



Innovative projects of KazNU



INNOVATIVE PROJECTS OF KAZNU



Almaty - 2021

**UDC
CBS**

«INNOVATIVE PROJECTS OF KAZNU»

Al-Farabi Kazakh National University / Almaty: Kazakh University Publishing House, 2021 - 164 pages.

ISBN

This scientific book includes the best innovative projects of scientists from KazNU Al-Farabi.

The task of the First President of Kazakhstan - Leader of the Nation N.A. Nazarbayev on the development of the experience of successful projects in the field of higher education and the results of the tasks of the Head of State K.K.Tokayev on the development of science, as well as the Kazakh language in science and technology.

In addition, grouped scientific discoveries allow us to solve urgent problems in various areas of our economy.

**UDC
CBS**

ISBN

THIRTY ADVANCED PROJECTS –

THE GIFT OF SCIENTISTS TO THE TREASURE FOR INDEPENDENCE

The first President of Kazakhstan - Elbasy Nursultan Nazarbayev for 30 years of independence paid special attention to the formation of youth as a professional, able to receive a comprehensive education and become a sought-after professional. At one of the regular meetings with young people, it was noted that “the first successful projects began to appear in the country’s leading universities. We need to expand this practice. “ This task has not lost its relevance so far.

The leader of the nation constantly focused on the fact that it is possible to increase the innovative potential of the Kazakhstani economy only through the creation of an effective scientific and innovative system, the basis of which will be research universities and innovation clusters.

The head of state, Kassym-Jomart Tokayev, in his Address to the people of Kazakhstan “The unity of the people and systemic reforms are a solid basis for the country’s prosperity” highlighted the importance of supporting sci-

entists, stressing that “the development of science is our most important priority.” In order to fulfill these tasks, the Al-Farabi Kazakh National University, which has a glorious history of almost ninety years, is making efforts to implement innovative projects using modern technologies aimed at improving the well-being of the population and creating an innovative competitive economy.

Today KazNU strives to become a “world-class university” and an innovation hub of the national economy. Thus, the university con-



ducts research in the framework of fundamental and applied programs, innovative, industry, international complex scientific and technical developments, as well as contractual work in priority areas of science development. The university employs a large number of talented scientists, whose names and achievements have determined the formation and development of Kazakhstani science and technology. Scientific schools of KazNU are known far beyond the borders of the country. For example, quantum chromodynamics, in the physics of non-ideal plasma, plasma nanotechnology and nanomaterials; particle physics; chemical physics and combustion; chemistry of macromolecular compounds and organic chemistry; information technology, information security, machine translation; microbiology, biotechnology, ecology; modern theory of language; Kazakh literature, Abay studies; archeology and many others.

The university has created a unique scientific and technical park, which is not found in other educational institutions of the country. More than 30 research institutes and centers work in it, implementing most of the research projects being implemented in Kazakhstan. The modern educational scientific center of the “neewlett Packard” company was opened, the “Copisa Minolta” company created a laboratory of advanced technologies at the university.

The educational institution has created all the conditions for carrying out research work. Proof of this is the innovative

projects implemented by our scientists. Several types of products manufactured and patented in the laboratories of the university are currently presented on the domestic market. One of them is the geoproduction of the Earth Remote Sensing Center at KazNU for various industries. Industry experts are of the opinion that such innovative GIS-based offerings are promising. After all, one of the ways to save resources and prevent human and economic losses when it comes to an emergency is to use the capabilities of space technology.

Our scientists at the center conducted a space analysis of the Ridder fire and quickly analyzed how much of the country’s forest reserves were affected by the disaster. Therefore, we are confident that the scientific and technological base of the educational institution will serve the country in emergency situations.

Geo-hardware systems are indispensable not only in extreme conditions, but also for the development of various sectors of the economy. Proof of this is the digital platform for tourists. In the material “TourismKaz - Technological Trend” you can familiarize yourself with a mobile application that will be beneficial both for travelers and for entities in the field of tourism. Materials under the headings “Digital world without borders”, “Monetization of a mobile application” answer many of the reader’s questions.

Another unusual project is an energy-saving lamp of a new type, developed by specialists of the national open-type nanotechnological



laboratory. Scientists say that the main feature of this lamp is that it is cheap in cost, and the quality is high of analogues. You can learn more about the intricacies of the project in the section of the book “Thirty advanced projects of KazNU” - “Economical lamp based on nanotechnology”.

Also, the specialists of this laboratory have developed a new project that will allow a deeper study of physics. They note that this innovative device will become an indispensable tool for institutions of secondary and secondary specialized education.

At the time of an exacerbation of the coronavirus, our scientists lecturing at the international level have developed unique tinctures with antiviral properties aimed at strengthening the immunity of the population. Currently, the production of dietary supplements has been established on the campus. Organic waste can be recycled using the larvae of the flies *Hermetia illucens*, found in South America, according to biologists. University specialists effectively implement this technology. We hope that the Golden Fly and Golden Soil products, which are the main products of the project, will contribute to agriculture. Because the project leaders proudly state that a universal product has been prepared for poultry, fish and animals, which will become a complete feed and natural fertilizer.

The collection includes the best innovative projects of scientists and university teachers, including artificial intelligence, nanomaterials, medicine and energy, microalgae production, agriculture, chemical and food industries, as well as environmental projects. The instruction of the First President of Kazakhstan - Elbasy N.A. Nazarbayev on the development of the experience of successful projects in higher educational institutions and is intended to reflect the results of the implementation by the head of state Kassym-Jomart Tokayev of tasks for the development of the scientific sphere, as well as the translation of the Kazakh language into the language of science and technology.

All articles were published in the Kazakh University newspaper in the Kazakh language, translated into Russian and English as required.

The scientific and educational book “Thirty advanced projects of KazNU” was prepared as a gift for the 30th anniversary of the country’s independence.

We hope that readers will give a worthy assessment!

Zhanseit TUYMEBAEV,

*Chairman of the Board - Rector of Kazakh
Al-Farabi National University*



KAZNU REMOTE SOUND CENTER

The commandment of our ancestors “Know the seven kinds of teachings” is a professional principle for innovative young scientists of Al-Farabi Kazakh National University. Our specialists, who have mastered the language of space technology, have created new projects that will help increase the potential of the country’s economy. For example, since 2018, the University’s Center for Remote Sensing (ERS) has been developing geoproducts for various industries based on geographic information systems (GIS) and satellite imagery.



Geoinformation products are the results of expertise obtained on the basis of remote sensing, ie observation data. Cartographic, statistical and meteorological data from other sources are also used. This system is an indispensable approach to significant changes in many sectors of the economy. For example, it is most effective for agriculture, construction, emergencies, ecology, environmental protection and transportation. Such innovative products are a direct way to be competitive in the world market.

According to Omirzhan Taukebayev, Deputy Director General of the Engineering and High Technologies Cluster of the University, the main activity of the center is the acquisition, processing and distribution of space images of different spatial accuracy. Carrying out various analytical works, monitoring using this information. Also to teach students the basics of geoinformation applications.

In 2019, Al-Farabi Kazakh National University signed a partnership agreement with SuperMap. Accordingly, the University has the right to distribute, train and provide technical support for SuperMap GIS software in Central Asia and Russia. SuperMap is the world's largest manufacturer of geographic information platforms and has more than 1,000 partners around the world, including HUAWei, IBM, and Microsoft.

The main features of the Earth Remote Sensing Center of KazNU are:

The center has a virtual station SatSee, which belongs to the Chinese Academy of Sciences.

This allows you to take pictures of the desired area in QuickLook mode from five Chinese satellites, seeing the flying trajectory of the US spacecraft LandSat. In other words, the large number of spacecraft creates a favorable environment for faster and more frequent data acquisition than other Kazakhstani systems.

- Today, the Earth Remote Sensing Center not only monitors the ground, but also conducts internships for students and undergraduates of university departments. This academic year, together with SuperMap, the Department of Geography and Nature Management, Mechanics and Mathematics has installed 30 licenses for the SuperMap iDesktop program. In addition, on the basis of the Department of Cartography and Geoinformatics opened a laboratory "Geoinformation Cartography" on the basis of innovative products of SuperMap. This program meets all the standards of the world and the main difference is that it can work on all platforms, such as Big Data, Artificial Intelligence and 3D GIS, which are modern trends. Another important point is that the program has the ability to perform more than 600 analyzes, - said Omirzhan Taukebayev.

SAVES WHAT IS SAVED

According to Omirzhan Zhalgasbekovich, when the Sardoba reservoir exploded last year, the Earth Remote Sensing Center conducted a joint study with experts from the Institute



THE MAIN FEATURES OF THE EARTH REMOTE SENSING CENTER OF KAZNU:

- ABILITY TO TAKE HIGH-QUALITY IMAGES OF THE DESIRED AREA;
- CAN TRANSMIT DATA FASTER AND MORE FREQUENTLY THAN IN KAZAKHSTAN;
- FACILITATES THE WORK OF RELEVANT STRUCTURES AND REGIONAL AKIMATS.

THE EARTH REMOTE SENSING CENTER PROVIDES SPACE MONITORING SERVICES IN THE FOLLOWING AREAS:

- IN CASE OF FOREST AND STEPPE FIRES;
- DURING MUDFLOWS AND FLOODS;
- PASTURES;
- ARABLE LANDS;
- FACILITIES FOR BURIAL OF HOUSEHOLD WASTE;
- IDENTIFICATION OF NEW FACILITIES;
- DEVELOPMENT AND IMPLEMENTATION OF A GEOGRAPHIC INFORMATION SYSTEM (GEOPORTAL).

of Aerospace Research of the Chinese Academy of Sciences. Based on satellite images of the GF-3 satellite, the area of flooded areas was identified and analyzed in a short time.

- At that time, together with specialists from the Institute of Aerospace Research of the Chinese Academy of Sciences, based on satellite imagery, we found that a 234-meter-long dam had burst. When analyzing the numerical model of the terrain, it became clear that the water flowing from the Sardoba reservoir to

the territory of Kazakhstan flows only at a distance of 25-30 km. For example, if the reservoir is 287 meters above sea level, the level of the border areas will drop to 210-215 meters, - he said. At the same time, it was possible to monitor the process of flooding in rivers through remote sensing technology. In addition to satellite imagery, meteorological data such as temperature, snow cover, and precipitation are used.

In 2019, representatives of the center analyzed 240 km of the Irtysh River. There are 65 settlements with an average population of about 138 thousand people. As a result, in May, the canal was flooded. This will allow flood prevention and agricultural planning.

MONITORING OF MORAINELAKES

Such lakes are formed in mountainous areas under the influence of glaciers. However, in the spring and summer, a calm lake in the mountains may overflow and cause catastrophic floods. Therefore, these lands are under the control of specialists.

- Currently, the Earth Remote Sensing Center is working to create an automated monitoring system for moraine lakes and mobile hybrid container-type power plants. There are 945 moraine lakes in Kazakhstan, 47 of which are dangerous. 14 of them are located near Almaty. In addition, flood and landslide-prone areas in the country need regular monitoring. The use of space technology will help prevent



disasters caused by natural and anthropogenic factors and reduce losses. And an automated intelligent system can measure several indicators at once. For example, it instantly determines water quality, soil temperature and humidity, and precipitation. And experts analyze the situation on the basis of the same data, sitting in the situational centers. In addition, 360-degree cameras will be installed to keep the situation under control, - said Mr. Omirzhan.

The main features of the Earth Remote Sensing Center of KazNU:

- Ability to take high-quality images of the desired area;

- can transmit data faster and more frequently than in Kazakhstan;
- Facilitates the work of relevant structures and regional akimats.

The Earth Remote Sensing Center provides space monitoring services in the following areas:

- in case of forest and steppe fires;
- during mudflows and floods;
- pastures;
- arable lands;
- facilities for burial of household waste;
- identification of new facilities;
- Development and implementation



of a geographic information system (geoportal).

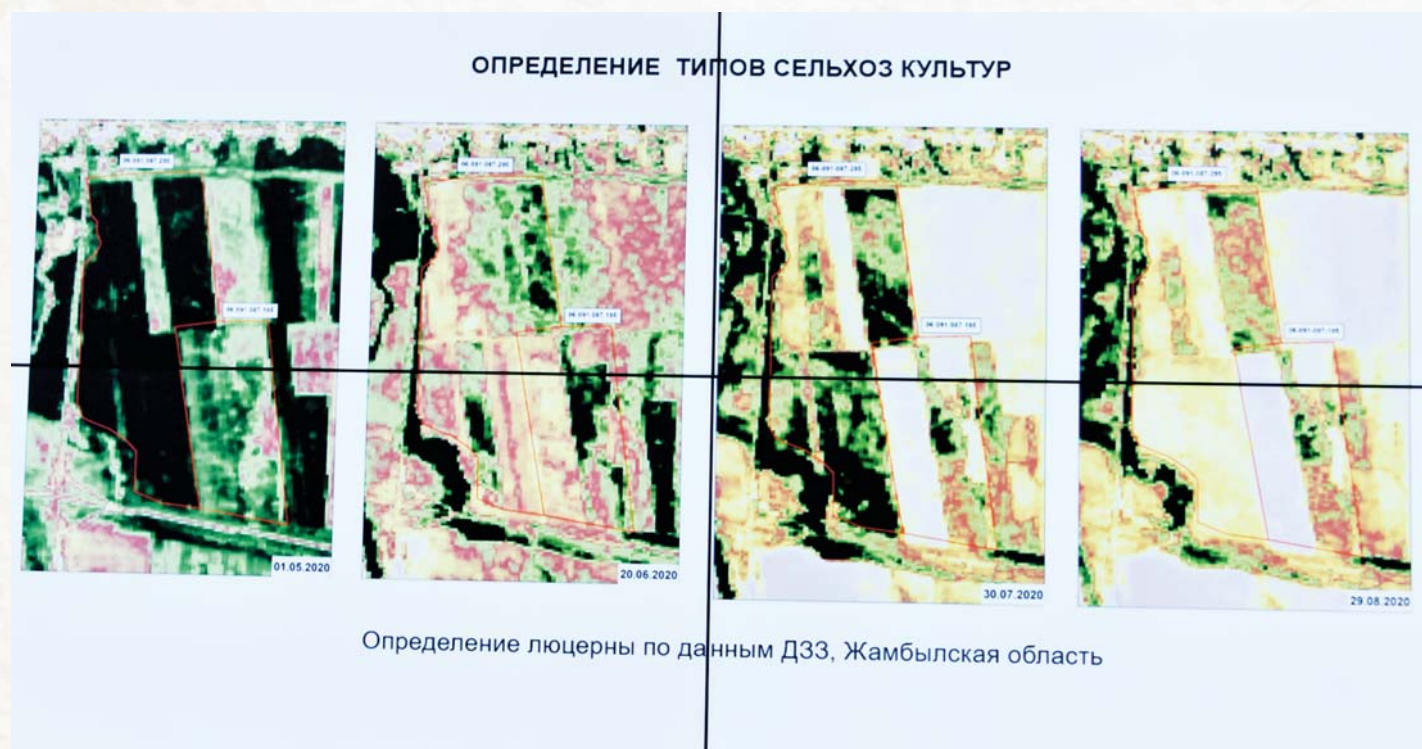
THE MAINSTAY OF TOURISM

The remote sensing center will also contribute to the development of tourism. For example, last year, in order to develop tourism, the center of our university together with Turanga Group LLP developed a map for tourists. The map shows three trails and tourist facilities in the Ayusai gorge, located in the Ile-Alatau National Park. At the same time, information about the length and complexity of the road became available to tourists. In the future, it is planned to develop an application

for smartphones and create a geoportal. Because all of this information is in digital format, it is very easy to edit it. Therefore, the map can be updated at any time as the infrastructure improves. Specialists of the center, along with representatives of the travel company, walked all three trails. This is necessary “to make sure that the data is correct and to avoid mistakes,” said Omirzhan Zhalgasbekovich.

CONTROL AND PLANNING

- We have another point that will be useful for local executive bodies, - says Mr. Omirzhan.
- For example, monitoring of landfills with satellite imagery has become available. The





landfill near Almaty is located near the village of Aitei. The amount of waste has increased 2.5 times over the past decade. This method helps to identify illegal landfills and unburied solid waste. This would also be a project aimed at preventing environmental problems.

One of the areas in need of new technologies today is agriculture. The state invests a lot in the development of this industry. Remote sensing of land will allow in the future to plan arable land on those lands, to predict their productivity.

In short, the use of geographic information systems and Earth remote sensing data

has led to significant changes in the era of globalization. The countries of the world have used it effectively and achieved great results. For example, Malaysia is using this technology to create a smart city, while Thailand is using Smart-Agriculture, ie China, and China is using a geoportal to prevent emergencies. Some countries even control the movement of goods through the use of geographic information systems in the field of logistics. If such projects are ordered by the state or local executive authorities, our specialists will create a new competitive project.

NANOSATELLITE LAUNCHED INTO SPACE ON A SCIENTIFIC MISSION

In his Address to the people, First President Nursultan Nazarbayev repeatedly noted that the innovation potential of the domestic economy can be increased only through the creation of an effective scientific and innovation system based on strong research universities and innovation clusters. Developing this strategic concept, the Head of State K. Tokayev set the task to form science and education as separate sectors of the economy. Scientists of the Al-Farabi Kazakh National University are implementing projects using modern technologies aimed at improving the well-being of the population and creating an innovative competitive economy as a whole.

One of such developments is the innovative designers of small satellites “ALFASAT”, designed to teach schoolchildren the basics of design, construction, construction, testing and operation of spacecraft. When working with a designer, students develop not only Hard

Skills, but also Soft Skills. By studying the materials of the team, users gain in-depth knowledge of the design of a particular spacecraft. Each student can assemble their own nanosatellite and send it into the stratosphere using a helium balloon.





SCIENTIFIC SCHOOL FOR THE CREATION OF SMALL SPACE-CRAFT – NANOSATELLITES

Currently, many foreign innovative companies and leading universities are engaged in the development and creation of scientific, educational and commercial nanosatellites. One of the reasons for the popularity of such satellites is that their construction does not require a lot of money compared to traditional satellites. In addition, there is an opportunity to

teach students through participation in practical work, which consists of all the main stages.

- One of such projects is the creation of nanosatellites. Nanosatellite (NS) is a spacecraft weighing less than 10 kg. The term “CubeSat” refers to nanosatellites developed according to the standard under the direction of Professor Bob Twiggs (Stanford University Department of Aeronautics and Astronautics). Such artificial satellites in the CubeSat format are being created in a short time and can be launched into orbit around the Earth. It is interesting





that students and young scientists are actively involved in such projects. Due to its low cost, it allows the development of commercial start-up companies within the university, - said Amirkhan Temirbayev, General Director of the Engineering and High Technologies Cluster.

The NS size of the CubeSat standard is $10 \times 10 \times 10$ cm, i.e. has the shape of a cube. Standard Allows you to combine 2 or 3

standard cubes on one satellite. They are labeled 2U and 3U and have dimensions $10 \times 10 \times 20$ or $10 \times 10 \times 30$ cm, respectively. Today nanosatellites belong to an independent category of spacecraft. Consequently, it can perform important tasks such as monitoring geophysical fields in orbit, collecting and transmitting data on water and land transport, as well as obtaining images of the Earth from space.

THE FIRST NANOSATELLITES OF THE AL-FARABI SERIES KAZNU

In September 2009, a new specialty “Space Engineering and Technology” was introduced into the classifier of higher and postgraduate education. Al-Farabi Kazakh National University was the first in the country to open the specialty “Space Engineering and Technology” at the Department of Mechanics of the Faculty of Mechanics and Mathematics. To develop a new direction, the head of the Department of Mechanics, Professor Zaure Rakisheva, invited Professor Shinichi Nakasuka from the University of Tokyo to cooperate as one of the best specialists in the field of small spacecraft.

In 2013, within the framework of the project of the Ministry of Education and Science of the Republic of Kazakhstan, five



doctoral and master students underwent a research internship at the University of Tokyo, working on the international UNIFORM project. Thus, five undergraduates of KazNU mastered all the necessary knowledge and skills to create small spacecraft.

As a result of the work done, on February 15, 2017, the university launched the country's first nanosatellite. The Al-Farabi-1 spacecraft is named after an outstanding scientist of the Turkic world. The country's first nanosatellite was launched in India

from the Andhra Pradesh cosmodrome. The launch became a record for the number of spacecraft launched into space: 101 nanosatellites, 2 microsatellites and 712 kg of main satellites were launched into orbit around the Earth.

More than a year later, on December 4, 2018, the second nanosatellite of KazNU "Al-Farabi-2" was launched into a synchronous orbit. The satellite was launched by the well-known company Ilona Musk SpaceX.

- In addition to the main educational

mission, spacecraft have scientific, technological and practical applications. The technological mission of the Al-Farabi-2 nanosatellite is work in space conditions, developed by the authors of the onboard computer, as well as testing its ground station and a number of software. The scientific mission is to study the effect of radiation on the memory cells of microcontrollers. In addition, Al-Farabi-2 includes the function of meeting ground stations in more than 10 languages. “The university’s nanosatellite flies over continents, automatically determines broadcasting radii for different countries and sends a welcome signal in their language,” said Omirzhan Taukebaev, deputy general director of the engineering and high technology cluster.

ALFASAT - STANDALONE SATELLITE PLATFORM

According to experts, the stage of commercialization of work results continues today.

- After the successful launch of university nanosatellites, we started to create our own satellite platform “AlfaSat” for educational institutions. These constructors represent a model of the standard CubeSat-1U

nanosatellite with all the main functional subsystems of the spacecraft. Schoolchildren and students can design their payloads and integrate them with the alfasat space system to launch into the upper atmosphere, says the expert.

Structure of the satellite platform AlfaSat

Today the university actively cooperates with scientific organizations from all over the world. In 2017, the University opened the Earth Remote Sensing Center in collaboration with the RADI (now AIR) Institute of the Chinese Academy of Sciences.

- The center is equipped with a virtual ground station satsee, which allows to take satellite images of remote sensing of the Earth from 6 Chinese satellites with a spatial resolution of 2 to 30 m. This is an important element of the space cluster created by the central university. Therefore, using satellite images, digital elevation models, hydrometeorological information, a wide range of tasks related to monitoring and assessing the potential risks of floods, floods, fires and oil spills are being solved, - said Mr. Omirzhan.

Earlier, the center’s specialists developed space monitoring technologies for agricultural land, natural biosafety, and solid waste landfills.



RIDDER FIRE SCIENTISTS DO SPACE ANALYSIS

Fires, floods, and earthquakes are catastrophic events. A forest fire near the town of Ridder also shook the country. While the relevant authorities were determining the cause of the silent enemy, our scientists analyzed the consequences with the help of space technology.

Specialists of the Center for Remote Sensing (ERS) at Al-Farabi Kazakh National University assessed the situation after the accident.

- We analyzed the forest fire near the town of Ridder on May 10-11, based on data from remote sensing of the Earth. This satellite image is provided by our partner, the Institute of Aerospace Research of the Chinese Academy of Sciences. Remote sensing data were obtained in three stages: on May 9, 2021 - before the fire, on May 15-16 after the fire. Due to the fact that the monitoring area was cloudy from May 10 to 14, the data was not available, - said Deputy Director General of the Cluster of Engineering and High Technologies Omirzhan Taukebayev.

Figure 1 shows the pictures of May 9 and 15 before and after the fire. Specialists of the center explained that the yellow part of the picture is the burned area. Its total area is 242 hectares. Picture 2 was taken on May 16. It is synthesized with a conventional color. The red area in this picture is the vegetation area, and the burnt area is black.

So what other opportunities does space technology have in the event of an emergency? In search of an answer to this question, we asked Bakhyt Sakhariev, director of the Center for Remote Sensing at our university. According to him, the data obtained from satellites are very convenient for the analysis of large areas.



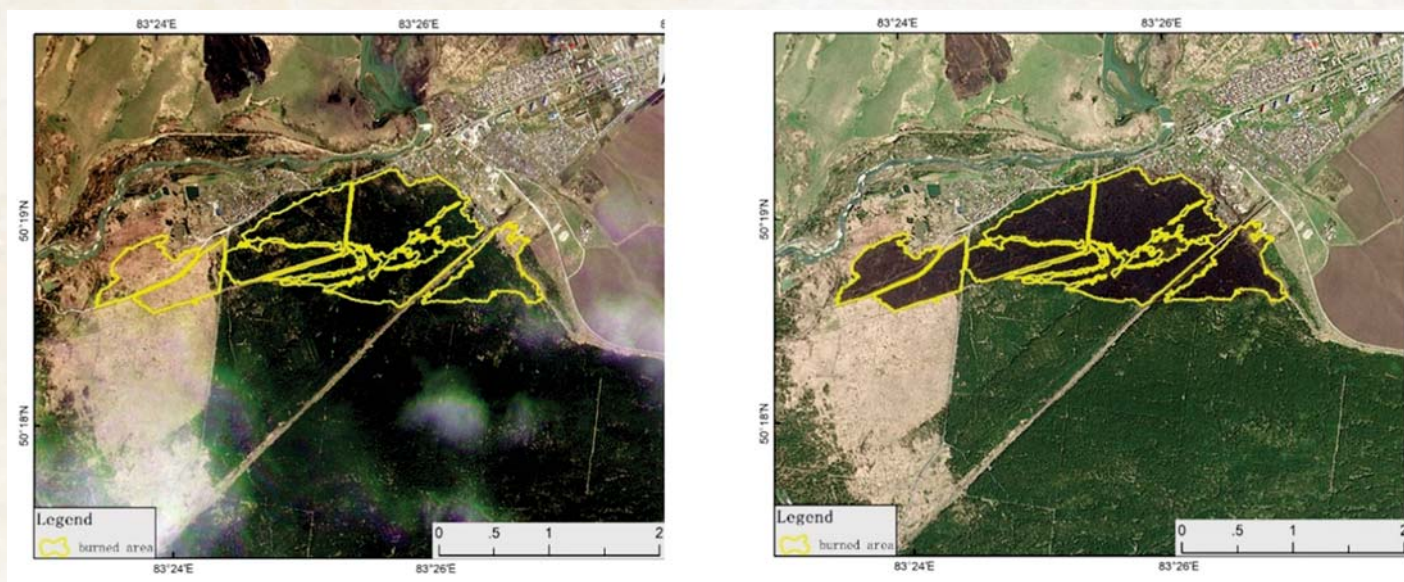


Figure 1. Pre-fire and post-fire forest resources

- Data from remote sensing satellites are useful for analyzing the consequences of emergencies, technical disasters and climate cataclysms. In addition, it is faster than ground or air surveillance methods. ERS is an indispensable method, especially for the analysis of areas with an area of more than 10-100 square kilometers. It is cheap and safe, - says the head of the center.

