ k_1,k_2,...,k_N,\gamma_1^-,\gamma_2^-,...,\gamma_N^-\right\} \tag{12}$$

and

$$\left\{r_+(k)=-\frac{\overline{b}(k)}{a(k)},\ k\in R,\ k_1,k_2,...,k_N,\ \gamma_1^+,\gamma_2^+,...,\gamma_N^+\right\} \tag{13}$$

are called the left and right scattering data of Eq. (5), respectively, here

$$\gamma_n^{\pm}=\frac{B_n^{\pm}}{\left.\frac{da(k)}{dk}\right|_{k=k_n}},\ n=1,2,...,N. \tag{14}$$

Functions $r_-(k)$ and $r_+(k)$ are called the left and right reflection coefficients, respectively.

We now turn to the question of constructing $u(x)$ and $v(x)$ from scattering data. Note that scattering data (12), (13) and $F_{\pm}(x)$ are bijectively related via transforms

$$F_{\pm}(x)=-i\sum_{n=1}^{N}\gamma_n^{\pm}e^{\pm ik_nx}+\frac{1}{2\pi}\int_{-\infty}^{\infty}r_{\pm}(k)e^{\pm ikx}dk. \tag{15}$$

To restore the coefficient functions $u(x)$ and $v(x)$ in equation (5) from the right reflection coefficient $r_+(k)$ we proceed as follows:

It is necessary to find the function $F_+(x)$ by formula (15) and solve with respect to $K_+^{(0)}(x,y)\in L_1(x,\infty)$, $K_+^{(1)}(x,y)\in L_1(x,\infty)$ integral equations

$$F_+(x+y)+\overline{K_+^{(0)}(x,y)}+\int_x^{\infty}K_+^{(0)}(x,t)F_+(t+y)dt=0,\ \ x\le y<\infty,$$
$$iF_+(x+y)+\overline{K_+^{(1)}(x,y)}+\int_x^{\infty}K_+^{(1)}(x,t)F_+(t+y)dt=0,\ \ x\le y<\infty.$$

Next, we have to define the function $\alpha_+(x)$ as a solution to a nonlinear integral equation of the Volterra type

$$\alpha_+(x)=\int_x^{\infty}\Phi(t,\alpha_+(t))dt,\ \ -\infty<x<\infty,$$

in which

$$\Phi(t,z)=\left[\mathrm{Re}\,K_+^{(0)}(t,t)-\mathrm{Im}\,K_+^{(1)}(t,t)\right]\sin 2z+2\left[\mathrm{Re}\,K_+^{(1)}(t,t)\right]\sin^2 z-2\left[\mathrm{Im}\,K_+^{(0)}(t,t)\right]\cos^2 z$$

and we put

$$K_+(x,y)=K_+^{(0)}(x,y)\cos\alpha_+(x)+K_+^{(1)}(x,y)\sin\alpha_+(x).$$

After that, the coefficients $u(x)$ and $v(x)$ of the equation (5) are determined by the equalities

$$u(x)=-\alpha_+'(x),$$

$$v(x)=-u^2(x)-2\frac{d}{dx}\left\{\left[\operatorname{Re}K_+(x,x)\right]\cos\alpha_+(x)+\left[\operatorname{Im}K_+(x,x)\right]\sin\alpha_+(x)\right\}.$$

It is worthy to remark that the functions

$$h_n(x)=\left(\left.\frac{da(k)}{dk}\right|_{k=k_n}\right)^{-1}\left.\frac{d}{dk}[f_-(x,k)-B_n^+f_+(x,k)]\right|_{k=k_n} \tag{16}$$

are solutions of the equations $T(k_n)y=k_n^2y$, $n=1,2,...,N$. For $\operatorname{Im}k>0$, using (7) and (8), we obtain the following asymptotics

$$h_n(x)\to e^{-ik_nx},\ x\to+\infty, \tag{17}$$

$$h_n(x)\to -B_n^+e^{ik_nx},\ x\to-\infty. \tag{18}$$

From asymptotics (7), (8), (17) and (18) we get

$$W\{h_n(x),f_+(x,k_n)\}=2ik_n,\quad W\{h_n(x),f_-(x,k_n)\}=2ik_nB_n^+$$

Evolution of the scattering data

In this section we derive time evolution of the scattering data which allows us to provide the algorithm for solution of the problem (1)–(3).

We set

$$U=\begin{pmatrix}v\\u\end{pmatrix},$$

$$L^*=\begin{pmatrix}0 & -\dfrac{\partial^2}{\partial x^2}+4v-2v_x\displaystyle\int_x^\infty d\tau\\ 1 & 4u-2u_x\displaystyle\int_x^\infty d\tau\end{pmatrix}. \tag{19}$$

Then the system (1) can be rewritten as follows:

$$U_t+\Omega(L^*)U_x=0. \tag{20}$$

where $\Omega(k)=k^2$.