Currently, remote sensing technology shows that it is possible to monitor even high-risk areas. The analysis takes into account the distance from the forest to the rugged terrain, roads and settlements. Another important factor influencing the speed and direction of fire is the composition of wind and forest vegetation. This is because

dry, diseased trees can burn quickly and pose a threat to engineering structures even in windless weather.

ERS data is also used to map fire-prone areas and compare with the frequency of forest fires in previous years. In this way, it is possible to find areas with high and low risk of fire and develop a rational strategy for disaster management.

Extensive analysis is performed based on ERS data of high and medium spatial accuracy. For example, a detailed analysis of the spread of fire; determination of the area of the burned area and assessment of the economic damage; planning of preventive measures to eliminate fires; identification of deep combustion centers of peat.

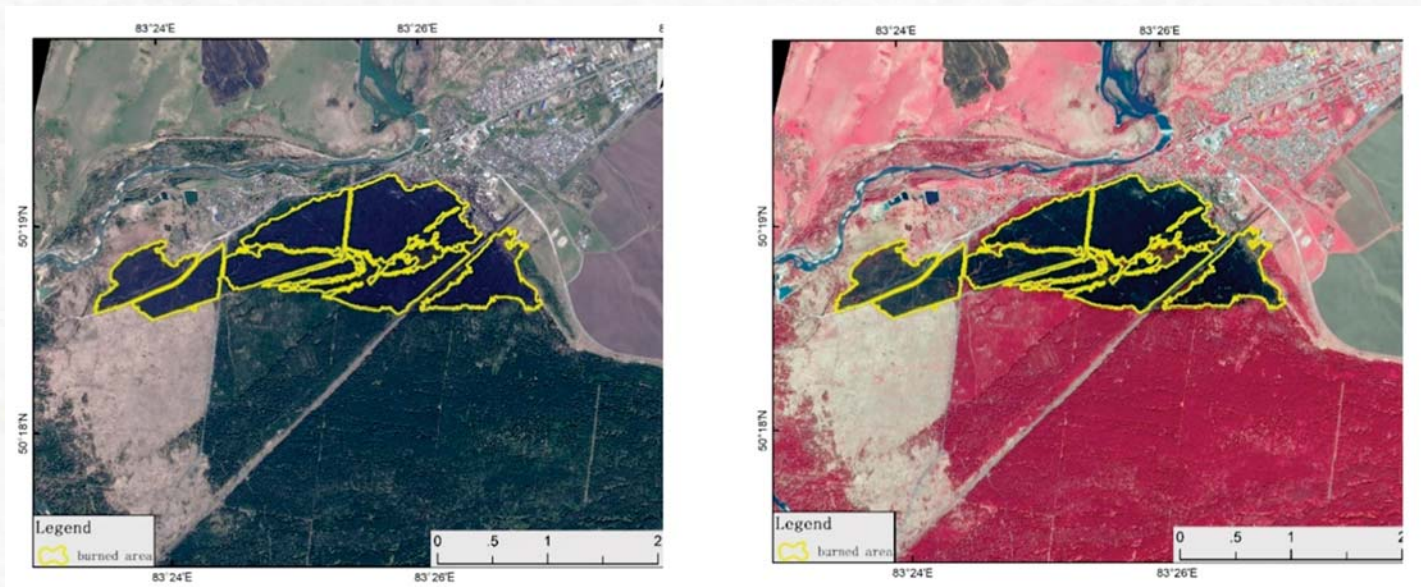


Figure 2. An image synthesized with a conventional color

SARDOBA PUT IN THE YELLOW

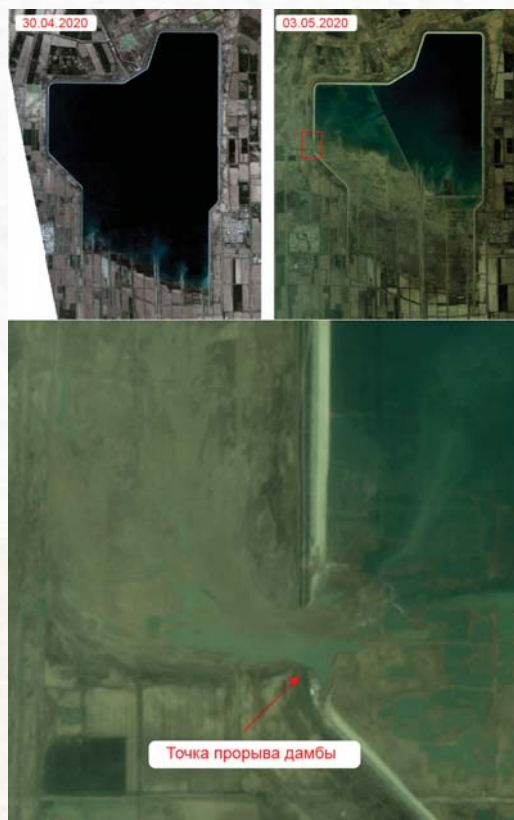
In addition to forest and steppe fires, one of the most frequent emergencies is flooding. A year ago, an accident at the Sardoba Reservoir in Uzbekistan caused a stir on both sides. At that time, scientists of our university on the basis of space imagery quickly and accurately identified the affected areas in Maktaaral district of Turkestan region.

According to experts, the total area of flooded areas in the two countries was 60 thousand hectares. Including 15.2 thousand hectares of land belonging to Kazakhstan. During the filming, experts found that 24 settlements of

the two countries were located in the disaster zone. Seven of them are located in our country. Depending on the terrain, the water flowed slowly. The relief analysis showed that the region in Kazakhstan is located on a slope. That is why a large amount of water immediately reached our settlements and fields. After the dam burst, most of the water was concentrated in the lowlands on the border between Kazakhstan and Uzbekistan, creating a large flood zone at a sufficient depth. As shown in the satellite images taken on May 3-4, 2020, the boundaries of the flooded areas have expanded. This can be explained not only by the slope of the terrain, but also by the lack of natural barriers to flooding and large drainage channels.



Specialists of the center also assessed the post-disaster condition of the Sardoba reservoir. As a result, after the dam burst, the surface area of the reservoir decreased by 24.1 square kilometers. In short, an emergency can occur in any area of our lives. One way to respond quickly to such threats is to learn new ways of processing data.



TOURISMKAZ – TECHNOLOGICAL TREND



Our university implements new projects using the potential of innovation in any field. Among them is the mobile application TOURISMKAZ. This platform, which is beneficial for both tourists and tourist service providers, is the first digital trading platform in the country. In order to find out the details of the application, we talked to the project manager Aliya Aktymbayeva.

He is the head of the Department of Recreational Geography and Tourism in November. According to the expert, this is a convenient platform for travelers. Because here you can look in your pocket and buy a tour that suits your taste. You can also book directly at the hotel and choose a driver. It also allows you to see the tourist object on the online map, get acquainted in advance, view panoramic

3D images and scan the QR code to get interesting information about this object.

The structure of all information in the mobile application is integrated into one system. Thanks to this, it is not difficult to find a tour you like, add it to your profile and buy it right away. At the intuitive level, the design and structure of the platform is very clear.

PROBABLY A COMPANION ON THE TRIP

Travel agencies, hotels, national parks, resorts and sanatoriums can sell their products through this digital platform. Therefore, the mobile application TOURISMKAZ is another channel for marketing services in the market. You can also choose a guide or guide, change the language, scan a QR code, buy tickets, take a virtual tour. With this in mind, we can say with confidence that the mobile application meets international standards.

- We plan that this mobile application will be a single system that will increase the popularity of domestic tourism among foreign and domestic travelers. In addition, with the help of this platform, travel business entities can automate some business processes and monitor the market through a system of ratings and ratings, - said Aliya Sagyndykovna.

The project manager also shared his thoughts on the impact of the mobile application on the development of the domestic tourism market.

- Tourism business is a mobile business, - he said. - Entrepreneurs in this field should be in constant contact with the client. Must be able to remotely coordinate any situation and respond to questions and comments as quickly as possible. In the event of an offer, you must be ready to offer cold tours. Please note that this list can be continued.

Innovative technologies have significantly changed the structure of the tourism market.

Any service for travelers is now very active in the use of mobile applications. This directly contributes to the development of tourism. As a result, a ready-made information environment has been created for citizens who want to learn about the world. It is clear that over time the demand for mobile “assistants” will increase, without which it is impossible to imagine the rapid development of the tourism business. Unfortunately, despite the development of information systems, these technologies do not play a significant role in the modern tourism business in the country. And abroad it is an integral part of major tourism and socio-cultural projects. Information systems play a special role in the development of projects for long-term planning of tourism development in the region.

- The mobile application TOURISMKAZ, which we are developing, can make a big difference in the way travel search and booking in the future. Offering a modern system and a package of useful features for travelers, our additional time and money will help you to find attractions. So, it is safe to say that he will be an indispensable assistant during the visit, - said A. Aktymbayeva.

It turns out that travel managers can increase the range of services provided to the client through this project. This application will be developed for the first time in the domestic tourism market. It unites domestic tourist subagents and farms providing agro-tourism services and promotes the development and expansion of tourist services.



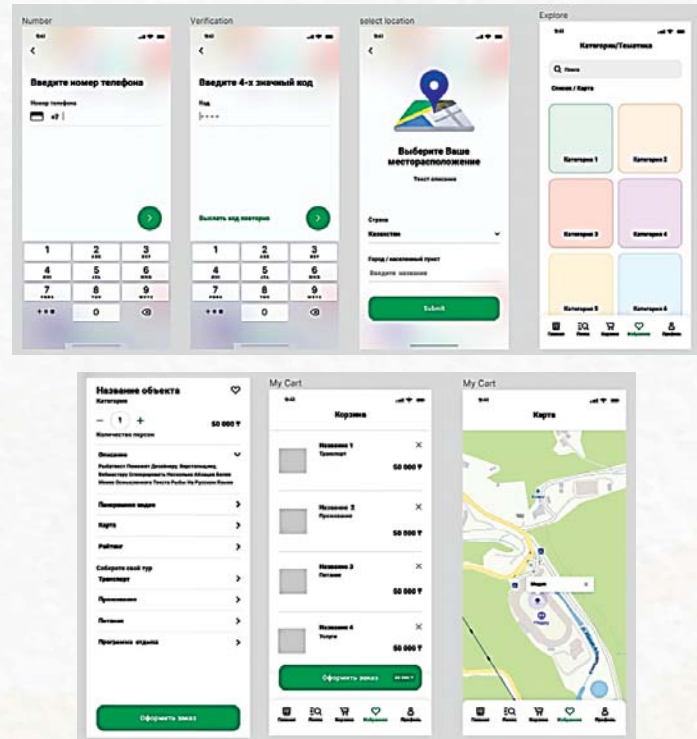
THERE IS PROSPERITY IN UNITY

“Where did the idea of uniting all tourist services come from?” The head of the department answered our question:

- In the tourism market of Kazakhstan there is no mobile application where you can get all the information a traveler needs in one place. Today, all tour operators offer the same tour packages, ie the most popular attractions. At the same time, it is necessary to expand the range of proposals and increase access to information through creative innovative solutions. This will increase the number of return visitors to the country.

According to the expert, there are problems with the creation of a favorable information environment for tourists in the country. For example, the integration of modern domestic tourism technologies and the low level of digitization. Second, the country is less aware of real tourist facilities. Third, the available tourist segments do not work as a whole tourism product. Each provides its own services. Fourth, there is a lack of Internet infrastructure, as well as low Internet access in remote areas. Fifth, market participants lack the professional skills to use the digital platform.

The above is very important for our country. It's time to use a professional mobile applica-



tion, especially combining the main functions of marketing and booking. In the future, it is necessary to consider ways to bring it to the international market.

- Thus, we decided to develop a mobile application TOURISMKAZ to provide visitors to the region with all the necessary information. In it you will find all the information about the location of tourist facilities, description of services and list of services for visitors. It will be prepared separately in two additional directions: for providers of tourist services and for customers, - said Aliya Sagyndykovna.



MONETIZATION OF THE MOBILE APPLICATION

- We act as an intermediary (agent) between tourists who want to book or buy tourist services and providers of these services. This business approach is also known as the “agency model”. Unlike other travel booking / purchase applications, we do not participate in agreements between travel service providers and travelers. This allows suppliers to independently manage tariffs and availability of places or services, as well as to provide transparent information about their rules and general offers. It is also planned that in the future some tourist routes and information will be provided for a fee, - said the project manager.

THE DIGITAL WORLD WITHOUT BORDERS

According to him, the same applications as such a complex mobile application have not been encountered yet. However, the expert said that “when analyzing the impact of mobile applications, it should be borne in mind that digital platforms have no boundaries.”

There are many vivid examples of how mobile applications affect the development of tourism not only in a particular country, but also in the region. There is no doubt that global platforms such as Booking.com, Airbnb, TripAdvisor, 2Gis, Google maps, Aviasales, Anywayanyday, Skyscanner have a direct impact on the development of tourism. After all,



the simplification of ticket purchases, the creation of different routes, the formation of the image, the rapid acquisition of the necessary information will help to adapt to the market and stay ahead. And the more tourists become mobile and travel, the more the entrepreneur's income increases.

- Countries such as France, the United States, Spain, Italy, China, Turkey, which are leaders in terms of the number of tourists and their income, are actively using various mobile applications. Therefore, it is necessary to develop tourism in Kazakhstan based on world experience and the use of various digital technologies, - said A. Aktymbayeva.

Last year, the head of state said that priority should be given to the IT and tourism sectors, which are new directions. "These industries will create about 300 thousand new jobs," K. Tokayev said. Indeed, these sectors have a lot to offer to the economy and a lot of inno-

vative potential. We often hear that the pandemic was just the beginning. However, it should be noted that Covid-19 slowed down the pace of international tourism, but also contributed to the development of domestic tourism.

For example, the number of tourists visiting Mangistau region alone reached 177 thousand. This is the figure for the last year. And the number of flights exceeded the pre-Kovid period. Of course, after the removal of quarantine restrictions. The public has increased the number of walks in nature and mountaineering. Ecotourism has gained momentum in the country. According to Say's economic theory, where there is a growing demand, any quality product will find a consumer. Therefore, it is necessary to provide maximum support to domestic products that are currently working to meet the needs of the tourism market.



PROVIDED BY SMART-SOLUTIONS

In the last century, we have experienced an industrial and technological revolution. The next stage is called the “information revolution”. Because the XXI century is a time of striving for heights through BIG Data. Collecting, processing and analyzing data is today’s demand. In short, they are called geographic information systems (GIS). Today we are talking about a program that will help you create a project that meets such demand.

In general, what are geographic information systems? It is a structure for data collection, management and analysis. It has four columns: maps, data, analysis and programs. Based on geography, this system combines many types of data. It analyzes spatial layout using maps and 3D views and organizes layers of information in visuals. Thanks to this unique

feature, GIS allows users to analyze data in depth, which helps them make smart decisions. Thousands of organizations in all industries use this technology to create maps that analyze data, exchange information and solve complex problems. In this way, the way the world works has changed radically.

Earlier it was reported that KazNU scientists



have developed several projects that will serve society with the help of space technology. Gaukhar Batay, a specialist at the Center for Remote Sensing of the Al-Farabi Kazakh National University, said that one of the main tools in the work is the SuperMap program. SuperMap develops and offers the latest innovative platforms and solutions for geographic information systems for global customers. The company's product line includes a full range of desktop, service, component and mobile GIS software. Therefore, it is one of the most advanced software platforms for geographic information systems. The SuperMap technology system is called BitDC. That is, B-BigData, I - artificial intelligence, T - 3D measurement, D - distributed technology and C - cross-platform. These five are the main directions of the company's development of GIS technologies.

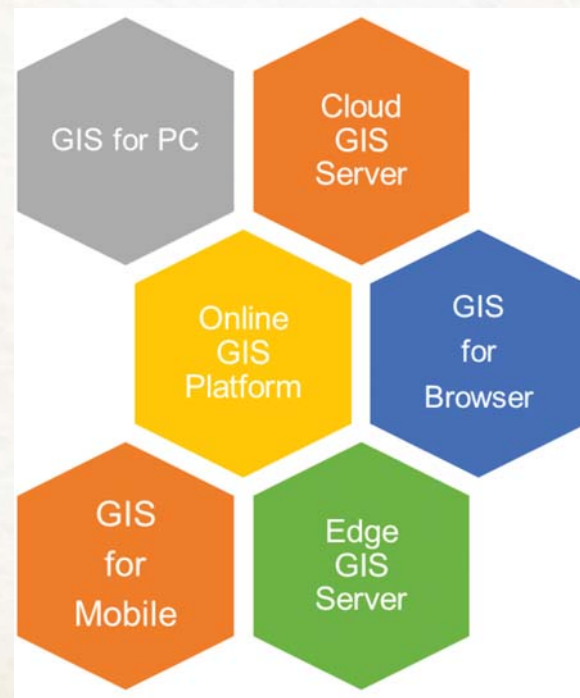
SuperMap is a complete GIS platform software package that includes desktop, service, component and mobile geographic information system platforms, as well as spatial data generation, processing and management tools.

THE MAIN PRODUCTS OF SUPERMAP

SuperMap iDesktop is a simple, stable and efficient GIS software. It is available in three basic, standard, professional and advanced versions. It includes data processing, mapping,

2D and 3D integration analysis, graphics, drawing, and more. has a complete set of geographic information system functions. SuperMap iDesktop simplifies a lot of work for professionals who process and analyze spatial data in various fields and require individual GIS applications at work.

According to the center's expert, one of the features of the SuperMap desktop geographic information system is that it can be updated online. The user can easily study the dynamic segmentation and hydrological analysis, taking into account the mechanism of the work process. In addition, due to the different formats and mechanisms of data, it fully meets the requirements of the user.



(The main products of SuperMap)



(Recognition of objects on the basis of artificial intelligence)

WHY CHOOSE SUPERMAP IDESKTOP?

In SuperMap iDesktop software, data can be displayed, processed, and analyzed in 2D or 3D format, and this does not require running 2D and 3D GIS in separate software. Such features significantly improve work efficiency. It also uses a multi-document interface (MDI) to display, process, and use data by opening it in multiple map windows at once. The latest tape interface is used to increase work efficiency and reduce visual fatigue.

SUPERMAP ISERVER

SuperMap iServer is a cloud GIS server based on a high-performance cross-platform GIS core. It has 2D, 3D integrated services publishing and management functions. It also provides multi-level expansion and development. You can quickly publish local and remote data as a SuperMap iServer service.

SuperMap iServer offers many GIS features such as maps, data analysis, 3D, Big Data and artificial intelligence, and a full range of interfaces, including interfaces, security and clustering.

SUPERMAP IPORTAL

It is a GIS portal platform for integrating, searching, allocating and managing GIS resources. SuperMap iPortal has advanced technologies and features such as zero code display control, registration of heterogeneous services from multiple sources and system control panels. SuperMap offers many web applications with an iPortal thematic display, three-dimensional visualization, distributed spatial analysis, a large screen display, and template applications.

AI GAZ

AI (Artificial Intelligence) geoinformation system is an integration of artificial intelligence and GIS. It specializes in managing, visualizing and analyzing GeoAI results. Optimizes user interface experience, operation and maintenance.

The AI GIS workflow tool supports the basics of model creation, model learning and application, image data classification, video data purpose definition and control, binary classification, landscape classification, relief classification, and more. analyzes image data, including functions.

LARGE GIS DATA

Gold Mine, which includes large-scale data storage and management, spatial analysis, streamlined data processing technology and

visualization. Large GIS data - Spark offers flexible processing capabilities for distributed media. Provides abundant and stunning spatial visualization of big data.

SUPERMAP SOLUTIONS

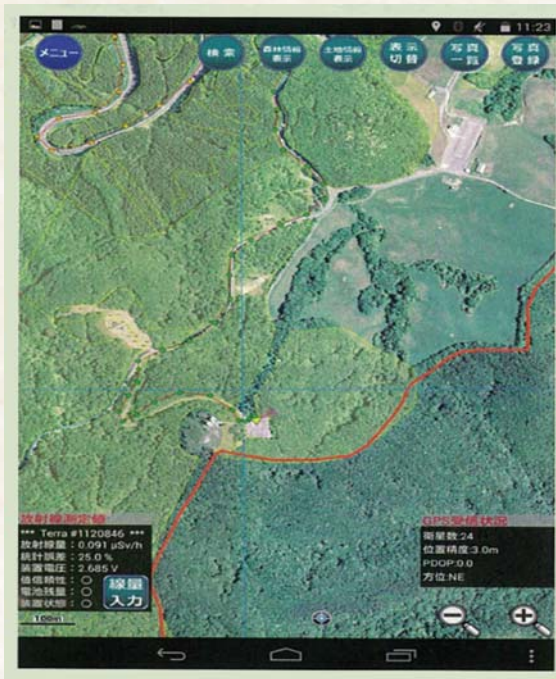
SuperMap offers smart solutions to the following issues: smart city, facility management, transportation, land management, natural resources, public safety, natural disasters and water conservation.

At present, the construction of smart cities has entered a new stage of pragmatic development with innovative technologies. With the help of the platform can exchange, share and coordinate city information resources. Provides comprehensive support for urban management and services. The most basic solution of a smart city is an effective combination of various basic, thematic and dynamic information of the city.

In terms of facility management, SuperMap is used to develop specific applications such as rail, road and transport facilities, electricity, communications, water supply and sewerage, heat and gas supply. It also manages production equipment, buildings and other data, facilities and property and works in conjunction with the ERP (automation of business processes of the company) system.

GIS has powerful information services and traffic management functions that can be applied to all aspects of traffic management. Compared to traditional methods, the use of





“High-precision portable deployment device for GIS forestry” SuperMap iMobile for Android devices”

GIS technology has unprecedented advantages in transportation planning, traffic management, traffic management and related issues.

SuperMap on land management is aimed at the application of innovations and new technologies in the land industry with more than 20 years of design experience. SuperMap provides land management, information management and use, land monitoring. For example, in Turkey, SuperMap helps to create a digital 3D cadastre to update the cadastral data size.

SuperMap explores the structural theory of natural resource informatization, integrates key issues of natural resources and offers new

methods and ideas for natural resource informatization with advanced technologies such as spatial data, 3D-GIS and artificial intelligence.

For example, in forestry management, the GIS Forestry High-Accuracy Portable Deployment Device is based on the SuperMap iMobile for Android devices with GPS functions. In addition, SuperMap manages disaster recovery data collection, local data collection and reporting, coordination of tasks with multiple terminals locally, mapping and inspection of the accident site, natural disaster assessment, comprehensive post-disaster information disclosure services, and disaster information supports sharing.



EFFICIENT LAMP BASED ON NANOTECHNOLOGY

With the development of civilization, the demand for all forms of energy is growing from year to year. Electricity tariffs are constantly increasing due to the increase in energy consumption and the reduction of surface reserves. Improving energy efficiency at the household level, energy saving depends on the consumer. However, scientists are also involved in solving this problem.

For example, scientists at Al-Farabi Kazakh National University have modernized the technology of energy-saving lamps and developed a new model of energy-saving lamps. Its main feature is the improvement of the technical characteristics of fluorescent lamps with the help of nanotechnology.

The energy-saving lamp is made in the National Open Nanotechnology Laboratory at KazNU. According to the project manager, Candidate of Physical and Mathematical Sciences, laureate of the State Prize of the Republic of Kazakhstan Merlan Dosbolayev, there are no significant changes in the technology

of lamp production. The main thing is the efficient use of energy resources.

- Our laboratory studies plasma physics and engineering. Plasma can be obtained in different conditions. The most suitable laboratory plasma is obtained by gas discharge. A gas discharge is the passage of an electric current through a gaseous medium. The resulting gas discharge plasma emits light. The result of our work is to increase the light intensity of the discharge and create a new type of energy-saving lamps, - says the project manager.

When studying the various physical properties of gas discharge plasma in the laboratory, scientists have noticed that the inclusion of





micro and nanoparticles in their composition increases several times. In other words, the luminosity of a gas discharge increases without changing the power consumption.

- At the same energy consumption in the laboratory, the light intensity of gas discharge plasma containing nanoparticles has doubled, - said M. Dosbolayev. - After more in-depth research, the idea arose to create a new version of gas-discharge lamps based on nanotechnology. Based on the results of this research in 2012-2013, we published scientific articles in the journals *Physics of Plasmas*, *CPP*. Then we took part in the competition of the "Science Foundation" to get a patent for this invention

in our country and why not implement it. Today we are working on the production of this project with a grant from the Science Foundation. There are questions in society: "LED lamps are effective, why should we go back?" Let me explain that expensive technology is needed for LED lamps to work effectively. Most of these lamps, which are now on store shelves, are made of cheap materials. And the real quality is expensive. Our lamps are much cheaper.

The project manager mentioned another advantage of this lamp. Lamps made by university specialists still use amalgam instead of pure mercury. "Amalgam is a small amount of



mercury in combination with other metals. In this way, it becomes part of the gas discharge, changes the spectrum of light and increases its intensity, “he said.

By the way, we know that this element has a negative effect on human health. Amalgama is a very effective solution from a safety point of view. According to the scientist, the old lamps would emit a certain amount of radiation if they broke. Sagi Orazbayev, a post-doctoral student at KazNU and a senior researcher at the institute, noted that “the former gas-discharge lamps contain pure mercury, while the nanoparticles we produce contain a mixture of mercury and metals.”

- We can not say that we have completely removed mercury. We replaced it with a mixture of mercury and metals - amalgam. In the future, we are considering ways to remove it completely, - says the young scientist.

According to him, the project was first presented in 2011 at a scientific seminar led by Academician Tlekkaby Ramazanov.

- The fourth state of matter is plasma. We have noticed that the inclusion of nanoparticles increases the intensity of light several times. We have published articles about this in highly rated foreign magazines. Representatives of the foreign scientific community welcomed him. Hence the idea of how to use this phenomenon. The field I am studying is called advanced science. Inside the plasma is a compartment called the dusty plasma. It is a buffer (pure) plasma containing monodisperse particles of micro, nano size. In pure plasma, micro- and nano-particles are introduced from

the outside or, in certain cases, grow from the inside. If we burn plasma with inert gases, we can get pure plasma. If these inert gases contain only slightly reactive gases: methane, silane, acetylene, etc. If we add, it grows out of nanoparticles. At the same time, the light intensity of the plasma increases several times, - said S. Orazbayev.

The applicant had a research internship at the Polytechnic University of Orleans, France.

- There was an opportunity to study in detail the effect of increasing the intensity of light and to determine how the intensity of light changes with the size of nanoparticles. Then we received a patent in 2013-2014, when KazNU had a good program called a student business incubator, under which we tried to apply this effect to a gas discharge lamp. As a result, we have developed a new high-intensity nanoparticle gas discharge lamp. This project won first place at the university, and in the same year won the nomination for the best social project in the Business Forum Almaty project, - he recalled.

There are many types of energy-saving light bulbs on the market today. But the scientist says that it is necessary to compare any world in terms of quality.

- Fluorescent lamps (a type of gas discharge lamp), LED lamps are at the forefront of the market as energy-saving lamps. There is another type of induction lamp that has not yet arrived in our country. It is also made on the basis of a gas discharge lamp. It is widely used in America, some European countries and



Canada. Because the efficiency is very high, - says the expert.

But now, following the principle of an open economy, in the market you can find both high-quality and low-quality goods. One of them is LED lamps. It is true that today ordinary consumers pay more attention to prices and prefer low-quality, cheap goods. But according to Mr. Sagi, low-quality LED lamps produce harmful linear spectra.

- Because its light intensity is given linearly. Damages certain capillaries of the eye that respond to wavelengths. Therefore, the eyes, which cannot distinguish colors and are blind in the dark, suffer from diseases. This has been scientifically proven by the world community.

Korea and Japan were the first countries to use these LED lamps. It is known that the root cause of eye diseases is mainly from this lighting system. The human eye is accustomed to natural light. And the closest to the sunlight are the same filament lamps. But it consumes a lot of energy. The next approach to natural light is fluorescent and induction lamps. Initially, this lamp also had many disadvantages. But over time, research has shown that it is possible to find solutions. At present, LED lamps close to natural light are made using special lenses using modern technology. For example, various focusing lenses, or more expensive technologies, are used to bring linear spectral light closer to natural sunlight. Therefore, such lamps are not cheap. In this regard,

high-quality LED lamps are also expensive, - he said.

When it comes to prices, we can not ignore the cost of production, production processes. Mr. Sagi said that we have not yet started to produce the raw materials needed to make lamps - glass, electrodes. "Although we have intellectual property, most of the raw materials needed for production have to come from countries like Russia and China," he said.

So far, the first three years of the project have been successfully completed. According to Mukhit Muratov, director of the National Open Nanotechnology Laboratory, the goal is to sell the product in the future.

- We are also considering the possibility of participating in public procurement tenders.

In the future, we plan to sell 100 thousand candles a year. Currently, there is a demand from educational institutions and government agencies, such as universities, schools, colleges. This is because most of these organizations have gas-discharge fluorescent lamps. Replacing another lamp is expensive. And our economical gas discharge lamp is much more profitable for consumers. At present, we have installed our own lamps in the building of the Faculty of Physics and Technology of our university, - said the head of the laboratory.

In the future, it is planned to use energy-saving lamps invented by KazNU scientists for all the needs of the university. Thus, we hope that the project will reach a level of self-sufficiency in three years.

Markizat MYRZABEKOVA, young scientist:

CHEAP PRICE, LIGHT - LIGHT MOBILE PHONE BATTERIES ARE EFFECTIVE FOR CONSUMERS

During the 30 years of independence, the First President of Kazakhstan, President Nursultan Nazarbayev, paid special attention to the comprehensive education of young people and their formation as modern professionals. During one of the regular meetings with young people, he said, "The first successful projects have started to appear in the leading universities of the country. This experience needs to be expanded," he said.





In his address to the nation “Kazakhstan in the new situation: the period of action”, President Kassym-Zhomart Tokayev spoke about the development of science. , emphasizes the importance of funding and supporting science.

Al-Farabi Kazakh National University currently employs about 300 young scientists under the age of 40. KazNU has started to fully present the scientific discoveries and developments of young researchers

studying and working. Our first heroine is Markizat Myrzabekova, PhD student at the Faculty of Physics and Technology, specialty “Materials Science and Technology of New Materials”.

- As a child I wanted to be a doctor. However, I loved math at school. If you know mathematics, you are interested in physics, as well as chemistry. I often heard among students that “physics is difficult, girls can not master it.” This word, on the contrary, motivated me



to choose the field of physics. However, when I entered the Al-Farabi Kazakh National University, I did not immediately notice that the doors to science were wide open. Only in 2012, when I was a sophomore, did I get a job at the Open National Laboratory of Nanotechnology (OPTL) and became interested in discovering new materials, nanotechnologies and exploring new properties. Soon after participating in the Farabi World Student Conference, my project “On the creation of humidity sensors” was recognized as the best innovative project among students. This device is designed to measure humidity and ensure the safety of equipment for proper storage of food and grain in the room.

In 2014, I graduated from the Faculty of Physics and Technology of KazNU and received a bachelor’s degree in engineering and technology. And in 2016 I received a master’s degree in this field. During my master’s degree, thanks to various programs of KazNU, I visited laboratories in Warsaw, Prague and Milan. The field of nanotechnology is well developed in Europe, America and Japan. So I wanted to go to these countries and see how this industry is being developed abroad. My dream was fulfilled by the Open National Laboratory of Nanotechnology.

As a young specialist, my workplace often sent me to conferences and exchanges. Igor Shvets, a foreign professor who once met at an international conference, asked, “Why

don’t you come to study with us?” He asked. “I don’t have the money now. I can’t go to Ireland. I come from a simple family,” I said openly. He introduced the Erasmus + program. If you get acquainted with the rules of admission, you can test yourself as a student or as a student. As I was not a student, I took a risk as an intern. As a result, I learned to work with many types of microscopes, such as scanning electron microscopes, X-ray photoelectron spectroscopy, tunneling microscopes, and transmission electron microscopes.

PATENTED INVENTION

- A few years ago, a Samsung mobile phone exploded. It was caused by a rechargeable battery. At that time, “why not make it an environmentally friendly battery?!” I thought. This question bothered me even when I was abroad. Thinking about it, I began to study this topic. I studied the work of foreign scientists in this field and weighed what we can do. Abroad, scientists are funded by Intel and Facebook. These companies tell researchers their problems, and scientists work to solve them. The second way is to come up with a ready-made patented idea, win money for its discovery and put it into production. I chose this second way. I patented my project (author’s certificate №107731), now I want to work on its further implementation.

The theme of my project: “Creation of su-



percapacitors that increase reliability based on domestic nanocomposites of graphene and manganese dioxide.” When graphene (a type of carbon) is added to manganese dioxide, a bond is formed and a current is formed. Using this current, I realized that it is possible to make a supercapacitor, ie a device that stores electricity.

Most lithium batteries in our phones. There is a risk of explosion and it also affects the weight of the mobile phone. In addition, the price of the phone is not cheap, and if you damage it, it will cost a lot to rebuild it. If we use a lightweight battery instead, it will lose weight and will not cause much environmental damage. I compared it with batteries made abroad. They use ruthenium oxide. Due to the small reserves of ruthenium in the world, it is very expensive for producers. And the country has enough reserves of graphene and manganese in my project. Moreover, the synthesis process is simple. That is why it is much more effective to implement my project. In all the other batteries I've seen, the synthesis process is very complicated. There are no such synthesizers in the country, so I decided to choose two raw materials that are more efficient in terms of minerals.

The issue of energy conservation is very relevant today. Mobile phones, electric cars, laptops, unmanned aerial vehicles need light, large and energy-saving devices. Even now, cars like Mercedes and Lexus don't look as great as electric Tesla. This is due to the fact





that scientists prioritize technologies that minimize environmental damage. From this point of view, my cell phone batteries are cheap, lightweight and long lasting.

I WANT TO MAKE A POWER BANK

- To make this battery, which I invented, you first need to buy raw materials. Then there should be a clean place to work. As the raw material undergoes special chemical treatment, employees must wear special uniforms. I think I need to make a new cell phone before I can put my batteries into production. This is

because the battery is small. If we put it in the Power Bank battery, it can be replaced. To be included in a mobile phone, you must also receive an offer from the phone manufacturer. It will also take some time to sign the contract. So for now, I want to start producing Power Bank, a portable charger. We can also increase its sales by using marketing tools, and Power Bank is a domestic product made in Kazakhstan. I would say that every product we make is an action for the development of our country. If we come up with something new, it will create new jobs, allow people to get jobs, and increase the number of people who choose physics.

For me, nanotechnology is a new and infinite world. Because the nanoworld is not subject to the classical laws of physics. What we are studying is a small world, atoms and nuclei. If you are a nanotechnologist, you can learn the properties of materials and have a deep understanding of technology. As Kazakhstan is a developing country, we can not say that the field of nanotechnology is highly developed. However, nanotechnology laboratories exist in several cities. Looking at those laboratories, we can see that we are moving forward. In this regard, I would like to thank my teachers for inspiring and guiding me in the path of science.

JINALYS ROOM ADAPTED TO NEW CONDITIONS

The coronavirus has introduced different patterns into our lifestyle. In this regard, there is a need for video conferencing services for all sectors of the economy. According to statistics, in 2020, daily video conferencing traffic increased by 535%. Today, video conferencing is not just an additional innovation, but an important business tool.

In this regard, the IT specialists of KazNU have developed the Jinalys Room web application based on the open-source solutions of Al-Farabi.

Jinalys Room is a Kazakhstan video conferencing service with functions of online conference, conference, conversation and recording storage system. It supports various API services for online learning, messaging, and integration with corporate information systems. The main goal is to provide online training without installing additional software. It is also possible to install it on the server infrastructure of the university. This

ensures data security and localization of video traffic.

Experts from the Center for Analysis and Processing of Data of our university say that the project was created for public needs.

- At the beginning of the global pandemic, all companies began to work online. At the same time, we saw that organizational measures in business, pedagogical lessons need a platform for online conferences. Initially, the use of services such as Zoom was difficult due to the increased load on foreign Internet traffic. Therefore, a system located on a Kazakhstani server was needed. We concluded that





it should not only fulfill the role of video conferencing, but also include the functions of a training system such as Univer. Currently, Jinalys Room is integrated with the corporate system of the Kazakh National University named after al-Farabi and the Univer system, - said the system administrator of the center, Chingiz Rabat.

According to him, any university employee can register on the platform through his account. According to a survey conducted by Digital in the Round, 98% of respondents believe that working via remote video conferencing will lead to increased productivity.

- Our next plan is to create an ecosystem in the Jinalys Room together with other LMS (Learning Management System) systems such as Platonus, Moodles, Kundelik. It doesn't matter if you are a student or not. For example, we have an



Chingiz Rabat



idea to create the ability to go directly from Kundelik to Jinalis's room. And all the information is gathered in one place. In addition, the user can watch the video in the Jinalys Room by clicking on the link in the Univer system, he said.

This project has great potential. We can prove this with the following data. For example, last year the value of the global video conferencing market reached \$ 7.87 billion. In 2019, it amounted to \$ 3.85 billion. This figure is expected to reach \$ 6.03 billion this year. According to the video conferencing statistics for 2021, the average annual market growth rate for the period from 2020 to 2026 will be 11.45%. According to some forecasts, this market could exceed \$ 9 billion by 2026.

The center's experts say that the advantage of the Jinalys Room is localization. Because all servers are located in Kazakhstan.

- Zoom is a third party server and the connection is established through third party traffic. And in our case, there is no overload due to the presence of local servers. We plan that each city will have a separate server. This will help to quickly exchange information, reduce costs and establish regular contacts, Chingiz Zheksenbeyuly said.

According to him, IT specialists are still working on the project.

- For example, now programmers are working on adding a poll module. This allows any organizer or teacher to access the online office and conduct a survey like Google Forms. The

- **ADVANTAGES OF VIDEO CONFERENCING:**
- **VIDEO CONFERENCING INCREASES PRODUCTIVITY BY 50%.**
- **IN 2020, DAILY VIDEO CONFERENCING TRAFFIC WILL INCREASE BY 535%.**
- **IN 2021, THE VALUE OF THE GLOBAL VIDEO CONFERENCING MARKET IS ESTIMATED AT \$ 6.03 BILLION.**
- **POOR MEETING MANAGEMENT COSTS MORE THAN \$ 399 BILLION A YEAR.**
- **90% OF PEOPLE EXPRESS THEIR VIEWS EASILY ON VIDEOS.**
- **76% OF EMPLOYEES USE VIDEO CONFERENCING TO WORK REMOTELY.**
- **IN THE FIRST HALF OF 2020, 40 MILLION USERS WERE USING SKYPE DAILY.**

organizer will be able to conduct a survey during the online conference and see the results in a timely manner. Alternatively, you can conduct a Q&A session, run a mini-test, get feedback from employees, and vote among employees. In short, you can create a survey according to your needs. The user chooses his time, the correct answer, - says Mr. Chingiz.

Jinalys Room is integrated with Univer, so online rooms are created on a schedule. The teacher does not create separate rooms for each lesson. If you are registered with Univer, you will have scheduled classes immediately. You choose a lesson, walk in and participate as if you were choosing an audience. Analytical engineer Madiyar Tasbulatov also said that

a “closed room” could be created here. That is, you select people from the user list and enter only those people who are in the room.

- Jinalys Room is based on open source solutions. In pilot mode, we held meetings in the administration through the Jinalys Room. The meeting was simultaneously attended by 170 people. In addition, for several weeks, students studied online through the Jinalys Room. As a result, we conducted a survey among the participants and found out their opinions. Citizens who have used the platform have shared their thoughts and suggestions. All this will be taken into account in the future, - said Madiyar Daniyarovich.

Another advantage of Jinalys Room, he said, is that you don't need to download and install anything, and if you have a browser, you can connect through any device. Foreign publications also report communication difficulties during video conferencing. For example, the problem of wasting time on video. If the technical settings are complex and confusing to the user, 30% of the meeting time will be wasted. Therefore, the project prepared by KazNU specialists offers rational solutions for many business structures or government agencies.



Madiyar Daniyarovich

It should also be noted that this type of video conferencing saves time and money. Because about half of the users can cut business travel by using video calling options. This is reported by Digital in the Round in its analysis. Doodle meeting statistics for 2019 show that more than \$ 399 billion is lost annually due to poor meeting organization.

Currently, the Jinalys Room project is officially certified by the state. You can connect to the information system by visiting jinalys-room.kz.



DIGITAL RAILWAY MODEL

Geographic information systems are effective information technologies in many areas, including transportation. According to Bakhyt Sakhariev, director of the KazNU Center for Remote Sensing. Al-Farabi, transport infrastructure specialists, carriers and passengers need information about transport networks and facilities. And it's hard to say that modern maps fully meet modern requirements.

The model of the railway, presented in the form of a geographic information system (GIS), currently forms the basis of the production activities of any enterprise in this area. International experience in the field of railway operation shows that this is necessary for the current and future planning, design and operation of the railway. According to the head of the center, now there is a wide range of users who need information about transport. However, in the modern domestic railway industry there is no electronic vector map, as the specialists of KazNU believe.

“They only have a raster map (a scanned copy of the map - ed.),” Says Bakhyt Sembae-

vich. - And the electronic card created by us can be edited several times, published on the portal and made available to Internet users. Currently, electronic maps of roads and railways are needed not only by industry workers, but also by passengers, road repairmen, dispatchers. For example, private railway companies are controlled by the Transport Committee. In this regard, an electronic card is very useful. Because it allows you to see every inch of the railroad.

Over time, you can use satellite imagery to make new changes. The electronic map contains a database. It is easy to map stations, infrastructure and railroad crossings from the





semaphore to each railroad. These are the possibilities of modern space technology. Satellites from the United States, France and China can capture 1 meter or 33 centimeters per pixel.

- In this case, we see the sleepers of any rail. When creating an electronic map, we do not use only images taken from space. In some areas, we are creating an important electronic system, integrating everything with a drone or laser. For example, a worker marks a defect on any section of the railway with a tablet on an electronic map. Thus, the dispatcher informs his situational centers. Then the leaders decide how to proceed," says the director.

It goes without saying that these technologies can be used to optimize the amount of

funds. Because experts know the length of the railway by coordinates. The company does not incur excessive costs, as it has accurate information about how many stones the railway needs, the length of the rails, and how many power lines are needed.

Currently, dispatchers determine where the train is going by informing the drivers. And through the electronic system, you can see the location of the object on the map. The amount of information allowed for each user is different. For example, the tables in the database for specialists are not available to passengers. They are provided only with information about the direction of the road, stations along the road.

- We've done it before. For example, earlier,

when we shot down the Almaty-1 station from space, we got an image that could fit in 50 centimeters per pixel. So, here we can clearly see the rails. We will vectorize these frames, that is, draw lines in the picture. This requires very little space on your computer. And space images take up a lot of space. Because every point in the image is written to a file. And on a vector map, each line is written with a function in the program. For example, a satellite image can be 100-500 megabytes in size. And if you vectorize it, then there will be a maximum of 50 kilobytes. There are only three objects in vectorization: point, line, polygon. With their help, we can draw any picture on an electronic map, says Bakhyt Sakhariev.

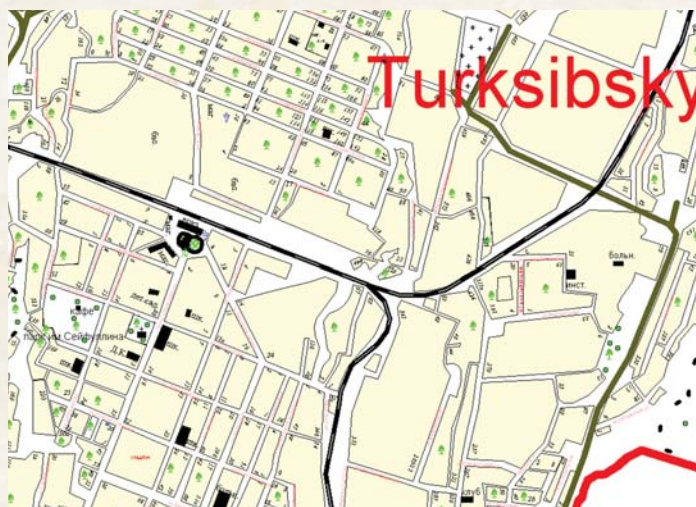
Specialists from the University's Remote Sensing Center have also mapped the route of the Makat - Inder - Uralsk railway. Based on this, company representatives will be able to accurately calculate the funds they need. It is also possible to calculate the relief of the railway track using satellite images. The center uses a drone to verify the accuracy of each piece of information. Thus, the customer receives clear information about how much soil needs to be dug, how much needs to be removed in order to level the grooves.

According to Mr. Bakhyt, sometimes the railway runs close to mountains and rivers. High risk of landslides and floods. Methods to avoid such an accident can be used through an electronic system.

- Also, with the help of the SuperMap pro-



gram, we can create an intelligent interface for the railway - a geoportal. This geoportal is used in the situational centers of the company. And we update the data based on satellite images. The smart interface is an automated workspace. In addition to the electronic map, we will create a program based on a mathematical model and include some functions. For example, it can automatically calculate the distance between two stations. On both sides of the railway, there should be an open area where no trees grow and no houses are built. All this can be found on the geoportal. We can also register private railways in the database. We add information about the owner of the company, the certificate, the security measures



used. This will significantly reduce the workload on staff, - said the head of the center.

As you know, some railways have level crossings. Some of them have no barriers. Bakhyt Sembayevich said that video surveillance could be installed at such crossings, which would strengthen security measures along the railway.

- It can be seen directly from the situational centers. You can determine in time whether the barrier is working properly or there are no stops along the railway. For example, a couple of years ago, during a traffic jam near

Almaty, a bus collided with a train, resulting in a major traffic accident. If the geoportal had information through video surveillance, the dispatchers would warn the driver in time. Such infrastructure is needed to prevent emergencies, - said B. Sakhariev.

Yes, according to statistics, land transport crashes nine times more often than air transport. Therefore, to reduce the risk, it is necessary to use innovative technologies. Scientists are also proposing a solution. Our goal is to use the opportunities of new projects.

«COMPETITION» IN BALKASH:

ECONOMY V / S ECOLOGY

In 1962, US President John F. Kennedy said, “Forget about oil, think about water.” Indeed, the Aral Sea crisis began in the 1960s. We have left half a century behind, but the issue has not lost its relevance. Once again, we have a “headache” in Balkhash. Because the fate of the Aral Sea may be repeated in Balkhash. This is a warning from international experts, not ours.

Scientists warn that the “Aral Sea syndrome” can be observed in other parts of the world. After all, the main cause of drying of the Aral Sea is man-made, environmental disasters associated with the accumulation of irrigation water. The main rivers in Central Asia are transboundary, which is probably why there is competition between irrigated agriculture and natural ecosystems. For these reasons, as the economic importance of Lake Balkhash increases, so do the environmental problems. Even the United Nations has said the lake is in danger of collapsing. The main reason for our concern is the decrease in river flow. If used inefficiently, the water level will drop.

The current situation is exacerbated by the industrial waste of the mining and metallurgical plant.

These issues were studied by the Al-Farabi Earth Remote Sensing Center. Because it is possible to conduct surface and space monitoring of water resources using remote sensing, and to identify emergencies and their consequences, to assess their consequences. It is implemented by the technology of the combined geographic information system.

Toxicological manifestations of Lake Balkhash can be seen in heavy metals flowing along the rivers through precipitation, as well as industrial waste. Trace elements - indicators



of water quality and pollution. Due to their biomigration activity, they significantly affect the processes of photosynthesis and respiration. It plays an important physiological role in the life of aquatic organisms and acts as a catalyst for redox processes and growth stimulants. Their quantitative and qualitative composition is the result of a combination of natural and anthropogenic factors.

The role of the city of Balkhash in the formation of trace elements in the biota of the lake. Among the pollutants, heavy metals pose a significant threat to aquatic biota. Because, unlike organic pollutants, metals do not decompose or disappear. Only the components of the ecosystem can be redistributed between sediments and biota (shrubs - ed.).

- Heavy metals - a group of non-ferrous metals with a density greater than the density of iron (7.874 g / cm³). These include: zinc, lead, tin, manganese, bismuth, copper, mercury, nickel, cadmium. Many of their compounds, especially salts, are harmful to the body. They do not break down when they enter the body through food, water or air. Kidneys, liver, joints, etc. accumulates in the human body and poses a threat to health. Therefore, the amount of heavy metals in the environment should not exceed the established values, - says Gaukhar Batai, a specialist at the Earth Remote Sensing Center.

Representatives of the center studied the pollution of Lake Balkhash with heavy metals. The work is based on the information bulletin of the Department of Environmental Monitor-

• LAKE BALKHASH IS LOCATED IN THE ARID ZONE OF CENTRAL ASIA IN SOUTHEASTERN KAZAKHSTAN AND IS SURROUNDED ON ALL SIDES BY SAND AND SMALL HILLS. THE LAKE BELONGS TO THE CATEGORY OF INLAND WATER BODIES AND IS ONE OF THE LARGEST LAKES IN KAZAKHSTAN. THE AREA IS VARIABLE: 17 - 22 THOUSAND KM², THE LENGTH IS MORE THAN 600 KM, THE WIDTH IS 9 - 19 KM IN THE EASTERN PART, 74 KM IN THE WESTERN PART. THE NATURAL DAM IS DIVIDED BY THE UZYNARAL PENINSULA INTO WESTERN AND EASTERN BALKHASH.

• THE AREA OF ARABLE LAND ALONG THE ILI RIVER IN CHINA INCREASED FROM 35 THOUSAND HECTARES IN 2018 TO 64 THOUSAND HECTARES IN 2020. FROM 1995 TO 2015, THE AREA OF IRRIGATED ARABLE LAND INCREASED BY 30%.

• MIXTURES OF HEAVY METALS, ESPECIALLY SALTS, SUCH AS ZINC, LEAD, TIN, MANGANESE, BISMUTH, COPPER, MERCURY, NICKEL, CADMIUM, ARE HARMFUL TO THE BODY. THEY DO NOT BREAK DOWN WHEN THEY ENTER THE BODY. KIDNEYS, LIVER, JOINTS, ETC. ACCUMULATES IN THE BODY AND POSES A THREAT TO HEALTH.

ing on the state of the environment in the country.

- Samples were taken from the villages of Zhideli, Bakanas, Bakanas, D. Kunayev, Tamgalytas, Karatal and Ushtobe along the Ili and Karatal rivers, which flow into Lake Balkhash. Based on these data, a map of heavy metal pollution of surface waters of the Balkhash basin was developed (Figures 1a, 1b). We used data from 2017 and 2020 to obtain a comparable result. As a result, the amount of heavy metals has increased significantly over the past year. For example, in the Tamgalytas gorge on the

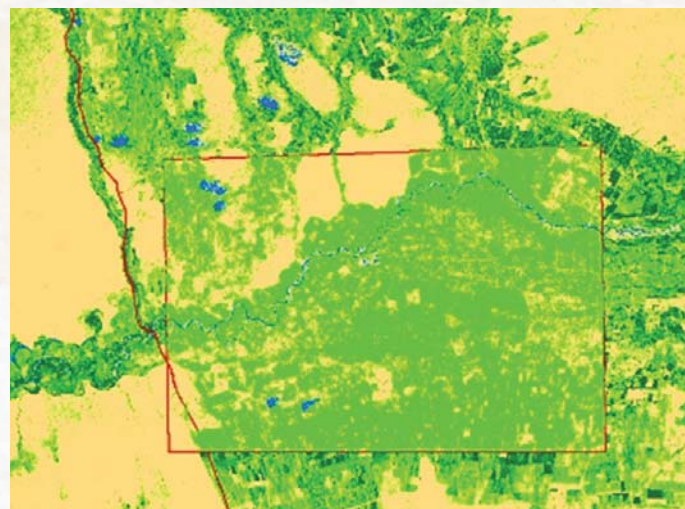


Ili River, arsenic exceeded the limit of 1.2 permissible discharges (MAC). Near the village of Zhideli, arsenic is 3.1 times higher than the norm, and in the area of the bridge named after D. Kunayev on the Ili River, arsenic is 3.6 times higher than the norm. In Ushtobe on the Karatal River, arsenic exceeded the norm by 1.3 MW, lead by 1.4 MW, - said Ms. Gaukhar.