Now we introduce the 'scalar product' notation

$$\langle V(x),W(x)\rangle=\int_{-\infty}^{\infty}[V_1(x)W_1(x)+V_2(x)W_2(x)]dx$$

for $V(x)=(V_1(x),V_2(x))^T$, and the vector functions

$$\Phi_1(k,x)=\left(f_+(k,x)f_-(k,x),\ 2kf_+(k,x)f_-(k,x)\right)^T, \tag{21}$$

$$\Phi_2(k,x)=\left(f_+(k,x)\overline{f}_-(k,x),\ 2kf_+(k,x)\overline{f}_-(k,x)\right)^T, \tag{22}$$

$$\Phi_3(k_n,x)=\left(h_n(x)f_-(k_n,x),\ 2k_nh_n(x)f_-(k_n,x)\right)^T. \tag{23}$$

Theorem. If the functions $v=v(x,t)$, $u=u(x,t)$ and $\varphi_m=\varphi_m(x,t)$ are solutions of the problem (1)-(4), then the scattering data of the operator

$$T(t,k)y\equiv -y''+v(x,t)y+2ku(x,t)y=k^2y,\ -\infty<x<\infty,$$

depend on t as

$$\frac{dr_+(t,k)}{dt}=8ik^3r_+(t,k), \tag{24}$$

$$\frac{d}{dt}k_n(t)=0, \tag{25}$$

$$\frac{d\gamma_n^+(t)}{dt}=-8ik_n^3\gamma_n^+(t). \tag{26}$$

Proof. It is easy to show that

$$\frac{d}{dt}a(k,t)=-(2ik)^{-1}\left\langle U_t+\Omega(L^*)U_x,\Phi_1\right\rangle,\ (\mathrm{Im}k\geq 0,k\neq 0), \tag{27}$$

$$\frac{d}{dt}b(k,t)-4ik^2b(k,t)=(2ik)^{-1}\left\langle U_t+\Omega(L^*)U_x,\Phi_2\right\rangle,\ (k\in\square^*), \tag{28}$$

$$\frac{dB_n^+(t)}{dt}-4ik_n^2B_n^+(t)=(2ik_n)^{-1}\left\langle U_t+\Omega(L^*)U_x,\Phi_3\right\rangle. \tag{29}$$

If $U(x,t)$ satisfies (20) then (27), (28) and (29) will take the following form

$$\frac{d}{dt}a(k,t)=0,\ (\mathrm{Im}k\geq 0,k\neq 0), \tag{30}$$

$$\frac{d}{dt}b(k,t)=8ik^3b(k,t),\ (k\in\square^*), \tag{31}$$

$$\frac{dB_n(t)}{dt}=-8ik_n^3B_n^+(t). \tag{32}$$

It follows that the zeros $k_n=k_n(t)$, $n=1,2,...,N$ of the function $a(k,t)$ also do not depend on time, which means (25). From (30), (31) and view of $r_+(t,k)$, we obtain (24). If we use (32) and view of $\gamma_n^+(t)$, we get (26).

The theorem is proved.

Remark 1. The obtained results completely define the time evolution of the scattering data, which allows us to find the solution of the considered problem (1)-(3) via the inverse scattering method.

References:

[1]. Kaup D. J. A Higher-Order Water-Wave Equation and the Method for Solving It, Progress of Theoretical Physics, 1975, vol. 54, issue 2, pp. 396-408.

[2]. Boussinesq J. Theorie de litumescence liquide appelee onde solitarie ou de translation, sepropageant dans un canal rectangulaire, Comptes Rendus Hebdomadaires des Seance de l'Academie des Sciences, 1871, 72, pp.755-759.

[3]. Matveev V.B., Yavor M. I. Solutions Presque Periodiques et a N-solitons de l'Equation Hydrodynamique Nonlineaire de Kaup, Ann.Inst. Henri Poincare, Sect., 1979, A. 31, no. 1, pp. 25-41.

[4]. Smirnov A.O. Real Finite-Gap Regular Solutions of the Kaup-Boussinesq Equation, Theor. Math. Phys., 1986, vol.66, no.1, pp.19-31.
[6]. Mitropolsky Yu., Bogolyubov N. Jr., Prykarpatsky A., Samoilenko V. Integrable dynamical system: spectral and differential-geometric aspects, Naukova Dunka, Kiev, 1987.
[7]. Maksudov F. G., Guseinov G. Sh. On solution of the inverse scattering problem for a quadratic pencil of one-dimensional Schrodinger operators on the whole axis, Dokl. Akad. Nauk SSSR, 1986, vol. 289, no. 1, pp. 42--46
[8]. Babadzhanov B.A., Khasanov A.B. Inverse problem for a quadratic pencil of Shturm-Liouville operators with finite-gap pereodic potential on the half-line, Differensial equations , 2007, vol. 43, issue 6, pp. 723-730.
[9]. Babadzhanov B.A., Khasanov A.B., Yakhshimuratov A.B. On the Inverse Problem for a Quadratic Pencil of Sturm-Liouville Operators with Periodic Potential, Diff. Eqs., 2005, vol.41, issue 3, pp. 310-318.