Water pollution in Lake Balkhash is another problem. If left unchecked, we may not be able to find polluted water for years to come. According to the center's expert, the dynamic changes in the water level and area of Lake Balkhash are directly related to the Ili River.

Therefore, the river was analyzed on the basis of space images.

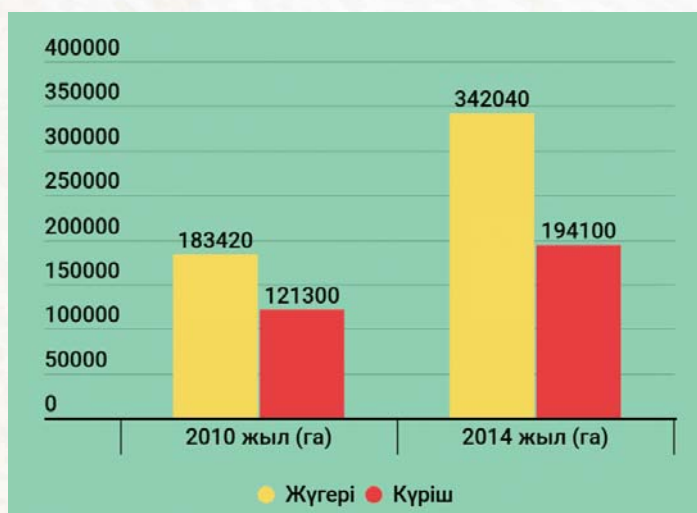
- Five rivers flow into the lake. The largest of them is the Ili River. It provides 80% of the total flow of fresh water. Atyrau ends with Western Balkhash. The Karatal, Aksu, Lepsy and Ayagoz rivers flow into the eastern part of the lake. Their total flow in the lake is 20%. The Ili Delta, with a total area of 8,000 km², is the largest natural delta and wetland complex in Central Asia. This river is important for the preservation of natural coastal ecosystems, such as the Ili delta and Lake Balkhash, - said Gaukhar Batay.



Ili is a transboundary river flowing through China and the Republic of Kazakhstan. Its upper reaches are located in China. There are three sources - Tekes, Kunes and Kash rivers. Among them, the Tekes Khan River originates in the north, and the Kunes and Kash rivers originate in the Tien Shan Mountains in China. These three rivers are formed by the melting of glaciers in the mountains.

As the main flow of Lake Balkhash covers China and Kazakhstan, the lower the water level, the more common it is for China and Kazakhstan.

- The object of study was the Chinese regions of Hocheng, Chapal-Sibosk Autonomous District, Kulja, Ili-Kazakh Autonomous District bordering on Kazakhstan. The total area of land along the Ili River in

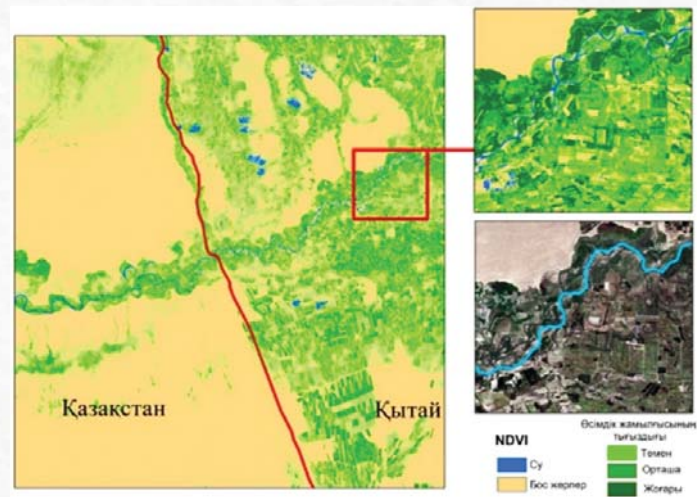


China is about 132 thousand hectares. As a result, the area under crops in this area increased from 35 thousand hectares in 2018 to 64 thousand hectares in 2020, - said Gaukhar Batay.

“From 1995 to 2015, the volume of irrigated arable land in China increased by 30%,” the researchers said. On the Kazakh side, it has not increased significantly.

- The Ili River in China is very suitable for agriculture in Xinjiang. The area under corn, cotton and rice has increased significantly from 2004 to 2010. For example, in 2010 corn increased from 183 thousand hectares to 342 thousand hectares in 2014, rice in 2010 from 121 thousand hectares to 194 thousand hectares in 2014, - said the specialist of the Center for Remote Sensing.

In Kazakhstan, most of Kazakhstan’s irrigated lands are located in the Ili River basin. According to statistics, including 447 thousand hectares of irrigated arable land, 41 thousand hectares of pastures and 11 thousand hectares of hayfields. The main crop is wheat.



Other important crops are corn, sugar beet, tobacco, fruits, vegetables and rice.

Gaukhar Batay briefed on the work. According to him, the NDVI index was calculated to assess the arable land along the Ili River. NDVI (normalized vegetation index) is standardized and reflects the relative biomass of the plant and its condition. It is also used to monitor drought, water surface monitoring, agricultural production, forecasting and desert mapping.

KAZAKH SCIENTIST PREPARES ANTI-VIRUS TINS

Phytotherapy is one of the oldest methods of treatment. According to the World Health Organization, alternative treatments have recently become popular. Among them is the field of herbal medicine, which is the basis of our topic today. According to Zhanar Zhenis, director of the Center for the Study of Medicinal Plants at Al-Farabi Kazakh National University, there are herbs with antiviral properties in the country.

- Our research area is medicinal and edible plants growing in Kazakhstan. There are fruits in it, - says Zhanar. - We are currently studying wormwood (*Artemisia L.*) in the center. In this regard, we have published international scientific articles. More than 81 species of wormwood grow in the country. 19 species are endemic. It takes at least 2-3 years to fully study a plant. Currently, the plants studied by researchers of the center are wormwood species in Almaty region and around East Kazakhstan. For example, in comparison with the species of wormwood grown in Kazakhstan and those

grown abroad, there are 60-70% similarities, but 20-30% differences.

According to the director of the center, in most cases, scientists study only one of the properties of plants, and plants are not fully studied.

- And we first study the polar, non-polar compounds and determine their biological activity by taking a total extract from medicinal plants and then separating them with different solvents. Flowers and fruits of various medicinal plants are widely used in cosmetics, food and pharmaceuticals, in the preparation



of biologically active additives, - says Ms. Zhanar.

In the course of the research, the specialists of the center will consider such various areas in detail.

- Undergraduate, graduate and doctoral students also take part in research on medicinal plants growing in Kazakhstan. The Center for Medicinal Plants Research has research projects on the fundamental study of wormwood for 2017-2022. In addition, we are conducting research in the field of medicinal plants for the treatment of skin dis-

eases. We are working with Griffith University in Australia on this project. Because we do not have the ability to determine the activity of the plant in connection with skin diseases, it is determined only abroad, - says the scientist.

According to the head of the center, the study of plant extracts with Griffith University showed that it was very active. KazNU doctoral student Aidana Kudaibergen took part in the project "Young Scientist" and won a project worth 54 million tenge. Zhanar Zhenis said that the students worked hard to





achieve such success. He even negotiated with foreign universities, helping students to master technologies that do not exist in the country. The scientist, who obtained the tincture from nature, said that at first there were many difficulties.

- In the past, we collected, dried, crushed plants and took them abroad for 10-20 kg for research. Because it was not possible to get a plant extract. And now, thanks to grants and university support, we have a rotary evaporator and special containers for extracting herbs. After that, we will take only 500 g or one ki-

logram of extract instead of 20 kg of grass, - he said.

But due to the pandemic it is impossible to go abroad now. Therefore, sorbents, column chromatography, various solvents were purchased for the Center for Medicinal Plants Research due to project grants. Thus, the work on processing plants and determining their composition is being carried out at the center.

- For example, highly effective liquid chromatography (HPLC) can detect biologically active compounds. One of our two devices is

made in South Korea and the other in Japan, - says Zhanar.

Among the objects of the scientist's research is our common apple. We do not pay much attention to the healing properties of this fruit, which we eat every day. Some types of cancer have been shown to be effective in counteracting the ill effects of cancer. Of course, this does not guarantee that the patient will recover. But don't they say, "Dig the gold from the waist", Kazakh ?!

- As Almaty is the homeland of apples, we studied 5-6 varieties, such as "Golden Delicious", "Red Crepson", "Aport", "Americanka", as well as one type of Uzbek apple. We took apples from each of the orchards in Talgar and Kaskelen and compared them with each other. They are very active against cancer. We need to study it further, - said the head of the center.

From April 3 to 17, 2020, the Science Foundation organized a competition "Stop-Coro-



navirus” in order to find effective solutions to prevent the spread of coronavirus infection and eliminate its consequences. More than 140 applications were received from all over Kazakhstan. Scientists, entrepreneurs and health professionals have presented their projects in the fight against coronavirus. Zhanar Zhenis was among 39 finalists. The scientist told how the idea of developing an anti-coronavirus tincture came about.

- Since 2003, the SARS-CoV virus has spread in Hong Kong, China. Since then, scientists have begun to study the antiviral properties of medicinal plants. As a result, it was found that many medicinal plants have antiviral properties and have different mechanisms of action. We have developed a research project to create a natural active ingredient against coronavirus from such medicinal plants growing in Kazakhstan. Our project reached the final of the competition.

When the pandemic broke out and there was a shortage of drugs in the country, private clinics in the city ordered tinctures of Zhanar Zhenis. The scientist created “Influenza Syrup” by adding plants that grow in our country, but their anti-covid activity was studied.

- In the first recipe I used only edible plants. So I’m not worried about the toxicity. All have a proven scientific basis, the dose is standard. Children are welcome. Later, when the demand for coughs and asthma began to grow, we prepared a second recipe. There are more medicinal plants there, - says Zhanar.

Usually people lose weight and lose weight.

Some patients develop diabetes as a result of medication. According to the scientist, the virus thickens the blood and aggravates the disease in the weakest areas.

- Taking into account these properties, we have included plants that strengthen the lungs, reduce phlegm, dilute the blood, lose blood fats, improve blood circulation, provide energy and regulate sleep. In general, there have been no side effects (allergies) for a year. Users are quick to sign up and express their gratitude.

By the way, allergies, this seasonal disease, is also a problem for many people. The scientist said that one of the reasons may be the liver. According to a study conducted at Nazarbayev University, this drug tincture has been shown to regenerate liver cells.

- In spring and summer, people with nasal congestion and swollen eyes take this drug to relieve allergies. We found that our second recipe affects the proliferation of liver cells. In addition, a man with a skin disease last year took medicine to boost his immunity. He later said that he had recovered. In fact, skin diseases are sometimes linked to the liver. Here, in addition to the flu, cough, covid, they show such good results, - says Zhanar Zhenis.

According to him, the anti-kovid tincture was taken by people suffering from a mild form of kovid, or by people who were treated, but did not have complete sputum, and were completely cured. And there was no opportunity to give to seriously ill patients.

- Because they were in the hospital. Most





people in Western medicine do not recognize the healing properties of the plant. The treated patients, on the other hand, suffered from a weak cough and a dry cough, despite the return of the virus. “People like me call me and thank me for using our natural mixture for ten days to two weeks, during which time they have lost their sputum and regained their strength,” he said.

Ms. Zhanar said that the mixture contains mint, licorice, cloves and chamomile herbs and useful plants. The scientist: “The Kazakh people have long had herbal medicine. In the

past, when a disease such as plague spread, it was treated with such medicinal plants. This supplement is good for people with diabetes, high blood pressure and bronchial asthma. This drug is used depending on the severity of the disease. It helps young people or people with high immunity in a short time, and older people or people with chronic diseases need to take it for a long time.

The Kazakh girl, who has worked in leading universities in Japan, China and South Korea, said that in the future a small plant will be built at KazNU to produce this drug.

OMSYSTEM-ANALYSIS SYSTEM IN KAZAKH

Today, systems for monitoring information on internet pages are in demand. Because both the government and business are eager to learn how society treats itself. Specialists of the Center for data analysis and processing at the University have developed a project called Opinion monitoring system. The main advantage of this system is the ability to process data in the Kazakh language.



According to the system administrator of the Center for data analysis and processing, Chingiz Rabat, the rapid spread of social online services and the development of Big Data Technologies aroused interest in the use of data obtained from social networks in various areas.

– Today, the technologies of “social listening” and content analysis are gaining popularity. These services are mainly represented by foreign developments, linguistic dictionaries created in English, and they are poorly adapted to Kazakh and Russian. And the domestic Information System of opinion control OMSystem, developed by software specialists at our university, provides the following opportunities:

- *control the information space and determine the scale of the problem;*
- *know the opinion of the public and promptly comment;*
- *evaluate users’ participation in the topic and determine whether key influencers have discussion topics that generate public opinion;*
- *identification of informational reasons and their relation to them;*
- *making the right management decisions;*
- *analyze the dynamics of brand/event/event alerts;*
- *assessment of the social well-being of society on the principle of the “litmus test”.*

Instagram Facebook, Instagram, Vkontak-

te, Telegram, Youtube, Twitter, as well as accounts of popular bloggers, opinion sites, accounts of Opposition resources and individuals, social networks and accounts of akimats will be monitored by the new service OMSystem.

– Opinion monitoring system-a system for analyzing the opinions of users in the internet space about any news or event and identifying active users. Today, this is very important, because social networks are becoming a large-scale source. Because users express their opinion on any situation. Therefore, it is necessary to monitor all such information, – says Madiyar Tasbulatov, engineer-analyst of the center. In his address to the people of Kazakhstan, our president K. Tokayev noted that “the implementation of the concept of a “listening State”, which promptly and effectively considers all constructive appeals of citizens, is a common task for all of us.” In this regard, the specialists of the center have developed and presented such a project to the public.

– I would like to note that there are no technologies for good understanding of the Kazakh and Russian languages. Our project can fill this gap. “I don’t know,” he said. In addition, we can provide statistics. For example, how many people watched one news, what popular groups exist, or how many people left comments. And in terms of demographics, we can find answers to questions such as how many of them are men, how many are women, and which regions are active. It is even possible to determine which social network users are ac-



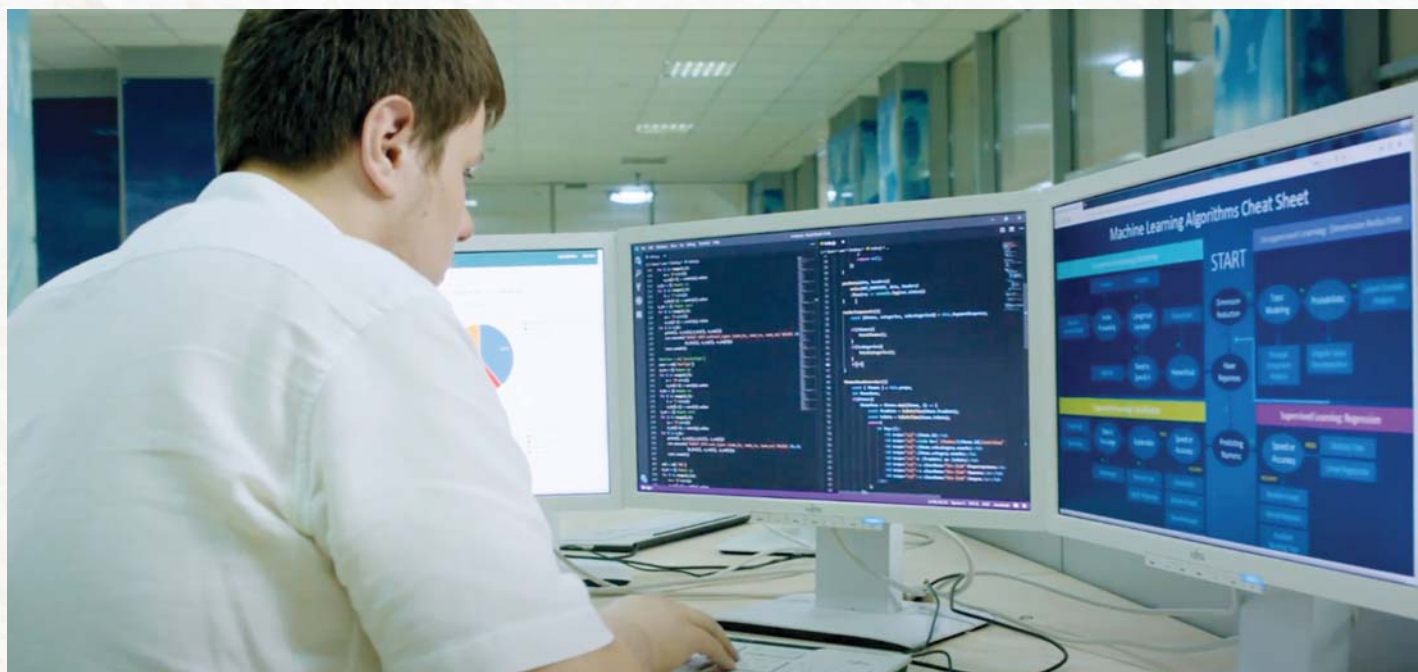
tive. There is a chance that everyone will notice consonants, such as the fact that everyone left a negative review of a particular event or said positive words. As a result, the customer determines how to act in accordance with what is happening, – says the engineer-analyst.

The most important thing is that the system will show the results of the analysis without coloring. According to the expert, you can not deceive the system, it always provides direct information. “One of the advantages is that all this work is done quickly. Your action is just to start the system and wait for the result,” he says.

- At the same time, you can use the help of political scientists as experts. They can look

at the reports generated in the system and draw conclusions. All this on a contractual basis you do. For example, once you sign up for the platform, your email will receive analytics on the topic you want at a certain time. The system installed on the servers is always working and our team is ready to answer any of your questions, – says Madiyar Daniyaruly. According to him, the OMS system was developed using the technologies of Social Listening, Machine Learning, Big Data and others.

- The system consists of three modules: the first is to search for news. As soon as you enter a topic, the system will automatically search for news from information portals and all social networks using keywords. Then its authors and reviews are collected and analyzed based





on it. It can show people's positive and negative thoughts about a particular event, -says the expert.

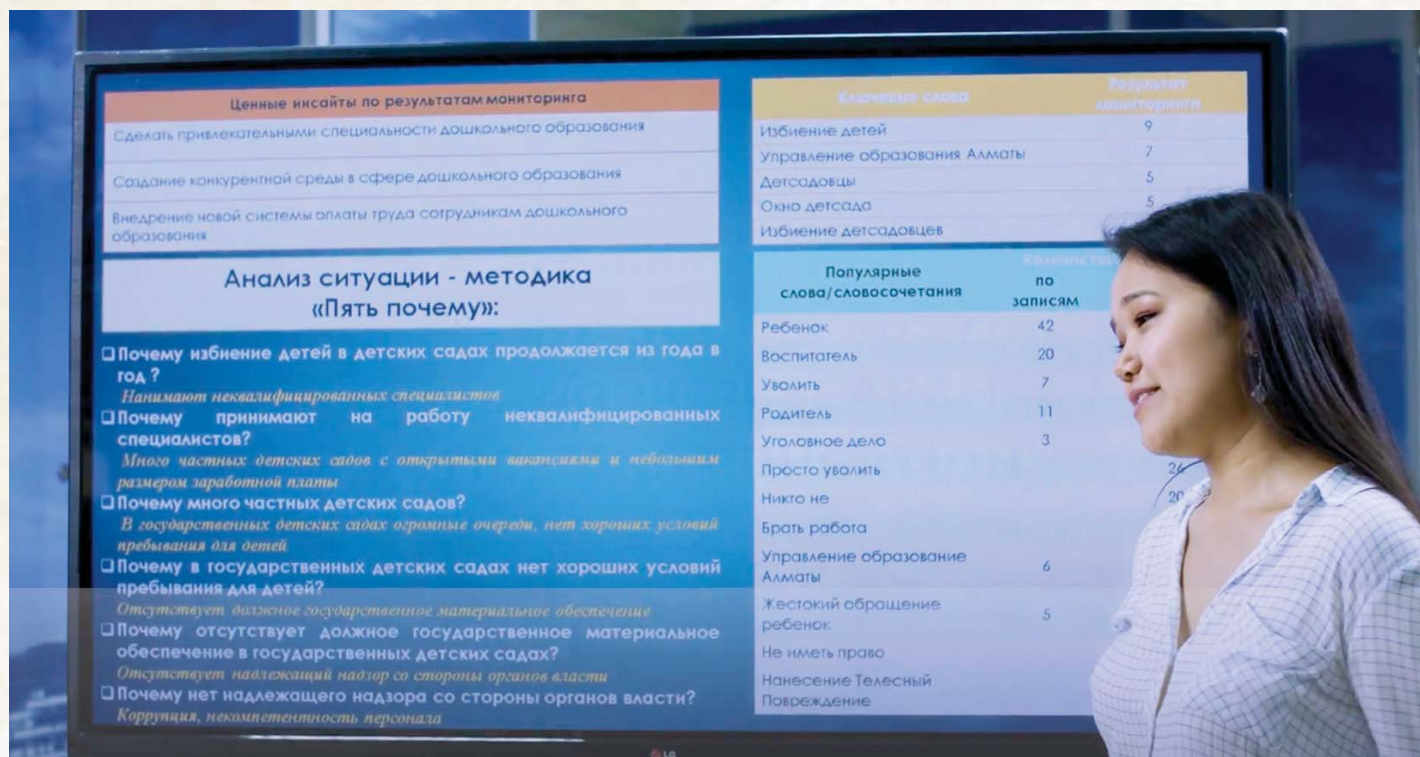
This system can also make generalizations, such as whether the next idea is good or the next one is bad. According to representatives of the center, Parsers is a special module. It collects information from internet resources. In addition, there is a linguistic constructor based on artificial intelligence. He reads every word and analyzes the accumulated data. At the very end, the finished report is generated. And artificial intelligence determines how people perceive certain information. The received data is sent in edited form in PDF or Word format to the customer's email address.

For example, during quarantine, such an analysis was carried out by the data analysis and processing center. The coronavirus, which revealed statistics of information about pneumonia. But users have left few comments on

such information. Specialists of the center also noted that in the test mode, orders were accepted from several clients.

When asked about competition in the market, the center's specialists pointed out that the OMS system has its advantages.

- Of course, there are such services. But we can say with confidence that the Opinion monitoring system is a fully functional system. After all, some of the other platforms that monitor social networks do not provide services in the Kazakh language. For this reason, our main advantage is that with the help of artificial intelligence, we can process information in the Kazakh language and draw conclusions. In addition, the Opinion monitoring system recognizes text on the image page. This is an excellent opportunity to conduct a full-fledged analysis of social networks, such as Instagram, where the main content is photos. Simple systems cannot read texts written on the surface of a photo. And the



OMS system can read and analyze it,” M. Tasbulatov said.

As proof of this, we conducted an analysis of the current topic “drought in Kazakhstan” through the OMS system. Engineer-analyst of the Center for data analysis and processing Zhanerke Sundetova prepared a reporting report with the results of the analysis. As we can see from the document, in the period from July 1 to July 12, 2021, 165 entries and 393 comments were identified using the

keywords drought, zasukha, selskoe khozyaystvo, etc. In particular, the texts had a positive key, and the comments had a negative key.

The demand for this type of service will continue to grow. For example, according to Fortune Business Insights, in 2027, the media monitoring market will reach 6 6.51 billion worldwide. In 2019, this figure amounted to 2.48 billion US dollars. Thus, on average, the market shows annual growth of 13.2%.

BIOFUEL PRODUCERS

Today, many countries use bioethanol as a fuel. Its main goal is to reduce the emission of carbon dioxide into the environment. As the urgency of environmental problems increases, so does the demand for them. According to Markets & Markets, the bioethanol market will reach \$ 64.8 billion by 2025. Last year, its total volume was US \$ 33 billion. However, despite the fact that the consumption of bioethanol alcohol is more efficient, the production process and raw materials are still controversial. KazNU scientists also have doubts about the latter.

*For example, the Faculty of Biology and Biotechnology is implementing four research projects aimed at obtaining biofuels. One of them is the project “Obtaining recombinant strains of microorganisms capable of effectively expressing cellulose genes for the production of biofuel from cellulose raw materials”, headed by Dr. Academician A. Bisenbaev. As a result of research in this area, transgenic industrial strains of *Saccharomyces cerevisiae* were obtained. It has the ability to accelerate the production of bioethanol. The scientist said that such industrial yeast strains have their share in the production of bioethanol.*





«GET READY FOR WINTER FROM SUMMER»

- Our country is one of the richest countries in mineral resources. We also have many underground energy sources, that is, natural reserves of oil and gas. Kazakhstan accounts for 1.8% of world oil production and 0.7% of gas. This is a very large figure. But over time, its size will decrease, as oil and gas are non-renewable energy sources.

According to some forecasts, the amount of oil in the country may decrease by 60% by 2050. This leads to an energetic dependence on another state. Currently, all policies are based on energy sources. Therefore, developed or developing countries conduct a very high level of scientific and technical research to create energy sources that can be an alternative to underground energy sources, said Amangeldy Kuanbaevich.



Considering that the country adheres to the concept of “Eternal Country”, the scientist stressed the importance of paying attention to this issue.

- We need now to think about what will happen in 100 years. Because without energy, the development of a country, its dependence on other countries and, in general, its survival as a state raises questions.

There are many alternative energy sources now. One of them is bioenergy, which we are studying. Kazakhstan is very rich not only in mineral resources, but also in biological resources. Our country ranks 9th in the world. This means that we have the ability to obtain energy from biomass, - he said.

“What is biomass energy?” We will answer the question based on the opinion of the scientist. This saves energy throughout life. For example, plants. Compared to oil and gas, factories are renewed every year. Amangeldy Kuanbaevich believes that “this is also an inexhaustible source of energy.”

- Now the question is how to use it. How can it replace oil and gas? Bioenergy sources are biogas, bioethanol, biodiesel. Our goal is to obtain bioethanol from biomass. Currently, the leading bioethanol producers are the USA and Brazil. Bioethanol is sourced from corn in the United States and sugarcane in Brazil. According to him, according to forecasts, in 2030-2050, the world production of bioethanol will reach 280 billion tons.

LESS CARBON DIOXIDE EMITTED

“In general, what is bioethanol?” We received the following answer to our question:

- We call it fuel ethanol. For example, in Europe, America, Brazil and many other countries, filling stations use gas instead of gasoline. Gasoline is a mixture of gasoline and alcohol, i.e. ethanol. Ethanol accounts for about 60 percent of Brazil’s vehicle fleet. In the United States, ethanol is blended with 15% gasoline, and in Europe with 6-10%. In some countries, the ethanol content of fuels can be as high as 25 percent.

According to experts, the addition of alcohol to gasoline reduces carbon dioxide emissions by 30% and the emission of harmful gases by 40%. This is due to the fact that oxygen in alcohol causes complete decomposition of harmful components of gasoline. Consequently, the use of bioethanol will solve huge environmental problems. In addition, when bioethanol is used as a fuel without additives, water and carbon dioxide are released (in very small quantities, about 0.03 percent).

FOOD OR ENERGY

- Makes alcohol from food in America and Brazil. For example, corn and sugar beets or sugarcane are used to make bioethanol. This, in my opinion, is an immoral method. Be-





cause many people all over the world are starving. In this case, it would be immoral to waste grain and food on fuel, that is, on ethanol. It's one. Secondly, this situation will lead to an increase in food prices. Thirdly, we will lose the possibility of rational use of agricultural land. It is clear that if everyone sows corn to get bioethanol, there will be inequality in agriculture. So I decided that I really needed to learn how to do it right. "My project is based on the production of bioethanol based on lignocellulose biomass," A. Bisenbaev said.

According to the scientist, 17 million tons of wheat were produced in Kazakhstan in the 90s. 39 million tons of straw will remain in the fields. Only 1% is used. Most of the straw left over from cereals is burned right in the fields. This, in turn, results in the release of large quantities of air pollutants. Therefore, the main need is to find an alternative way to get rid of the excess wheat straw. The most efficient way

is to use agricultural waste as an energy source.

- We cannot eat lignocellulose biomass. Therefore, it is necessary to mix it with the enzymes necessary for its degradation. This is an expensive technology. Secondly, grass and paper waste, wood chips can be obtained as lignocellulose biomass. How to get energy from lignocellulose biomass? For example, all life on Earth works like a machine. We need not only fuel, but also energy. In fact, every one of the trillions of cells in the human body breathes. The mitochondria in each of them are responsible for the respiration process. Their energy source is glucose. Herbs, wood, and paper are made from polymers called cellulose. And cellulose is made up of billions of glucose. Wheat starch is also a polymer that also contains glucose. But the difference between them lies in the interaction of glucose. Starch is called alpha, cellulose is called beta-glucosidic binder. We do not

have an enzyme that breaks the bond between α -D-glucopyranoside. The enzyme amylase in human saliva tends to destroy the binding of glucose to starch. All cells use this glucose as an energy source, says the expert.

GENETIC ENGINEERING HELPS A LOT

According to the scientist, in the genome of fungi there are “instructions” for the synthesis of certain enzymes. They are capable of cleaving cellulose macromolecules into short chains.

- Mushrooms can use the glucose in cellulose as an energy source through an enzyme called cellulase. Therefore, information about the enzyme cellulase is recorded in the gene. For example, one of them is *Lentinula edodes*, *Aspergillus niger*, a celluloid mushroom. According to the project, we will isolate the gene from these mushrooms. *Saccharomyces cerevisiae* are yeast cells used in the production of bread or alcohol. This technology has not changed for millions of years. However, these microorganisms cannot consume cellulose as an energy source. We insert genes into these yeast cells

that are needed to make the enzyme cellulase. The result is recombinant or genetically modified yeast cells. With the help of these microorganisms, we can obtain ethanol from straw or sawdust of grass, cereals, - says Amangeldy Kuanbaevich.

Taking into account the laws of market relations, in addition to the quality of any product, the price also plays an important role. According to the project developed by KazNU scientists, the cost will be very low, since waste is used as a source of raw materials.

“There are four different strains in our laboratory now. Of course, enzyme alone is not enough to completely break down cellulose. At least four enzymes are required, so four different genes must be introduced. And you need the elements that regulate the implementation of the information stored in the gene. When cellulose breaks down, a substance called cellobiose is formed. He needs a carrier to enter the cell. In a word, this is a very complex technology, - said Amangeldy Bisenbaev.

In short, both science and the scientists who serve it contribute to improving the environment. Now the work is in the hands of citizens capable of reforming the country’s fuel policy.



BIOPLASTIC BACTERIA

When you say “natural plastic,” you may have misheard. But you heard right, because the biotechnologists of our university have developed bioplastics. It is water-soluble, completely biodegradable and produced by bacteria. This will be one of the biggest innovations of KazNU scientists.

Of course, the world market for bioplastics has long been mastered. Bioplastics are vegetable oils and cornstarch, straw, sawdust and shavings, recycled food waste, etc. such as plastics from renewable biomass sources. Common plastics such as petroleum are sometimes called gasoline polymers or are derived from natural gas. Bioplastics typically require sugar derivatives, including starch, cellulose, and lactic acid. As of 2014, bioplastics account for about 0.2% of the global polymer market.

University specialists produce bioplastics that are completely biodegradable by newly discovered microorganisms, including bacteria.

- We have bacteria that secrete polyhydroxybutyrate. This is a separate procedure.

Depending on the type of microorganism, it can synthesize substances that are completely or partially soluble in water. After all, the plastic that the bacteria has identified dissolves completely in water. It also has its advantages and disadvantages. Initially, we had the idea to use bioplastic as an alternative to modern plastic containers. At the same time, the bioplastic secreted by bacteria was found to have antimicrobial properties. It is resistant to bacteria such as *Staphylococcus aureus*. This bacterium causes inflammation of the mucous membranes and skin, as well as the formation of purulent ulcers. Therefore, we are currently planning to create plasters, patches and gels that can be used for medical purposes. If it is used in medicine, it will be necessary to determine



the class of pathogenicity of these microorganisms, says biotechnologist Lyudmila Ignatova.

Acne mainly affects young adults and adolescents. The scientist claims that the main pathogen may be *Staphylococcus aureus*. In this case, topical application of bioplastic gel can cure some diseases. But this requires serious testing. Meanwhile, scientists are working to identify the microorganisms involved in the production of this substance. According to Ignatova, these bacteria belong to *Pseudomo-*

nas and *Bacillus*. A patent document is currently being processed.

Now let's talk about the process of obtaining bioplastics by microorganisms.

“To do this, we grow bacteria that synthesize growth fluid, and we grow and precipitate this fluid using biotechnological methods. We make plastic from this growth fluid. So far, all this is the result of laboratory research, so the amount is small. However, according to scientific research, the potential of these bacteria is very high and can be expanded and pro-

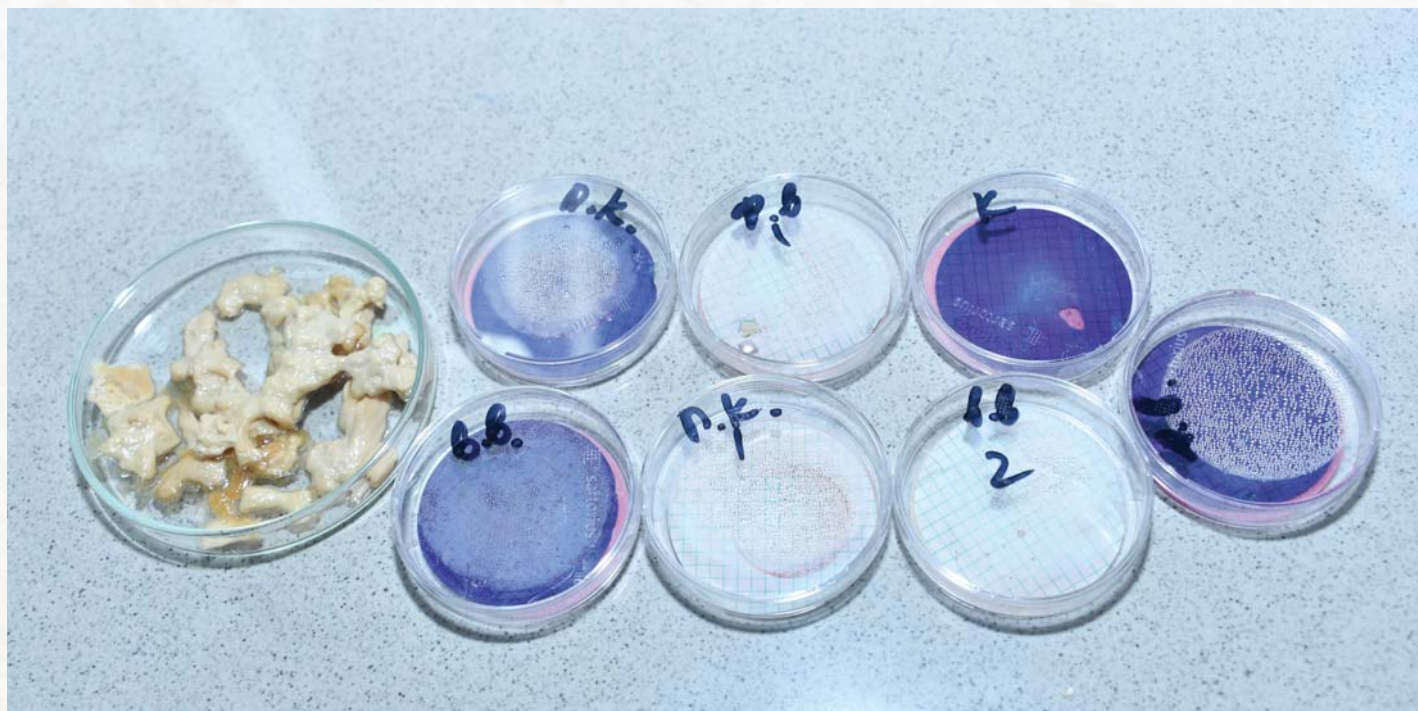
duced at the production level. But first you need to decide in what area it can be used. We plan to conduct research in this area together with chemists. “These experts will help us fully understand the composition of bioplasts,” he said.

According to the expert, certain nutrients are added to the environment in which microorganisms live to accumulate bioplastics. There is no need for very expensive equipment.

- In the future, we will look at ways to use industrial or household waste. This is due to the fact that the aforementioned pseudomonas (*Pseudomonas*) grow and multiply, getting rid of various organic matter and feeding

on waste. So, if our idea comes true, we can get bioplastics from waste. But while all this is a matter of time. The most important thing is that we have obtained strains that no one else can produce with bioplastics, - says L. Ignatova.

It should be noted that there are no obstacles to the production of bioplastics on an industrial scale in Kazakhstan. “Because it is enough to have a bioreactor, a nutrient medium and a strain that we have identified. We found him, identified him, yes, he produces bioplastics. Now, if its production is launched, we will be able to save on oil. This is a really good idea,” he said. However, it is necessary to determine the pathogenicity of the first





growth and submit it to the global or national collection of microorganisms.

The idea of obtaining bioplastics arose from the search for ways to decompose conventional plastics. According to Ignatova, the scientist initially studied bacteria that decompose plastic.

- But there were many difficulties, after looking at the literature in this area, we realized that there are bacteria that produce

natural plastic. There are many types. Besides utensils, there are also water-insoluble types suitable for making prostheses and implants. That is, the properties, structure and strength of bioplastics change depending on which bacteria they produce. After researching the methods of obtaining such microorganisms, we isolated this strain. I do not hide our surprise. Of course, in order to keep our plastic in shape, a widely used plasticizer is added to

it. But with the help of bioplastics, it also breaks down faster than usual, ” says Ignatova.

Today, this bioplastic is used to make disposable items such as dishes, cutlery, pots, bowls and pipes. There are even several commercial applications in this area. In fact, they can replace oil-based plastics, but their cost and performance are an issue. In fact, their use requires special regulations or laws restricting the use of conventional plastics to ensure financial viability. For example, in 2011 a special law was passed in Italy. Stores should use BIO packaging and shoppers, he said. Even electroactive bioplastics are being developed to generate electricity.

Conventional plastics, consisting of bioplastics and supplements, are fully biodegradable in a variety of environmental con-

ditions, including soil, water and compost, i.e. fertilizers. Therefore, they are more suitable than conventional plastics. The structure and composition of a biopolymer or biocomposite also influences the biodegradation process. Various microorganisms live in the soil, which contributes to the biodegradation of bioplastics. However, the decomposition of bioplastics in the soil environment requires high temperatures and a long time.

The age of stone, iron, bronze and “plastic”. Who knows? Thousands of years later, the present period can be marked in this way in the pages of history. However, it is clear that some of the world we created will be lost in the future. Therefore, every solution proposed by scientists, every project must have special support from society.



A HOLOGRAM THAT DOES NOT ALLOW ARTIFICIAL PRODUCTS

Today, there are “critical” directions in world science and technology. These are microelectronics and microtechnology. This direction determines the competitiveness of industries based on scientific discoveries.

Since the second half of the twentieth century, micromeres have become a priority in ensuring scientific and technological progress. Currently, the development of technologies in this area has reached the submicron level and moved to the nanoscale. The term “nanotechnology” was coined in 1974 by the Japanese scientist N. Taniguchi.

The term, once coined by a Japanese scientist, has now become one of the hottest areas of science. We see results in all areas of our lives. For example, KazNU scientists use nanotechnology to create a hologram that confirms the authenticity of a product. Specialists of the National Open Laboratory of Nanotechnologies of our university use modern tech-



nologies in this project, such as electron-ion lithography. This made it possible to create images and reliefs on different surfaces in the country. It can be said without exaggeration that this technology is not widespread in the CIS countries.

- Today it is customary to create artificial types of goods or products. Therefore, with the help of such technologies, the authenticity of the product can be noted. We can use electron-ion lithography on color micro- and nano-stripes to obtain the necessary samples in our work using electron beams, scanning electron microscopes and atomic force microscopes. For example, on polymers, we can apply the signs we need. “With the help of methods such as plasma treatment and spraying, it is possible to obtain a changing color grammar,” says Mukhit Muratov, director of the National Open Laboratory for Nanotechnology.

The only thing that makes this project competitive is the saturation of the image in the hologram. In addition, avoiding exposure to heat and exposure to low doses of 1–150 $\mu\text{C} / \text{cm}^2$ during operation will shorten the time required to create a relief or other image.

“Speaking of dimensions, we can make invisible marks on the surface of products from 10 nanometers to 500 nanometers. These symptoms can be seen with external radiation or heating. Of course, this requires special tools and equipment. These technologies not only ensure the security of the object, but also

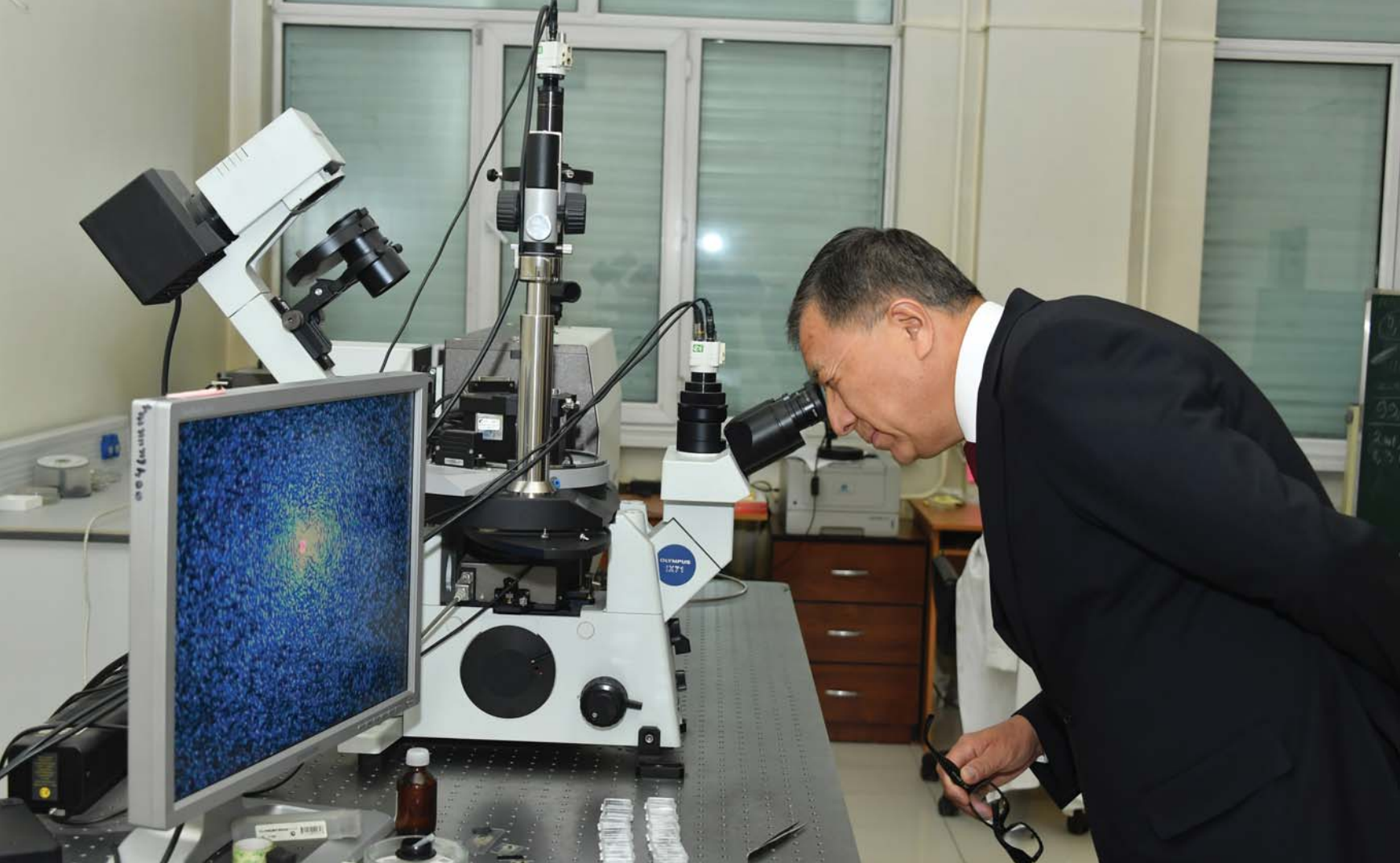
limit the possibility of counterfeiting, says Mukhit Mukhametnurovich.

Institutions producing coins or jewelry use similar tokens. According to the authors of the project, this invention is directly related to the field of nanolithography. Therefore, a holographic security image can be used in minting coins or in the form of a mask in photolithography; in addition, a floating hologram can be used to create holographic grids and integrated circuits.

- We create a polymethyl methacrylate resistor, that is, an image of an electron beam on the polymer surface. This can be done on the surface of other metals such as aluminum. Regarding the final structure of the electron lithography, the difference between the background and the inscription on the surface is whether it is dark or light. We adjust it by controlling the dose of the electron beam. For example, 150 microcoulombs per square centimeter consume energy. You can write on a silicon surface with aluminum or, conversely, on an aluminum surface with silicon. During the experiment, we control the color saturation. It all depends on the dose and duration of exposure, says Mr. Mukhit.

This method differs from traditional lithography in that you can create reliefs without touching the subject. For example, printing is done by leaving a mark on the surface of an object. However, according to the expert, the stamp used in this method becomes unusable after 10 uses. Our technology is





highly efficient and has a long service life, since it does not come into contact with the marked surface.

Interest in the field has grown with the advent of devices that can see the nanoworld, according to the director of the university's nanotechnology laboratory. But in our country this industry is still developing. In many foreign countries, this method prevents industry fraud. This is especially true for gold and bullion companies that use their holograms to mark their products with this method.

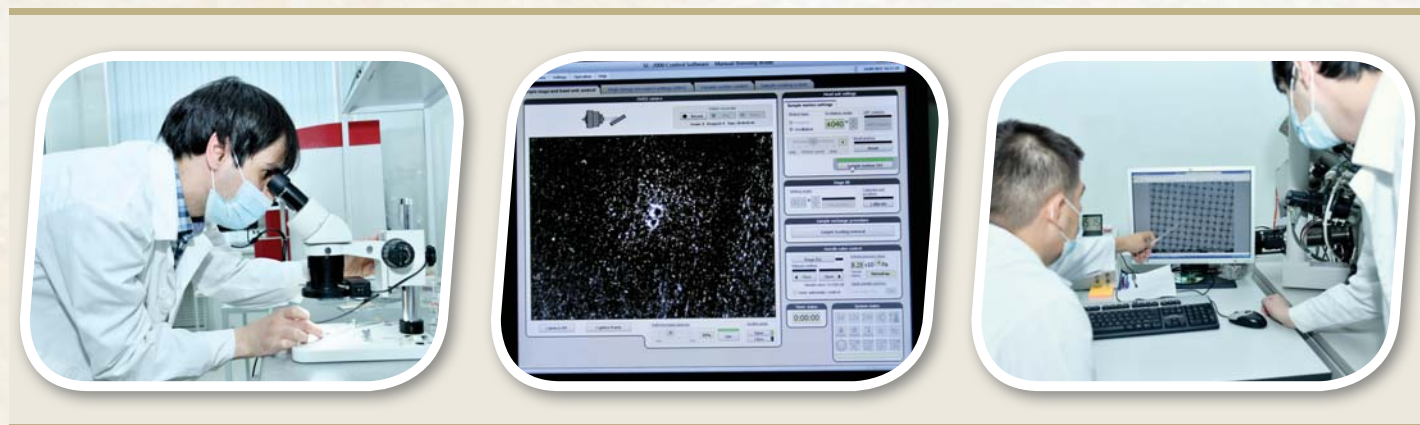
Of course, getting acquainted with any new

world, you inevitably ask: "How many such technologies are available in Kazakhstan?" the question arises. Mukhit Mukhametnurovich answered this question: "There are practically no companies dealing with nanoscale lithography. We are working in this direction. But the creation of such signs should be a large number of companies," he said.

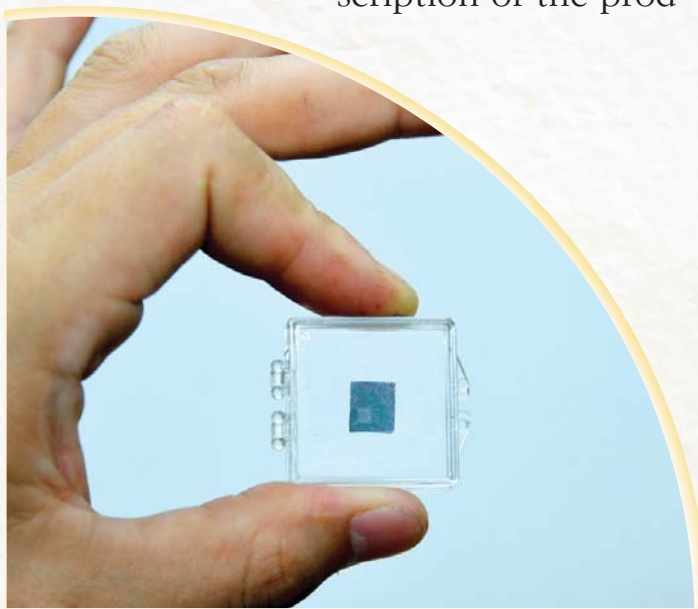
The project received state grant funding. The scientific report on the project is complete and successful. The allocated funds have been fully used.

"But if there is a financial opportunity, this





project can be developed and automated,” says the head of the laboratory. “Secondly, we want to have a terrain coding device that can be placed on any surface. This allows you to specify the location of the hidden relief in the product manual using ciphers. Because looking at the nanoscale is a very long process. If there is a code in the description of the prod-



uct, then specialists can find the secret brand of the product and check its authenticity. The range of applications is wide: from simple telephones to securities that can be marked in the form of a hologram. In the future, we plan to publish it in the form of stickers. But for now there is a limitation on the size of the models we work with.

Within the framework of the project, KazNU scientists worked with scientists from the Institute for Problems of Microelectronics and Technology of Special Materials of the Russian Academy of Sciences. In order to conduct joint research, doctoral students of our university underwent scientific training at this institute. In addition, professors from the same institute came to us and gave lectures. Specialists of the National Open Laboratory of Nanotechnologies conduct consultations and exchange experience with experienced Russian specialists in this field.

Young scientists are also showing interest in this project. There are two doctoral stu-

dents and three undergraduates working on this project.

- At the initial stage, we voluntarily began research in this area. Later, in 2018, when the competition for grant funding was announced, we decided to try out the garden. When the project received funding, we raised the level of research somewhat and achieved good results. The project has its own requirements for grant funding. For example, before entering a competition, you need to do some research. The next level of hologram design for precious metals and securities is commercialization. In the future, we plan to participate in competitions in this area. The next stage is bringing the product to the market," says Mukhit Muratov.

According to him, the invention received a

state patent called "Technology for the transportation of nanoparticles." It took about a year and a half to review it. At present, domestic investors are also showing interest in the project. Their main requirement is 100% availability of the production line. Therefore, research continues to be carried out using available technologies.

But it is better to consider different ways of commercialization. For example, you can sell by providing services in this area or teaching others the finer points of this technology. The first is a service, and the second is the belief that it will find its consumer in the form of an intellectual product. KazNU specialists are ready to exchange experience through mutual cooperation of interested universities in this area.







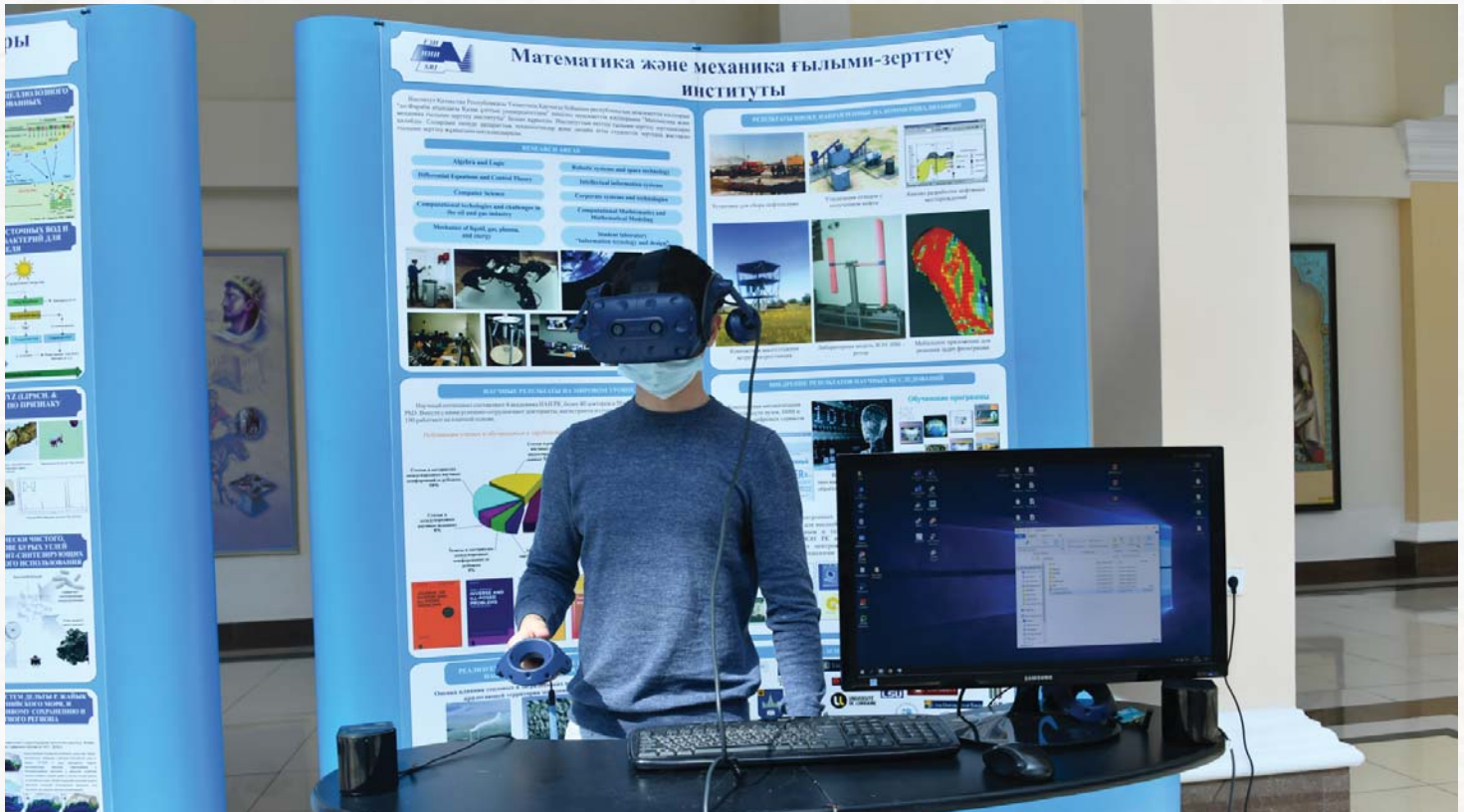














Ақпараттық технологиялар факультеті

УЧЕБНО-МЕТОДИЧЕСКАЯ

БАКАЛАВРИАТ / BACHELOR

Mathematics
Actuarial mathematics
Mechanics
Robotic Systems
Mathematical and computer modeling
Data Science
Space engineering and technology

МАГИСТРАТУРА / MASTER

Mathematics
Mechanics
Mathematical and computer modeling
Space engineering and technology

ДОКТОРАНТУРА / DOCTOR

Mathematics
Mechanics
Mathematical and computer modeling
Space engineering and technology

ДОСТИЖЕНИЕ / ACHIEVEMENT

SMARTCITY
Innovative Approach Towards a Master Program on Smart Cities Technologies

Разработка ОП для магистрантов технического профиля, содержащей дисциплины, направленные на приобретение навыков разработки и испытание

Оқу-әдістемелік жұмысы

Ақпараттық технологиялар факультетінің негізгі мақсаты - ұлттық экономиканың IT-секторын динамикалық тұрғыда дамытып, өлеңді деңгейге жеткізетін жоғары білікті мамандар даярлау.

ҚАЗАҚ ДИПЛОМ

- Ақпараттық технологиялар факультеті - 234
- Информатика - 320
- Еңбекті ұйымдастыру және басқару - 334
- Информатика кәсіпін - 344
- Ақпараттық технологиялар факультеті - 352

ЖАҚА БІЛІМ БЕРУ БАҒДАТНАМАЛАРЫ

- БИЗНЕС АНАЛИТИКА И ВОД DATA
- АКВАРИТҚ ҚҰҚАҚСЫЗ ТЕОРИЯСЫ
- АКВАРИТҚ ҚҰҚАҚСЫЗ АҚПАТ
- АКВАРИТҚ ҚҰҚАҚСЫЗ КҰҚАҚСЫЗ БАСТАН
- КӨБІТТЕУ ЛИНГВИСТИКАСЫ
- КОМПАЬТЕРІН МОНІТОР ЖӘНЕ МОНІТОР БАҒДАТ

Научно-исследовательская работа

Түрлендірілетін бағдарламалар

- Системалар бағдарламасы - 23
- Түрлендірілетін бағдарламалар - 31
- Ақпараттық бағдарламасы - 33
- Математикалық бағдарламасы - 34
- Түрлендірілетін бағдарламалар бағдарламасы - 35

Наука-инновациялық бағдарламалар

- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы

Инновациялық бағдарламалар

- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы
- Информатикалық бағдарламалар бағдарламасы



Research areas and breakthrough projects



Учебные классы от вендоров

Учебный центр «ИР»

Центр ИБ от «Kaspersky Lab»

International relations

Double diploma programs

Academic Partners



РАБОТА

PROGRAM

ACQUIN

ACQUIN

ACQUIN

ACQUIN

ACQUIN

ACQUIN

DEVELOPMENT



Трикладная учебная программа по освоению и интеллектуальных роботизированных



International education in space-based remote sensing for monitoring of our system to reach sustainable development



Great Britain

Imperial College London

Imperial University

University of Manchester

Cardiff Brookes University

Hankai West University

ATIONS

Bulgaria

Technical University of Sofia

Netherlands

University of Twente

Czech Republic

Technical University of Liberec

Australia

University of New South Wales

НАУЧНОЕ НАПРАВЛЕНИЯ

Лаборатория алгебры и логики

Лаборатория вычислительных технологий проблем и нефтегазодобывающей

Лаборатория исследования

Лаборатория дифференциальных уравнений и теории

Лаборатория механики жидкости, газа, плазмы и энергетики

Лаборатория исследования

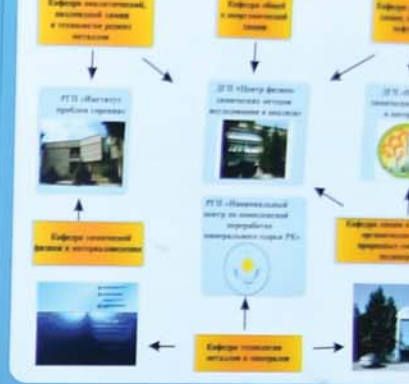
NAZARBAYEV UNIVERSITY

EHCK

GOC

TEK

Финансирование осуществляется на основе грантов от ведущих научных организаций России, Европы, Азии. Научные исследования проводятся в рамках выполнения грантов от ведущих научных организаций России, Европы, Азии. Научные исследования проводятся в рамках выполнения грантов от ведущих научных организаций России, Европы, Азии.



DIRECTIONS OF SCIENTIFIC ACTIVITY

- Development of new technologies of hydro-metallurgical processes, extraction, concentration and refining of rare, precious and other metals
- Development of new analytical methods for environmental and safety monitoring, development of methods of utilization and clean-up of industrial and agricultural wastes
- Colloid chemistry of water-soluble polymers and their association with surfactants
- Investigation and improvement of radiochemical procedures and separation techniques
- Synthesis of new organic compounds and chemistry and technology of polymeric materials
- Chemistry of natural compounds
- Physical-chemical basis for obtaining multifunctional biomedical (nanofilms) with antibacterial and anti-inflammatory properties
- Development and creation of the experimental coal-gas-oil-chemical process
- Fundamental investigations of combustion technologies and synthesis of carbon nanotubes in a fluidized bed reactor and their application in electric power systems



INTERNATIONAL COOPERATION

The faculty has established close relationships with leading international universities in Germany, France, China, USA and Japan. Professor staff of the faculty has received grants to perform research with international participation (Newcomer, Erasmus, etc.) According to the IAESTE program the faculty has provided higher education institutions: Belgorod National Research University (Belgorod, Russia), Valencia (Spain), Lille University of science and technology (France), China University of Petroleum.

Université Lille 1

University of Reading

KAISERSLAUTERN

Aix-Marseille

Bar-San University



EQUIPMENT FOR PURCHASING «CLEAN COAL»

Our country is very rich in coal reserves and is a world leader in terms of coal production. According to some estimates, coal reserves are expected to reach 500 to 1,000 years, including current consumption levels. Therefore, the fact that today the share of coal energy has reached 85% is surprising.

However, in recent years the world's alternative energy sources are developing rapidly. In civilized countries, solar and wind energy began to compete with coal (about 1% of our country uses alternative energy sources). It is no secret that coal causes a lot of damage to the environment and ecology. In industrial areas, there have even been cases of animals eating grass in the area when the waste from coal mining is released into the air, mixed with steam and falls to the ground as acid rain. In any case, scientists say that we will not give up the "black stone" because it is both cheap and affordable. Therefore, there is no other way but to reduce its damage to the environment and ecology.

Because production depends on coal capacity. But there is a problem here: our mines are dominated by low-grade and high-ash coal dust. In fact, the exhaust gas contains a lot of harmful impurities and ash. How to reduce its size? Is there a way to get rid of black dust and ash? This is the key problem that domestic scientists have found. They developed a plasmatron to equip the dust-coal boilers of thermal power plants with plasma filling systems and increase energy efficiency, which ensures the combustion of the boiler without the use of fuel oil. It was once exhibited at the international exhibition EXPO-2017.

What project is this? What is its economic efficiency? We asked these questions to the





author of the project, Doctor of Technical Sciences, Professor of the Department of Thermal Physics and Technical Physics of Al-Farabi Kazakh National University Vladimir Messerle.

IT IS EASIER TO PAY A FINE THAN TO INSTALL A PLASMATRON

The “foundation” of this project was laid in the 90s of the last century. Since then it has matured.

- If we install a plasma-fuel system (PPS) in the dust boilers of all 240 thermal power plants in the country, its economic efficiency would be 50 billion tenge per year. We do not add to this the environmental efficiency of harmful wastes and incompletely burned fuels, which will be reduced with the introduction of POZ. This means that the project, along with a positive economic performance, has great environmental impact, - said Vladimir Messerle.

Given the fact that almost all of the total

thermal coal produced in the country is of low quality, the relevance of the project is self-evident. As a result, 10-15% of coal in thermal power plants does not burn. Where does unburned coal go? Of course, it does not disappear by itself. It emits smoke from the chimney and pollutes the air. Unburned carbon and flue gas containing nitrogen and sulfur oxides mix with water vapor in the atmosphere and fall to the ground in the form of acid rain. This can be solved by heating the air to 5-6 thousand degrees by means of a plasma-fuel system (plasmatron) and even by burning a plasma flame with a lot of ash from the cold kiln. As a result, it burns completely. When using the plasmatron, there will be no visible black smoke and dust at any power plant. The amount of harmful emissions into the air: nitrogen oxides - 50, and sulfur oxides - 30-40 percent.

It is worth noting another advantage of plasma technology. For example, in the case of faster burning of coal and more complete combustion, the height of the boiler can be reduced by 25-30%, which reduces the metal capacity of power equipment. Despite such economic efficiency of the software, the implementation of the project is difficult. And it is widely used abroad.

- The presentation of the project usually goes well, but when the issue reaches the feasibility study, investors are disappointed. Entrepreneurs do not like the fact that the project will pay off in four years. It is much easier

for them to pay environmental fines than to modernize boilers, - says the author of the project.

OUR TECHNOLOGY IS USED IN CHINA

If we take into account that the energy sector is the basis of production, the issue is very relevant. Isn't it known that the rest of the basic production center will develop with this energy source?

The situation with existing thermal power plants in the former Soviet Union is about the same. Their resources are depreciated, 60-70% are at the level of depreciation. New power units will not be introduced. In this regard, the scientist expressed his opinion: "We are still working with the equipment of the former USSR. As a result, we cause great damage to the environment or spend a lot of money on the elimination of hazardous waste. If we did not allow the formation of waste at the initial stage, we would not have suffered such losses and mistakes."

Modernization, technological re-equipment of the high ecological and economic indicators mentioned in the Address of the President of the country is a modern requirement. These days, the introduction of old equipment into production is expensive and environmentally inefficient. In this regard, the President instructed the government to work with businessmen to develop a comprehen-





sive program of technological re-equipment of basic production. It is impossible to talk about technological progress without such work. The invention of domestic scientists, this plasma-fuel system was introduced into production in China. The author of the idea said: “Our technology is used in China. They revived the idea and equipped 627 boilers in their country with our system. As a result, it has achieved economic efficiency of 25 billion yuan since 2008. For comparison: there are 240 dust-coal boilers in Kazakhstan. China solved this problem quickly with the support of the state: the government made a decision in 1995 after I conducted the first test of anti-aircraft missiles in that country. At that time, they set up a special state-owned company and allocated funds. Thus, in 2002, in addition to his country, he entered the markets of Russia, Turkey, Korea and Indonesia. Today, five state-owned companies are involved in the

introduction of plasma technology in the energy sector in China. “Each of them earns billions of yuan a year and improves the environment.”

According to Vladimir Messerle, when he presented his project in China, the Chinese media reported that the innovation of our scientist was “an invention of Chinese scientists with the participation of Kazakhstan.” After that, the scientist refused to sign a contract with Siemens, which gives us the right to use our domestic technology around the world.

PUBLIC PROJECT

In 2022, JSC “Samruk-Energy” intends to launch a system of fuel-free combustion of boilers.

Over the past decade, the world has paid special attention to improving the efficien-

cy and environmental safety of solid fuel combustion in dust-fired thermal power plants (40.6% of electricity and 24% of thermal power).

JSC “Samruk-Energy”, which is responsible for increasing capacity in the country, uses fuel oil to ignite and burn boiler units in the production cycle. For example, Ekibastuz GRES-1 LLP consumes 6,600 tons of fuel oil per year for this purpose, which is equivalent to 1 billion dollars. Modernization of oil refineries contributes to the reduction of production of this type of fuel. For example, the decline from 3.05 million tons in 2017 to 2.06 million tons in 2018. Despite the decline in production, fuel oil prices are rising. In 2017, its tonnage was 52 thousand tenge, in 2020 it increased to 130 thousand tenge.

Plasma-fuel system is used as an alternative technology for burning boiler units without fuel oil. At one time, this project was in the form of EXPO-2017. Today, this technology is used in many countries around the world.

Serik Totabayev, Director of Production and Asset Management of Samruk-Energy JSC, has several scientific papers on the introduction of plasma-fuel systems in thermal power plants. By the way, S. Totabayev is a student of Vladimir Messerle. He told the media: “It was

not put up for industrial sale because there was no need for prototypes of equipment developed by scientists at the Kazakhstan Institute of Combustion Problems. Decades later, it began to be considered a necessity. After the decline in fuel oil production, the increase in the price of liquid fuel was recognized as an economically justified and effective step.

In 2019, employees of GRES-1 LLP, with the support of CITIC Construction Co LTD, made a special visit to power plants and equipment plants operating in China with plasma-fuel systems. They got acquainted with the equipment of several companies. As a result, it became clear that there are economic benefits due to the difference in the cost of fuel oil and coal. In particular, the plasma technology of ignition of thermal coal allows to establish at the initial stage of the block combustion process. When the unit is ignited with fuel oil, the equipment has to be switched off and on with all fuel oil injectors.

Thus, in 2022, JSC “Samruk-Energy” intends to launch a system of fuel-free combustion of boilers. Vladimir Messerle, a scientist who heard such good news, said: “Eventually, our project received high attention. If the equipment is introduced in domestic thermal power plants, our work will not be wasted,” he said.

«BLACK SOLDIER» WASTE-FREE TECHNOLOGY



*Flies help solve environmental problems. The scientific name is *Nermetia illucens*, a fly larva popularly called the “black soldier”. It not only turns organic waste into a natural, pure fertilizer, but is also indispensable in the creation of protein-rich compound feed. Today, in many countries of the world, the production of black worms, found in South America, is rapidly growing.*

In the Science and Technology Park of our university, the production of highly efficient products for the agricultural sector is currently being established, and we are talking about these beneficial flies. According to the technopark engineer at the educational institution, Ermek Tauasarov, this made it possible to solve three pressing problems at once: firstly, the disposal of organic waste, secondly, obtaining environmentally friendly organic fertilizers and improving the quality of vegetables and fruits and even grain crops, and thirdly, obtaining products rich in proteins.

This universal fertilizer is in high demand in greenhouses and flower shops. Worms can be used as food for various domestic animals, fish, amphibians and reptiles, as well as some species of birds and rodents. Poultry feeding on the black soldier fly larvae lay 15-20 percent more eggs and do not get sick. Even a chick that has just hatched from an egg can feed on these worms from day one. When grinding and mixing the larvae of black flies and adding them to cattle feed, the incidence of diseases decreases and milk production increases. The meat of such cattle is more nutritious. Indeed, the body of worms contains all amino acids, including such biologically valuable substances as lysine and methionine. Also, the biomass of these worms is rich in enzymes, vitamins and useful microelements.

According to Ermek Kambarovich, the production of fertilizers using the larvae of the black soldier fly in Europe and Russia has only been gaining momentum over the past ten

years. Previously, this technology was widely used in America, Indonesia, China and Japan. These worms use any organic waste as food, except plastic, iron and polyethylene.

Flies live in special insectariums. Their main needs are light, warmth, humidity. Here the humidity level should be 70 percent. The room temperature is maintained at 25-28 degrees. In addition, we regularly spray water with a special agent. It takes seven days for a fly's egg to turn into a worm. They grow in special containers where food is also placed. Food is prepared from bran and waste in a ratio of 1/3, - says greenhouse specialist Sabyr Temirbayev.

Many now understand that food must be environmentally friendly. Soils mixed with such biofertilizers are not only fertile, but also increase productivity by 2-3 times, and maybe even more. In the West, vegetables grown in the zoogum from the black soldier fly are much more expensive than manure or mineral fertilizers.

Eating pure, natural foods provides ample amounts of biologically active substances that help counteract the negative effects of the environment. Description of the project "Production of humus" in the Technopark: "In the process of life, worms transform the substrate into a complete protein (worms), and granules - into an environmentally friendly fertilizer - zoogum. The volume of the finished product reaches 40-60%, depending on the type of substrate and the living conditions of the worms. Thus, from one ton of organic waste, 400-600 kg of zoohumus and 100-200



kg of protein mass (worms) are obtained. It should be noted that due to the activity of worm cultures in organic waste taken out for disposal, the growth of bacteria decreased five times, and the number of pathogenic microorganisms decreased 28.5 times. Therefore, this technology should be considered as a biological method of sterilization. Simply put, a zoogum made from black soldier fly larvae is safer than fertilizers from animal or pig manure.

- Poultry factories produce thousands of

tons of waste every month. To process at least 100-150 kg of waste per day, 20-50 kg of fly larvae are needed. These worms process not only food waste, but also animal and poultry manure. We are currently experimenting with various wastes as nutrients. For example, when bread is mixed with bran, we find that the worms grow faster. The main advantage of zoohumus is that it contains a very high concentration of macro and microelements. For example, for 10 liters of water, 20-40 g of zoohumus is enough. It should be noted that,





compared to local flies, the “black soldier” does not contain toxins, because it feeds only on water,” says Ermek Tauasarov.

Studies of birds, pigs, fish, rats and other animals have shown that meal made from worms is no less nutritious than meat, bone or fish meal. At the same time, the cost of food will be reduced by 40%, and the cost of feed - by 33%.

According to experts, the humus of mosquito larvae contains many nutrients, vitamins, antibiotics, amino acids and beneficial microflora, which are directly assimilated by plants. Improves the physical and chemical properties of the soil. It also prevents nutrient leaching, reduces exposure to harmful salts and phytotoxic elements, radionuclides and heavy metals. One ton of zoohumus replaces

15 tonnes of manure in terms of its ability to restore soil fertility. For example, 3-6 tons per hectare is enough. The advantage of zoohumus is that it prevents weeds from growing in the fields. If ordinary manure is used as fertilizer, the proportion of weeds will increase by 30%.

In addition, the content of humic acids in zoohumus is 1.5 times higher than in humus, and the amount of fulvic acid is four times higher than in vermicompost.

The use of such an efficient technology in agriculture will solve a number of problems. Firstly, it will reduce the amount of household waste disposed of in landfills, and secondly, it will allow for the natural recovery of chemically contaminated agricultural land and wastewater.

FROM COMPLEX ETHER TO DRUG PRODUCTION

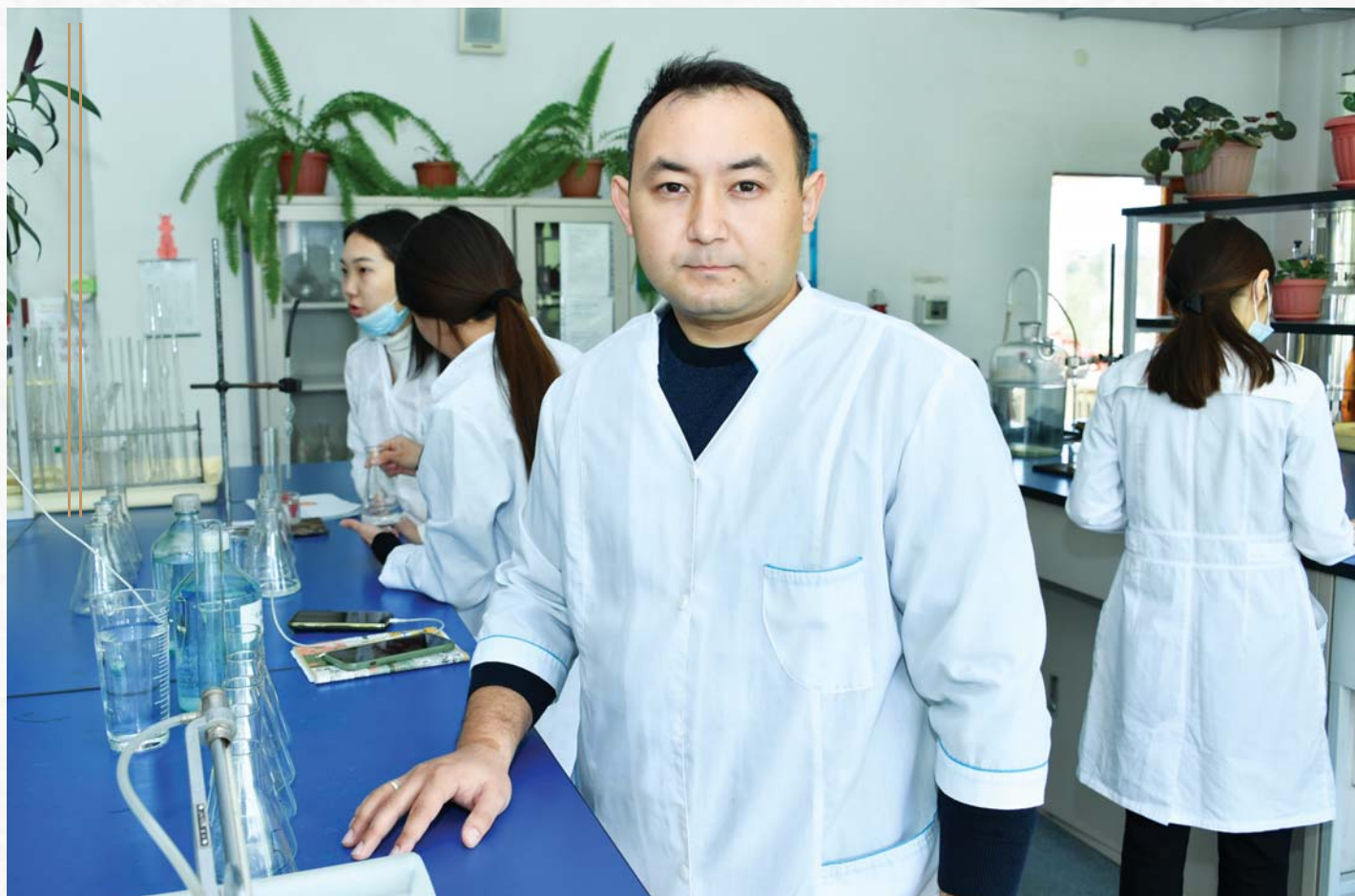
Today, scientific technology is developing very rapidly. As a result, large-scale changes are taking place in the world community. Human genome, artificial intelligence, neuro-technology, 3D technology, etc. This is evidenced by the new research in the field. “As part of that universe, we must strive to improve science and innovative technology. Currently, the state pays great attention to the development of education and science. As you know, the government has a state program for the development of education and science for 2020-2025. A new approach to science began to take shape in society, and the state began to provide real support. Now we, young scientists, need a comprehensive search and action,” said Nurbolat Kudaibergenov, Deputy Dean for Research and Innovation and International Cooperation of the Faculty of Chemistry and Chemical Technology of Al-Farabi Kazakh National University.

THE BEGINNING OF THE PRODUCTION OF AROMATIZERS

Several projects are being implemented under the leadership of Nurbolat Zharylkasynovich. One of them is a project

to develop a scientific method for complex metal hydroxyl carbonization of olefins C4-C10 in oil refining. The priority of this project is “Geology, production and processing of minerals and hydrocarbons, new materials, technology, safe products and struc-





tures.” Simply put, to create a scientific basis for the hydro alkoxy carbonylation of metal complexes with C4-C10 olefins in oil refining for use in the synthesis of esters of carboxylic acids of practical value, ie biologically active substances, flavorings, solvents and others. Unfortunately, there is no production of perfumes in the country. The required amount of synthetic fragrances (100%) is imported from near and far abroad. If the project is implemented, it will

be possible to produce aromatizers and drugs based on esters of carboxylic acids in domestic production.

The authors of the project developed an effective one-step method for obtaining complex esters of carboxylic acids by hydroxyl carbonization reaction in the presence of catalysts based on palladium complexes of palladium at low pressures of carbon monoxide (<2 MPa). This method of obtaining carboxylic esters is, first of all, economical. Secondly,

it is environmentally friendly. Third, the quality of the target product is very high (including additives) compared to the current industrial method. The cost of obtaining esters by the new method is 2-4 times lower than the current method of industrial production.

The scientific direction of research is the carbonation of organic compounds in the soft state of the process by means of complex catalysts based on carbon monoxide. There has never been such a branch school in the country. The founder of this field was Doctor of Chemical Sciences, Professor Hakim Suerbayev, who was the scientific adviser of the authors of the project. At present, the students continue the scientific career of the teacher. If the project is implemented, it is possible to create aromatizers and drugs based on carboxylic esters. Apparently, for the production of the following drugs: novovalidol, corvalol, ethyl esters of alpha-bromovaleric acid. The project uses petrochemical petroleum prod-

ucts, i.e. olefins. This process is carried out using elements of group 8 of the Mendeleev table, metal complexes such as palladium, platinum, rhodium, ruthenium as catalysts.

We have already mentioned that the production of perfumes in the country is underdeveloped or even non-existent. Therefore, the scope of research of economic and new technologies of this project is very relevant for the synthesis of aromatizers, drugs and their semi-finished products. It is worth noting that esters of carboxylic acids are an important class of organic compounds. The scope of practical application is very wide. For example, polyester-based polyfunctional organic acids and polyhydric alcohols produce a number of resins and synthetic fibers. Many esters have physiologically active properties and are used in the manufacture of pharmaceuticals. For example, aromatic esters are used in the perfume and food industries. It is also used as a solvent and extractant.



OUR MEDICINE IS 2-4 TIMES CHEAPER

– There is a pharmaceutical company “Sultan Pharm” in the country. They buy ethyl isovalerate, the main active substrate for volocardine and corvalol, i.e. ethyl ester of isovaleric acid from abroad as a substrate. It has its own components, usually esters, menthols, which enrich the composition, although they are not active particles. For example, medicines are presented as liquids, they are added to taste and sold. Here are the experts of the same pharmaceutical company: “We liked your projects, let’s work together.” Now we need a source of funding for further development of the project. We have calculated the amount needed, the project will require about 300 million tenge. That’s not a lot of money. However, you know that the requirements for medicines are special, and the products that are marketed in this area must be pre-clinical and clinically tested. At the request of pre-clinical testing, we will conduct a series of experiments on the future drug in the body of a monkey, starting with a mouse. And based on clinical requirements, it has to be used and tested by at least 1,000 people. This is also a financial issue and it will take a long time to do all this work. Therefore, to date, clinical trials have not been completed. However, we did not want to sit idly by and study the composition of such drugs sold in our country. Medicines imported from

abroad, especially from Ukraine and Russia, contain up to 10% of additives. And in our product the mixture is only 2%. This is the first priority of the product. Pharmac operates in Daritsa, Ukraine. They have one process, ie one reaction from start to finish, lasting 48 hours. In our case, we spend four hours on one process. Here is another benefit of the product. Of course, we can’t say that their products are not effective, for example, Ukrainians do not use expensive catalysts like us. Once we have our valuables, our catalyst becomes more expensive. But the additive is small, it is good for human health. According to Pharmac’s technology, the reaction goes through three different stages. As the reaction time increases, the cost of each substance in it increases by 20%. Compared to the cost of two products, ours is 2-4 times cheaper. Because we have only one reaction. Even with the use of precious metals, it is cheaper. So, our project has a future. Investors who do not know where to invest, should think, - said Nurbolat Kudaibergenov.

MEASUREMENT IN SCIENCE IS A TREND

There is a small branch of science called “measurement in science”. Most scientists do not pay attention to this. Basically, it calculates how much each scientist is growing.



– This is a trend, so it must be obeyed. By this measure, Kazakhstan’s science is developing at a good pace. Previously, as you know, there were no magazines included in international databases. Now chemistry, geology, mathematics, etc. industry magazines are included in this database. This is a great achievement. In recent years, grant funding for science has increased. For example, I won a competition for young scientists. So, I won 50 million tenge for my project for 2021-23. This is a great honor for our team, support and renewal of the material base. Now there are many different competitions, which give an incentive to young scientists. In addition, it now allows 500 young scientists a year to undergo internships abroad. All this is a desire to develop science, to motivate young scientists, - said the young scientist.

FACT AND FACT

An increase in production in the petrochemical industry by 1 dollar will increase by 2-3 dollars in other industries. After all, 96% of consumer goods are produced with the participation of petrochemicals. For example, the pharmaceutical industry is the youngest in the country. It is known that the development of the chemical industry will allow the development of the domestic pharmaceutical industry. According to the official data of the Ministry of Industry and Infrastructure Development, there are 68 pharmaceutical companies in the country. Three of them are large, 11 - medium and 54 - small enterprises.

While the demand for chemical products in the domestic market is 3.5 billion US dollars a year, the country annually imports chemical products worth about 2.4-2.8 billion US dollars.



A SPECIAL METHOD OF GETTING SYNTHESIS FROM MEDICAL WASTE

Every day in the world from each hospital bed is released 0.5 kg of biomedical waste. Kazakhstan produces 18 thousand tons of raw materials a year. Today, especially after the coronavirus pandemic, the importance of disposing of such waste has increased. This is due to the fact that as the volume of infected and highly toxic media increases, it poses a threat to human health. Alexander Ustimenko, head of the department of thermophysics and technical physics at the Research Institute of Experimental and Theoretical Physics, offers an innovative way to solve this problem.

The scientist is implementing a project to convert biomedical waste into synthetic gas with the help of plasmatronics. Biomedical waste (BMW) is waste composed of infected materials. This includes laboratory wastes containing environmentally hazardous organisms and biomolecules. The plasmatron works even when there is not enough oxygen. That is, you do not need to burn gasoline, gas or fuel oil to raise the temperature. According to A. Ustimenko, heated air is used as an agent in the gasification process.

- As a result, we get a synthesis gas. It can be used to generate electricity and many chemical processes. Waste treatment technology is a new field for us. Therefore, it is necessary to look at each process in a different way. As part of the waste management program, we monitored the gasification of all types of waste. We have seen that everything from power plant waste, from ash dumps to agricultural, timber and biomedical waste, can be gasified without any waste. Of course, the amount of mineral waste is much lower than coal, - he said.





ТОО «НТО ПЛАЗМОТЕХНИКА»

УСТИМЕНКО А. Б.

+7 777 228 1429
+7 727 377 3369

ust@physics.kz

There is no equivalent of plasma technology and plasma chemical reactor for the disposal of biomedical waste around the world and is protected by a patent. In addition, the decomposition of complex substances in plasma is very effective. Because of the lack of oxygen, biomedical waste is converted into gases and pyrolysis takes place. And during combustion, these processes do not take place. KazNU scientists are implementing the project together with several foreign specialists.

- For the first time we worked with the AV Lykov Institute of Heat and Mass Transfer (ITMO) of Belarus. We have also implemented several projects with the Institute of Thermophysics named after SS Kutateladze in Novosibirsk. In addition, we used the technology

of thermodynamic modeling of the Moscow State Technical University named after NE Bauman (MSTU) during the project. Initially, our main focus was directly on coal. For example, plasma fuel systems, and before that the gasification of coal was our main topic. Professor AL Mosse of the Institute of Heat and Mass Transfer also uses plasma in pyrolysis and gasification processes. Together with this professor we decided why not to take a new direction. In fact, Professor Mosse is a scientist who specializes in the treatment of radiation or liquid waste rather than energy. So we wanted to create a new world. As a result, we started processing solid waste with the help of plasmatronics and reactors, - said A. Ustimenko.

Compared to household waste, biomedical waste belongs to the hazardous class. These include medical masks, gloves, protective clothing, boots, medical and vaccination equipment and bandages, etc. used in the treatment of patients with COVID-19 infection. There is. Medical materials, malignant microbiological cultures, surgically amputated organs and other infected medical materials, laboratory waste and used instruments such as needles, scalpels, lancets are also considered biomedical waste.

Hospitals, clinics, nursing homes, ambulances, morgues and funeral homes are among these biomedical waste disposal facilities.

- They are more dangerous than radioactive, chemical, industrial and universal waste. Because they can cause the rapid spread of infectious diseases. Currently, the only way to dispose of it in the world is incineration. There are three types of devices for this: stoichiometric or excessive volume of air and combustion in rotary kilns. However, one of the disadvantages of all these methods is the formation of highly toxic chemical bonds, such as dioxin, furan, benzene (a) pyrene, - said A. Ustimenko.

According to sanitary and hygienic research, medical waste is more harmful to the environment than chemical waste. And our country, like other CIS countries, does not pay enough attention to this issue. Because its volume is much smaller than industrial and household waste. And since such types of garbage have not been selected before, its composition is very complex and cannot be identified. This

seems to prove the urgency of the problems surrounding this issue.

- Therefore, it is important to choose the most universal method of disinfection and sterilization during the processing of unselected waste. Plasma disposal of biomedical waste meets all the above requirements. Electric arc plasma with a temperature above 5000 kelvins decomposes organic and inorganic compounds by increasing the rate of decomposition. This technology prevents thermal disinfection of these types of waste, which are considered dangerous to human life, and the formation of compounds such as dioxins and furans. The result is a gaseous and non-toxic condensed product. It also helps to process large amounts of inorganic substances and unselected biomedical waste. And because of the small size of the plasma chemical reactor, the amount of energy consumed will be small, - says the scientist.

According to him, plasma disposal technology has more advantages than combustion, even in intensive gas-dynamic mode. For example, the capacity of the reactor can be reduced by 6-8 times while maintaining production capacity. This means that the area of the required production facility will be reduced and the temperature in the plasma chemical reactor will reach 2000 kelvins.

- Plasma treatment technology generates a plasma flame with a plasmatron by transferring biomedical waste to a lined plasma chemical reactor. As a result, non-toxic gases and mineral wastes are formed from the waste and processed in a plasma flame. An electric arc



plasmatron is installed in the middle of the upper part of the reactor. In addition, an intermittent single-chamber plasma chemical reactor is used. The energy consumption of the process is 1-2 kWh / kg. In particular, it is necessary to disconnect the plasmatron for a while and take into account that the reactor is cleaned of mineral waste, - says the scientist.

Finally, new methods of biomedical waste treatment need to be developed to overcome the COVID-19 epidemic. This is because after incineration of such wastes, toxic solid wastes can enter the groundwater through the soil. Toxic gases are also released into the atmosphere during the combustion of plastics. They adversely affect humans and animals and cause enormous damage to health. Can cause cancer, respiratory and cardiovascular diseases. As you know, waste incineration not only depletes the earth's ozone layer, but also exacerbates climate change. It is not surprising that the constant presence of toxins and chemicals in such air can even lead to the ex-

tinguishment of some plant species. The process of plasma pyrolysis and gasification allows us to solve these problems and eliminate biomedical waste in an environmentally friendly way.

- Every year the world generates about 30 million tons of such medical waste. In particular, in Russia - 100 thousand, and in Kazakhstan - more than 18 thousand tons. Unfortunately, in practice, the waste generated by the response to the COVID-19 pandemic is not properly treated. In some places there is no mention of processing. Therefore, the issue of its elimination is of great importance not only for Kazakhstan but also in the world, - said A. Ustimenko.

Residues generated by medical interventions to treat patients with the COVID-19 virus also require attention. Therefore, taking into account the above issues, the need to use the technology of plasma utilization of biomedical waste is very relevant and important at the national and international levels.

ALL IN ONE:

AUXILIARY FOR TEACHING ELECTRO-MAGNETIC PHENOMENA

Not only the educational program but also the quality and structure of the experimental equipment are important for competitiveness. Scientists of KazNU have developed an innovative software and hardware complex for students studying the basics of electromagnetic phenomena in schools.

According to Askar Zhunusbekov, a senior researcher at the Research Institute of Experimental and Theoretical Physics, the main goal of the project was to provide schools with modern, comfortable and safe teaching aids. This is because many educational institutions still use obsolete equipment left over from the Soviet era to conduct experiments in physics.

- The new equipment itself comes from foreign countries, including Russia, China and India. The technology of the last two countries does not meet our standards, and Russian devices are three to four times more expensive than domestic products. That's why we decided to make a cheaper, more convenient product than the imported model. The device

we offer meets domestic standards. One of its peculiarities is that we can make changes in accordance with the requirements of the curriculum. It is known from the fifth year that the physical laws do not change, but the teaching methods may change, in which case we will restructure the apparatus, taking into account the state requirements, - he said.

According to the scientist, in the past, when teaching physics, he had his own small suitcase for practical work on each topic. Scientists of the Kazakh National University have combined all these more than twenty works into one device and built a hardware complex.

- For example, this single device can measure electrical phenomena such as voltage,





current, resistance and its so-called parallel and series power. The software and hardware complex is small. It does not need to be plugged in because it has a battery inside. There is no stress that endangers human life, so there is no need to worry about the safety of children. Because even if students make mistakes during the experiment, they will not be electrocuted. There are also ways to protect against large and small charges, short circuits, - says Askar Turysovich.

Before the device was put into operation, it was tested in the laboratory of KazNU. And the representatives of the scientific group,

who are sure that the device works properly, will distribute pilot versions to schools. Among them is the gymnasium №138 named after M. Bazarbayev. According to Mauletbek Slamiya, a physics teacher at the university, the complex has the potential to integrate with information technology.

- The developed complex is designed to study the basics of the phenomena of electricity and magnetism in the course of school (college) physics. Electrical and magnetism, including visual demonstration of processes and laws in electromagnetic circuits, modern methods of using hardware and software, as

well as the ability to integrate with information technology. For example, the ability to obtain the volt-ampere characteristics of non-linear elements and to automatically graphically represent and analyze them on a personal computer (laptop, tablet) is a good description of the physical processes here. Depending on the capabilities of the functional generator with the elements that make up the hardware-software research complex, it is possible to study the processes, not just linear, in the introductory lesson to this complex electronics and radiophysics. This indicates that the scope of application of the complex is expanding. We can also increase the scope of work of the complex by using additional elements and tools. In my opinion, the laboratory complex is an indispensable tool in the educational process, - he said.

The research complex has a number of indisputable advantages, such as compactness, mobility and autonomy. Equipping secondary schools and colleges with such devices is relatively inexpensive. The physics teacher also said that with the help of this complex it is not difficult to study at home, in the hospital. "In this regard, I appreciate the work of the hardware and software research complex and I am confident that it will be widely used in the future," said Mauletbek Slamiya.

In addition, the hardware complex was widely presented to teachers at many exhibitions in Almaty and Shymkent. Askar Turysovich said that he had a number of suggestions for further improvement of the device.

- Based on this, we updated the design and made changes. Early versions of the device used lead-acid batteries as a power source, while the latest models use lithium. Currently, physics classrooms in Kazakhstani schools need 100,000 such laboratory devices. If we produce at least 1,000 copies a year, it would be enough to justify the project. It can be said that this project has export potential. For example, among the members of the Customs Union, our Kyrgyz brothers and the curriculum in Armenia are similar to ours, - said the expert of the institute.

According to Askar Turysovich, since physics is a fundamental science, its laws will not change in Eurasia or Africa. However, there may be differences in the methodology of teaching physics. For example, in Western countries this subject is not studied in depth. However, the principles of the devices used in the experiment are the same.

- At present, there are digital models of such devices. Everything is displayed on the screen only. In our version, the student creates the chains with his own hands. There were proposals to create a computer version of the device in the project. Earlier, we launched the device in the amount of 158 thousand tenge. The cost does not exceed 100 thousand tenge. The more expensive version has a screen and a small computer. It costs 225 thousand tenge. But it is better to use the simplest version in schools, - he said.

According to the expert, the specialists of the Research Institute of Experimental and



Theoretical Physics will do the work themselves, such as the assembly panel required for the hardware complex. And additional devices, such as digital multimeters, have to be imported. It measures current, voltage and power.

- Initially, this project was a scientific project that emerged as a result of research in the laboratory of the science and technology park

of the university. For the purpose of commercialization, a state grant for a period of three years was allocated through the Science Fund. With these funds we organized a small production workshop. The intellectual potential of the project is high. Therefore, we are very proud that young scientists are carrying out such work in our laboratory, - said Askar Zhunusbekov.

A UNIQUE METHOD FOR DETECTING AIR POLLUTANTS



Al-Farabi Kazakh National University manages the global hub of the United Nations Academic Advocacy Program for Sustainable Development. Therefore, the university calls on the international academic community to implement the UN Sustainable Development Goals. One of them is environmental protection.



Al-Farabi Kazakh National University held a round table dedicated to World Environment Day. World Environment Day, established by the United Nations in 1972, is one way to draw the world's attention to environmental issues. The event was organized by the Ban Ki-moon Institute for Sustainable Development at our university with the support of the UN Information Office in Kazakhstan. Speaking at the forum, the rector of KazNU Zhansait Tuimebayev noted that the deteriorating environment is now a global problem. Mankind's actions against nature are causing ecosystem damage and irreparable damage.

Employees of the Laboratory of Biosphere Ecology at KazNU implement the project "Development of a semi-automatic station for monitoring the concentration of organic pollutants in the air of cities by chromatographic methods." As part of it, a study was conducted to determine the level of air pollutants in Almaty, such as BTEK (benzene, toluene, ethylbenzene and acid). The average concentration of benzene, a carcinogen of group I in the city, in 2016 was $53 \mu\text{g} / \text{m}^3$, and the maximum concentration in the same year was $237 \mu\text{g} / \text{m}^3$. This is in line with data from heavily polluted cities such as New Delhi, Cairo and Rome. Therefore, these substances should be constantly monitored.

Dr. Nasiba Baimatova Ph.D. In his dissertation, he identified about 16 polycyclic aromatic hydrocarbons, heavy metals and inorganic salts, which are common in the air of Almaty. As a result, it showed high concentra-

tions of toxic compounds, especially polycyclic aromatic hydrocarbons. The amount of BTEK in the air did not exceed the maximum allowable concentration. "One thing to keep in mind is that these norms are outdated," experts say. Because you can't show how much damage it does to human health. Almaty ranks 8th out of 20 cities polluted by BTEK toxic compounds. Our city ranks third in terms of benzene pollution. This is data determined by a special methodology.

The Laboratory of Biosphere Ecology under the Center for Research and Analysis of Physics and Chemical Methods at KazNU has implemented many projects in this area. Currently, the laboratory staff has developed a research program on "Improving air quality in Nur-Sultan and Almaty using modern analytical methods and modeling tools." As part of the project, experts recommend the use of specific methods of analysis of atmospheric air. According to Nasiba Baimatova, a leading researcher at the laboratory, chemical analysis and receptor model PM2.5 will be used to study the share of air pollution sources in Nur-Sultan and Almaty. Five different filters are used to analyze PM2.5: 1) metals, 2) inorganic anions and cations, 3) polycyclic aromatic hydrocarbons, 4) organic and elemental carbon (OC / EC), and 5) nitrate loss. It is performed in the laboratory by the thermal / optical method using an OC / EC analyzer (purchased as part of the program).

PMF (Positive matrix factorization) is used as a method of modeling receptors to iden-



tify sources of contamination. PMF is a method of multivariate factor analysis. It uses the least squares method to solve problems. Mass concentrations of organic pollutants in air samples of Almaty and Nur-Sultan were determined in the Laboratory of Biosphere Ecology at KazNU. "The study will be carried out with the use of gas chromatography with mass spectrometric detection, along with thermal desorption," experts say.

Spatial and temporal changes in the concentration of air pollutants in these cities of Kazakhstan are also analyzed. The data of the national network of ground control stations "Kazhydromet" or the website www.airkaz.org are used in the work.

- According to the results of PMF modeling, the share of sources of pollution of PM_{2.5} particles in Nur-Sultan and Almaty is estimated. Concentrations of various pollutants in the air will also be assessed. The values of mortality, morbidity and economic damage are assessed. The program to identify sources of pollution and improve air quality can be further applied to other heavily polluted cities in Kazakhstan. The results of this program can serve as a basis for the development of action plans for air quality programs for individual cities, - said a leading researcher of the Laboratory of Biosphere Ecology at KazNU Nasiba Baimatova.

The results of the program allow to address some points of strategic and program documents. For example, the item "Strengthening the capacity of science" in the state program

for the development of education until 2025. Second, the concept of transition of the Republic of Kazakhstan to a "green economy", ie Section 3.6 "Reduction of air pollution." Third, the Strategy "Kazakhstan 2050", Chapter 4 "The health of the nation - the basis of our successful future."

Air pollution, especially in urban areas, is one of the most acute problems. This is detrimental to ecosystems, both economically and socially. The level of air pollution in major cities of the country is too high. In a 2013 World Bank study, experts linked the root causes of population morbidity and some economic costs to this problem. In the IQAir ranking, in 2019, Kazakhstan ranked 29th in the world in terms of average annual pollution levels. In winter, the city of Nur-Sultan is one of the ten most polluted cities in the world (IQAir, 2020).

The level of air quality in the country is widely discussed in the media, but the number of peer-reviewed studies is limited. Sources of air pollution are coal burning in power plants and houses, heavy industry, transport, dust, construction sites, agriculture, etc. may be. We have not seen the special research of the World Health Organization for the cities of Kazakhstan in this area. However, only one city in the country, Kurchatov, with a population of 13,000, was surveyed.

Increased levels of PM_{2.5} in the air have a negative impact on human health. In particular, it can lead to many cardiovascular and lung diseases and, consequently, a decrease in quality of life and even premature death. We



have reached a point where we can't save children, especially from this problem. Because polluted air has a negative effect on the functioning of the lungs, the development of the brain and inhibits the development of the mind. The risk of dementia is higher in the elderly.

In this case, "Why 2.5 microns?" The question may arise. This is because all particles and droplets smaller than 2.5 micrometers float in the air. They are found both in the forest and at sea. But the most dangerous area is the city. Firstly, their concentration is usually high in the city, and secondly, the chemical composition of finely dispersed aerosol (PM2.5) in the city is dangerous compared to the natural environment. Also, PM2.5 particles are easier to overcome biological barriers that protect the human body from foreign substances than large air pollutants. This poses a serious threat to the body's ability to function properly.

Both PM2.5 aerosol composition and individual particle parameters may vary from city to city. For example, the most common in ur-

ban areas are soot, the smallest parts of asphalt and car tires, particles of mineral salts (sulfates, nitrates), heavy metal compounds (mainly oxides).

According to CORE epidemiological research, 25.5% of Almaty residents suffer from bronchial asthma. A recent study by Denis Vinnikov, head of the KazNU Health and Environmental Research Laboratory, provides scientific evidence of the negative effects of high levels of PM2.5 particles in Almaty on people working outdoors in the winter. This is because the concentration of PM2.5 in different parts of the city varies from 120 $\mu\text{g} / \text{m}^3$ to 1500 $\mu\text{g} / \text{m}^3$. This figure exceeds the standards approved in the country.

A program to improve air quality for the cities of Nur-Sultan and Almaty will be developed using modern research methods and modeling tools. The program will include an analysis of the situation with air pollution in selected cities, an analysis of world best practices and recommendations for improving air quality.



PROTECTS STURGEON FROM BACTERIAL DISEASES

In recent years, the production of sturgeon in aquaculture has grown significantly due to the high demand for caviar on the world market. Sturgeon farming in aquaculture is one of the most important measures aimed at reducing the population and restoring the life cycle of sturgeon. However, the rapid development of aquaculture leads to an increase in diseases caused by bacterial infections, which in turn can lead to high mortality of sturgeon in aquaculture and catastrophic economic losses.

Sturgeons are one of the oldest species of fish, they mature sexually late and live long. And caviar and meat are important as an indispensable source of protein for the human body. Currently, sturgeon species are threatened with extinction due to high levels of poaching, water pollution and habitat loss. Therefore, their cultivation in aquaculture is organized. But it also has a negative effect. Although sturgeon are rescued from poachers, they are caught in the trap of infectious bacteria.

Amangeldy Bisenbayev - Director of the Research Institute of Biology and Biotechnology at KazNU, Academician of NAS RK, Doctor of Biological Sciences, Professor. Under the guidance of the scientist, “New antibacterial drugs for the treatment of sturgeon diseases” were developed. According to Amangeldy Kuanbayevich, the most dangerous bacterial diseases for sturgeon in aquaculture are Pseudomonas and Aeromonas infections.

- At present, due to the widespread and frequent use of antibiotics without any control,

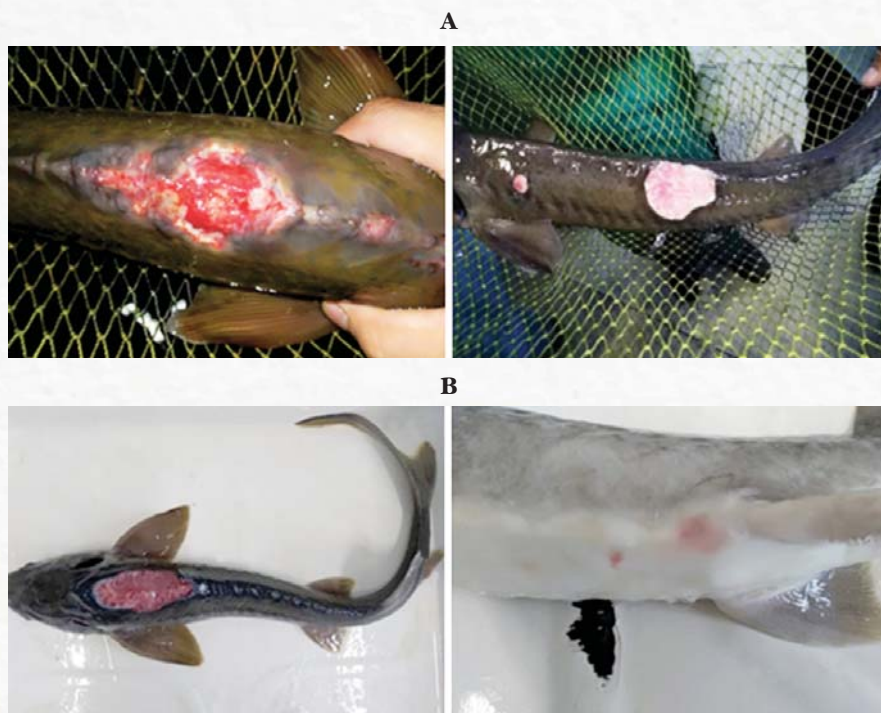
the number of antibiotic-resistant bacteria has increased dramatically. This phenomenon is the main cause of dangerous diseases and deaths in aquaculture. It also leads to the failure of antimicrobial therapy. As a result, there are concerns about the safety of fish products. Therefore, new strategies are needed to combat drug-resistant pathogens, - says the scientist.

According to the professor, endolysin therapy is now a promising alternative to the treatment of complex infections. "Over the past 10 years, the field of endolysin research has

gained momentum. First of all, some endolysins, including chimera endolysins, developed by various companies against gram-positive and gram-negative pathogens of humans and animals, are currently undergoing pre-clinical and clinical trials. However, despite the fact that fish, like other animals and humans, are constantly attacked by microbes, the potential of endolysins as antibacterial agents has not yet been studied in the field of aquaculture," said A. Bisenbayev.

The project proposed by KazNU scientists is aimed at developing new chimeric endoly-





Hemorrhagic septicemia of sturgeon

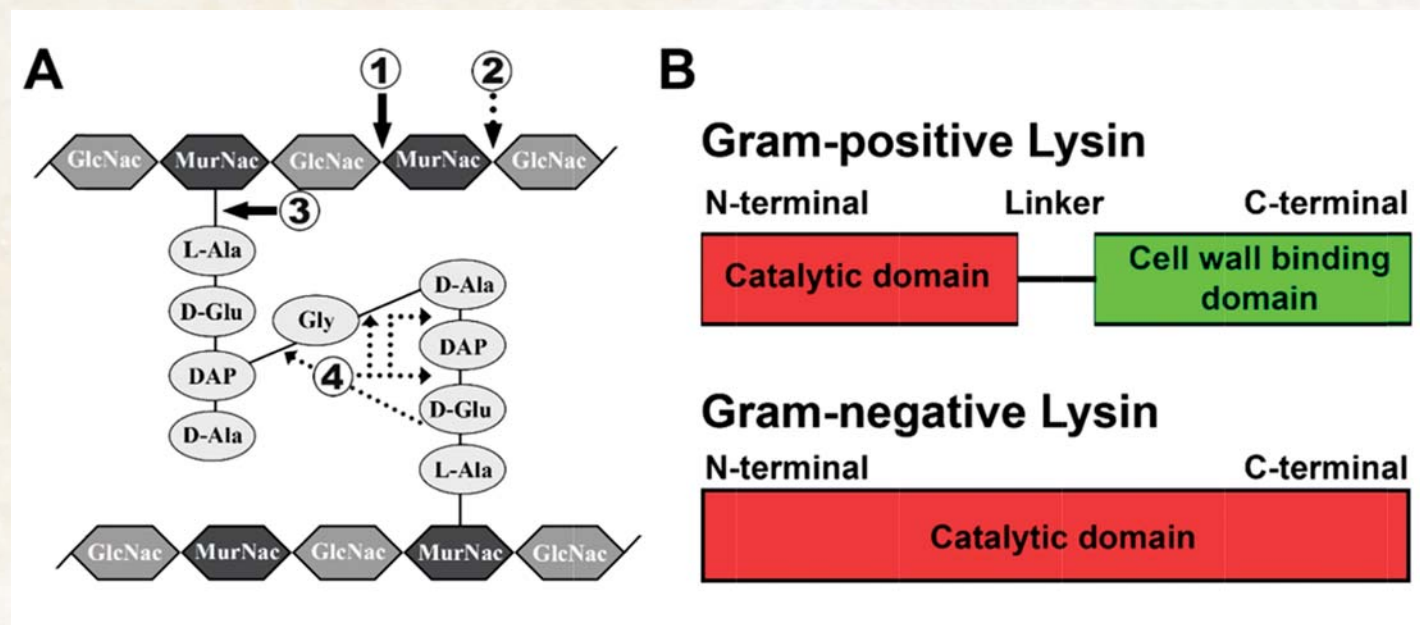
*Aeromonosis (A) and pseudomonosis (B) of sturgeon; Infected sturgeon from LLP
“Experimental production training and scientific complex of aquaculture production” LLP
(Uralsk, West Kazakhstan region)*

sins with high lytic activity against gram-negative and antibiotic-resistant bacteria, which are the main cause of sturgeon diseases in aquaculture.

- Endolysins can be an alternative to antibiotics. They kill bacteria efficiently and quickly, regardless of their physiological condition or resistance to antibiotics. Endolysins are classified into three groups according to their enzymatic activity: glycosidases, which include glucosaminidase, muramidases and lytic transglycosylases. The action of these en-

zymes is aimed at breaking down the - (1,4) -glycosidic bonds of sugar. Amidases hydrolyze amide bonds between the main chain of sugar and peptide branches. Endopeptidases hydrolyze a peptide bond between two amino acids. The structure of endolysins can be globular or modular, - says academician Amangeldy Bisenbayev.

Thus, endolysins promote the effective and rapid elimination of bacteria, regardless of their physiological state or resistance to antibiotics. According to the scientist, bacte-



Structure of peptidoglycans and sites of separation by hydrolases

A) 1 - Glucosaminidase; 2 - muramidases (lysozymes) and lytic transglycosylases; 3 - L-alanine amidases; 4 - end peptidases; GlcNac - N-acetyl glucosamine; MurNac - N-acetylmuramic acid; B) The scheme of the structure of gram-positive and gram-negative endolysins

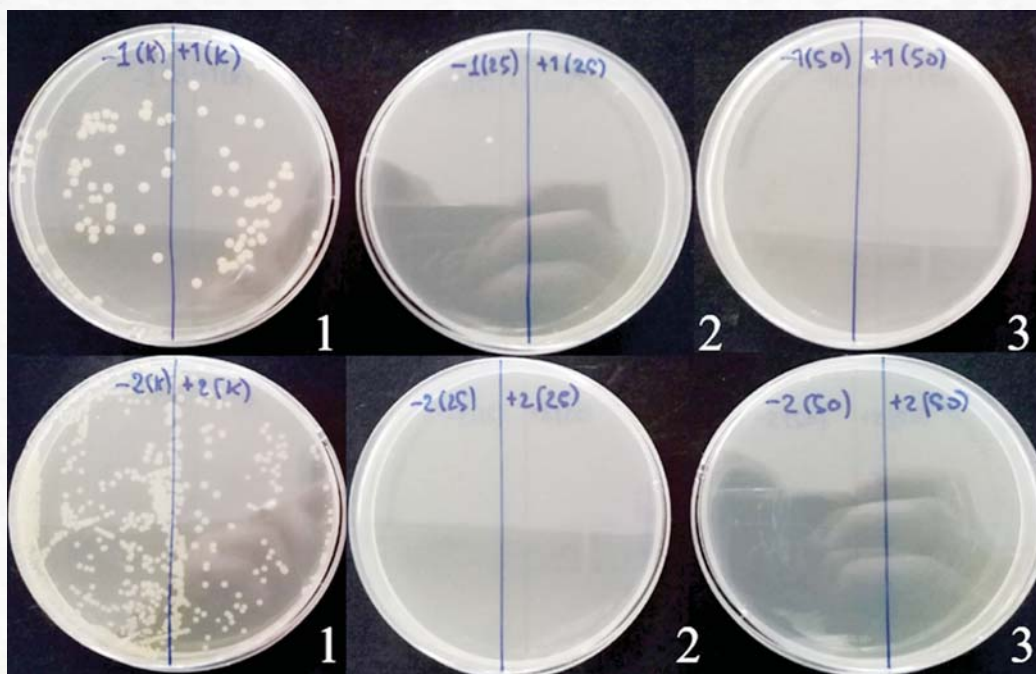
rial strains do not develop resistance to endolysins, unlike antibiotics and bacteriophages.

As a result of the study, the bacterial pathogens of sturgeon *A. hydrophila*, *A. salmonicida*, *A. caviae*, *A. sobria*, *P. putida* and *P. fluorescens* were isolated and their susceptibility to antibiotics in vitro (in vitro). checked. Chimeric endolysins will also be developed and the genes of three primary and seven chimeric endolysins will be cloned and their expression in *E. coli* will be optimized. The antibacterial activity of endolysins is determined and meth-

ods of treatment of sturgeon are developed.

At present, endolysin therapy is a promising alternative treatment for complex infections. This is because endolysins are enzymes that encode phages characteristic of peptidoglycan hydrolase activity. Therefore, they are able to break down the bacterial cell membrane. This allows the phage to leave the host cell after replication.

The products obtained as a result of the project can be consumed by fishing enterprises, including industrial aquaculture complexes and fish farms, as well as fish farmers. This



Results of antibacterial activity of endolysin in vitro

1 - control, 2 - endolysin (25 mcg), 3 - endolysin (50 mcg)

is because the high density of fish species on the farm can lead to a sharp increase in the number of pathogenic microorganisms and their mass extinction. Therefore, from an economic point of view, this factor is an obstacle to the development of aquaculture. According to experts, preventive or curative measures to reduce reproductive costs are often carried out with the use of antibiotics, which are often added to food. In addition, residues of antibiotics used in the treatment and prevention of bacterial infections are found in foods made

from fish grown in aquaculture. This not only harms the consumer, but also pollutes the environment. Thus, antibiotic-resistant bacteria can multiply rapidly. As mentioned above, endolysins do not have the same side effects as antibiotics. And it does not affect the normal microflora of the body. At the same time, a very important aspect is that bacteria cannot develop endolysin resistance. Thus, endolysins, being a good alternative to antibiotics, have great potential in the fight against various pathogens.

AN INNOVATIVE METHOD OF DIAGNOSING DEPRESSION

You may have heard the saying, “Proper diagnosis is half the battle.” Depression is one of the most common diseases today. This makes members of the community incapable and leads to a decrease in activity. Psychologists talk about the negative effects of depression in many forums. However, one of its difficulties is diagnosis. KazNU scientists want to solve this problem.

The World Health Organization estimates that the economic cost of depression is about a trillion dollars a year. This is because depression, which causes stagnation of cognitive functions, forces the tactics of absenteeism, that is, dismissal or presentation, that is, pretending to be at work. Therefore, the working capacity of the population decreases.

According to Professor Almira Kustыbayeva, Candidate of Biological Sciences, behavioral disorders often lead to criminal activity and can pose a direct threat to society. If left untreated, it can lead to suicide, low quality of life, and social ills. For example, if

we look at the statistics, the suicide rate in Kazakhstan is 26.9% per 100 thousand population.

- Along with the stigma, the situation is aggravated by the lack of objective methods of diagnosing depressive conditions. With this in mind, we see an urgent need to develop new objective methods for diagnosing depressive conditions. The main novelty of the research is the determination of new EEG biomarkers that accurately determine the state of depression during cognitive stress. This method allows the majority of the population to be tested for depression. The research fo-





cuses on the identification of specific patterns of EEG, reflecting the depressive conditions of the local population in the theoretical scientific direction, and the computerization of biomarkers of depression in the applied scientific direction. Thus, it contributes to the timely and objective diagnosis of depressive conditions and the prevention of behavioral disorders and suicide, - said Professor A. Kustubayeva.

According to Ms. Almira, for the first time, valid EEG biomarkers were identified on the basis of cognitive tasks given to Kazakhstani citizens. That is the uniqueness of the results of the study.

- As a result, the most informative indicators of spontaneous brain activity during sleep were identified. In addition, a description of the brain potential generated during the performance of cognitive tasks for the control of executive function and decision-making. These results were discussed and published at annual international conferences. He also stressed the importance of the final results for implementation in practice. The psychometric methods developed in the current study were introduced into this psychotherapeutic practice in a timely manner. Due to the increase in depression during the pandemic, domestic psychotherapists, in cooperation



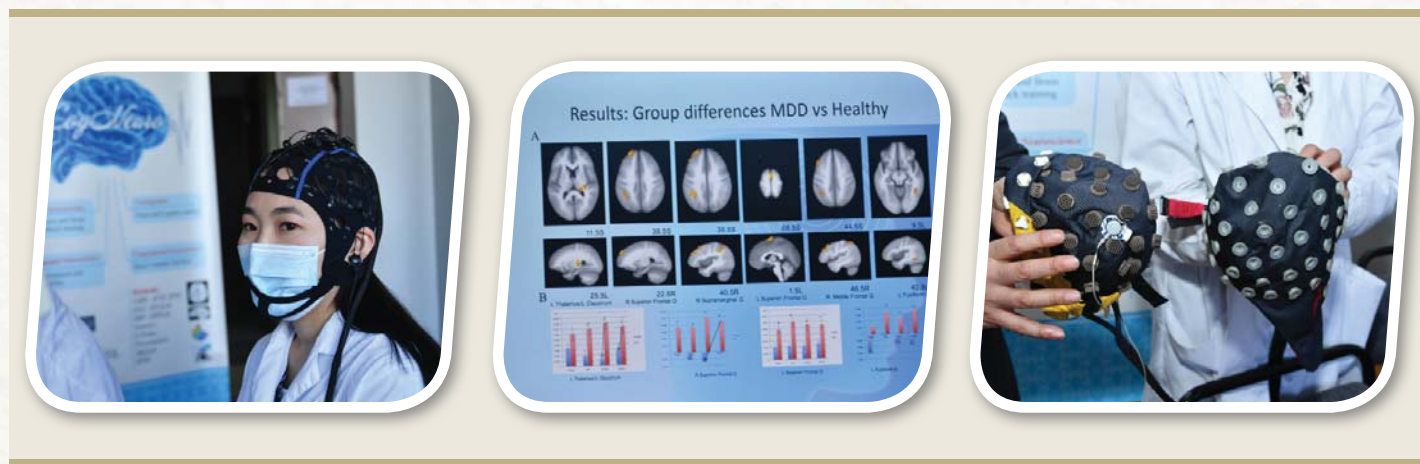
with UNICEF and UNESCO, provided free consultations. Now EEG biomarkers are ready for the development of technical equipment for the diagnosis of depression, - said the professor.

The results of the study show that well-developed cognitive and emotional loads allow to determine the patterns of changes in brain signals characteristic of depression.

- Cognitive tasks selected to study the control of executive functions and decision-making help to identify differences in brain function during cognitive activity. In general, our results showed that in patients with depression is associated with a deterioration of control over the executive functions of the brain and a decrease in the activity of the brain to certain stimuli. The main scientific results of the study can be introduced in the form of a computer program for the diagnosis of emotional depression and the creation of a domestic production tool for future commercial-

ization. Implementation will allow timely diagnosis and treatment of the disease at an early stage, prevention of suicide. Ways to create a domestic production tool for the diagnosis of emotional and depressive conditions are also considered. For the first time, a computer program based on a scientifically based experimental set of psychometric, cognitive tasks and psychophysiological methods will be developed to study the diagnostic criteria for depressed conditions, adapted and validated by the local population, - said the scientist.

EEG biomarkers, which indicate a lack of brain activity and a decrease in the stability of the brain in depression, are the main criteria for the diagnosis of depression. Therefore, this device can be widely used in clinical practice for the prevention of depression and suicide. According to Almira Kustybayeva, the data can be widely used in national and international practice. Because the obtained results can be





used in the activities of psychological and psychiatric, security, human resources, medical, research and educational institutions.

A 2011 study found that general practitioners have difficulty diagnosing depression. Because about half of patients try to remain silent about the symptoms of depression. Many are afraid that their doctor will prescribe antidepressants. And now one believes that

emotional control is a personal matter, not a doctor's. There is also a reason why a warning about depression will be included in the medical record and will be known to the employer. Today, short questionnaires are more commonly used as a screening tool for depression. Objective diagnostic tools, such as EEG biomarkers, are also needed to diagnose and treat it completely.

A PRODUCT THAT WILL «REVOLUTIONIZE» THE MARKET OF SWEETS

Today, according to the International Diabetes Federation, 463 million people worldwide suffer from diabetes. The COVID-19 epidemic has caused irreparable damage to health care due to the prevalence of diabetes (SD) and obesity. This is because the flow of infection increases in patients with this disease.

Scientific data collected during the pandemic showed that patients with diabetes and obesity should pay more attention to the prevention of COVID-19. A raw material component such as stevia plays an important role in the production of functional foods. Its use in the food industry allows you to partially replace sugar, which is very important to solve the problem of proper nutrition.

Specialists of the Laboratory of Plant Biotechnology of Al-Farabi Kazakh National University implemented a research project on «Development of biotechnology for mass reproduction of stevia - a natural substitute for sugar for implementation in the industrial

sector of the Republic of Kazakhstan.» According to the project leader - Candidate of Biological Sciences, Associate Professor Saltanat Asrandina, stevia (*Stevia rebaudiana* Bertoni) is a perennial, thermophilic, herbaceous plant. It is endemic to Brazil and Paraguay.

- Diterpene glycosides (DG) are synthesized in stevia leaves, their aglycones is steviol. These compounds are about 300 times sweeter than sucrose. They are low in calories, do not have toxic and mutagenic effects. It is practically not absorbed into the human body. DG is very effective as a sweetener for people suffering from disorders of carbohydrate metabolism,





especially for people with diabetes, because they have hypoglycemic properties, - says the project manager.

According to Saltanat Shyntayevna, the main advantages of dieter glycosides: sweet taste, zero energy content, resistance to heating, storage and freezing, as well as acids and alkalis, soluble, low consumption, no harmful effects with long-term use and participation in metabolism does not require insulin.

Stevia components have sugar-substituting properties in the diet of people with metabolic

disorders, including people with diabetes, atherosclerosis, obesity and other concomitant diseases.

Stevia has a positive effect on the function of the liver and pancreas, eliminates allergic diathesis in children, improves sleep, increases physical and mental abilities. Stevioside prevents the formation of ulcers in the gastrointestinal tract (GIT). Acetyl-salicylic acid, butadione and other anti-inflammatory drugs taken with stevia do not adversely affect the walls of the gastrointestinal tract. Numerous

studies have shown that regular use of stevia lowers sugar, radionuclides and cholesterol in the body, improves cell regeneration, inhibits tumor growth, strengthens blood vessels, has choleric, anti-inflammatory and diuretic effects.

There is no age limit on the use of dieter glycosides. Therefore, they can be used for medical nutrition for children and adults. Also, due to the properties described above, stevia is used in the food industry, i.e. in the technological processes of cooking, canning vegetables, fruits, meat and cosmetology.

Transparency Market Research recently conducted a study of the sweetener market for 2020-2030. It provides a comprehensive analysis of the industry and its opportunities. As a result, it is estimated that the global confectionery market in 2020 will be estimated at 489 billion dollars. According to the forecast, the market can reach 731 billion dollars by 2030, with an annual growth rate of 4%. The use of stevia, syrup, honey, palm sugar, coconut sugar and other plant-based sweeteners in beverages and packaged foods will be available in the market in the areas where these plants grow. And it will help it to enter the world market.

Stevia is one of the most promising intensive sweeteners in the world. It can eliminate health-threatening carcinogens and food additives, as well as synthetic and high-calorie sweeteners that are banned in developed countries such as Europe, the United States, Japan and Canada.

In 2011, stevia was officially adopted by the European Union as a dietary supplement. Since then, new stevia-based products have attracted consumers in European countries. For example, Coca-Cola, the world's largest producer of soft drinks, uses 30% stevia instead of sugar in French-made Sprite and Nestea products. It was the first major company to introduce stevia after its official approval by the European Commission (EC). It also allowed Coca-Cola to take advantage of innovative opportunities and launch new beverages.

In recent years, the level of stevia consumption in the global food industry market has increased significantly. The «sweet» plant is rapidly gaining popularity on the world stage, conquering the beverage and food industries.

Based on Mintel's new products, about 450 new products using stevia are released each year. According to Grand View Research, the global stevia market will reach \$ 556.7 million by 2024. As for us, in 1996 the staff of the Institute of Plant Physiology, Genetics and Bioengineering in the country began work on the development of reproductive biotechnology and the acquisition of planting material.

From 2012 to 2014, the staff of the Laboratory of Plant Biotechnology of KazNU implemented a research project in this area.

- As a result of the study, we selected and modified methods of microclonal propagation of stevia in vitro culture. The effect of new synthetic growth regulators on the physiological and biochemical parameters of stevia was



studied. Methods of adaptation of regenerants to the open field have been optimized.

The patterns of accumulation and distribution of stevioside in plants grown in the field and the amount of glycosides, pigments, proteins, carbohydrates, vitamins and minerals were determined. The biological activity of extracts from stevia leaves was assessed for the growth and development of bacteria, - says Saltanat Shyntayevna. According to the project manager, the biological activity of stevia extracts on physiological and biochemical parameters was studied. This determines the resistance of wheat and corn to pathogens in laboratory and field conditions.

- On the basis of experimental fields of the Agrobiological Station of the Kazakh National University, stevia products (leaves) were grown and harvested. Concepts, technological instructions and recipes for several types of flour confectionery have been developed, replacing granulated sugar with powder from stevia leaves. These include pastilles, «crispy

bread», Bionan - «Minus appetite», «Plus stevia» therapeutic and prophylactic balm, «Plus stevia» probiotic bread, «Kurt plus stevia» plant-dairy products. Scientific articles and theses were published within the project. Five innovation patents have been obtained, - says Saltanat Asrandina.

It is no secret that the number of people with diabetes has been growing in recent years. Environmental problems in Kazakhstan also have a negative impact on the health of the population. And many are unaware of a new, natural source of stevia, which is leading to significant changes in nutrition. Mass production of stevia-containing medicinal products has not yet been established in Kazakhstan. Due to the lack of domestic raw materials, our industry is focused on imported stevia. The main competitors are foreign companies such as the United States, China and Russia. The cost of food products with natural sugar substitutes is high for domestic consumers.

Undoubtedly, the lack of stevia varieties





adapted to the conditions of Kazakhstan will delay the spread of this crop in the region and its introduction into agricultural production. Therefore, now is the time to provide the population of the republic with such food.

In this regard, today the staff of the Laboratory of Plant Biotechnology continues to work on the development of technology for the production of stevia for localization in the southern regions of Kazakhstan. Also, KazNU specialists together with scientists of Almaty

Technological University are conducting research on the development of technology for the preparation of «new generation» food for functional purposes, enriched with high nutritional value and therapeutic and prophylactic stevia.

To this end, the development of food processing technology will be aimed at improving the health of the population. It will also ensure food security and make a significant contribution to solving problems in this area.

A NATURAL MINERAL THAT CLEANSSES THE SOIL OF OIL



More than 1.5 million hectares of land in the country are polluted with oil and oil products. The volume of black gold exported exceeds 50 million tons. Science has solved many problems in the way of mankind. In this regard, KazNU scientists, based on several years of research, suggest the most effective way.

At present, there are many ways to clean the soil from oil. Most of them are expensive, based on complex processes, and reagents used in the process are not available. That is why cheap, effective cleaning methods are of interest to the public. One of them is the sorption method. Therefore, KazNU scientists have developed sorbents based on shungite rocks of the Koksu field. According to the project leader - Professor of Chemical Physics and Materials Science, Doctor of Chemical Sciences Erdos Ongarbayev, the main advantage of this is the ability to clean the land contaminated with oil waste at the final stage. That is, this method is used when the amount of oil in the soil does not exceed 5-10%. And it allows you to control the process, preventing secondary pollution.

Shungite is a natural mineral or mineral produced in the eastern and south-eastern regions of the country. Produced in Russia on the territory of Karelia. Sorbents made of shungite from the Karelian field are 1.5-2 times cheaper than coal and are effective as a filter element, catalyst, and biological disinfectant. This conclusion was reached during an industrial test for wastewater treatment. The reserves of shungite at the Koksu field in Almaty region are estimated at 620 million tons.

According to the professor, the peculiarity of shungite is that it contains carbon and silicon oxides, which ensure its high sorption properties.

- As we usually know, the sorbent - activated carbon contains only carbon, while shungite contains oxides and compounds of silicon and other elements. We all know that scientists of the faculty have previously developed and put into production filter materials on the basis of shungite to purify water from various harmful substances. The novelty of our project is the immobilization of strains of microorganisms in a sorbent based on shungite and its use for the first time in the purification of soil from spilled oil and oil products, - said E. Ongarbayev.

The «signature» of civilization can be seen in many environmental issues. Especially with the growth of industry, we see a decline in natural processes in the environment. The spread of black gold in the soil during oil production, collection, transportation, storage and preparation, repair of wells has become an environmental problem. Oil is one of the most dangerous pollutants in nature. Because it negatively affects the development of living organisms and plants in the soil.

In recent years, the industry has been widely using natural sorbents. The main factor influencing it is the widespread use of sorbents in nature. That is why the cost is low. In addition, they have high sorption properties and simple application technology. These minerals and natural raw materials can be used in various industries.

Shungite allows purification of water from oil and salts of heavy metals. Because its base is made of shungite carbon. The structure of



shungite carbon is similar to fullerene, i.e. it has an ordered structure, and also contains aluminosilicates, oxides of alkali metals, trace amounts of rare metals.

As mentioned above, today there are many ways to clean the soil and water from oil. For comparison, let's look at some of them. For example, there is a sorbent consisting of a suspension of glauconite and bentonite clays in a ratio of 1/3 and 3/5, enriched glauconite and fullerene shungite. Due to its low oil content, it is inefficient and does not increase the number of aboriginal oil-oxidizing microorganisms.

To obtain the following types of sorbents, a mixture of shungite and hydrolyzed lignin is heated to 100 °C and carbonized by raising the temperature to 700 °C in an argon or nitrogen medium. To obtain a sorbent consisting of shungite and rice husk, the mixture is heated to 150 °C, dehydrated at 150-200 °C, and carbonized at 200-400 °C in an argon or nitrogen medium. The disadvantage of these sorbents is that at the initial stage the raw material is processed in several stages and uses high temperatures.

Another type of sorbent is recommended for cleaning oil-contaminated soils. It consists of zeolite, shungite and potassium humate. They are introduced into the soil in a certain order: first mix shungite and potassium humate, then a week later zeolite, and then every two weeks the treated soil. Reading the process, you can see the shortcomings of this composition. Because of repeated tillage, the

use of additional reagents will require more resources.

Shungite rocks can be used as an enterosorbent to cleanse the body of toxins and microorganisms. For example, you can find an enterosorbent consisting of shungite rock with particles of $15.0 \cdot 10^{-6}$ m and 50-70 percent by weight of silicon dioxide. However, there is no information on how its use affects the absorption of microorganisms. In addition, an enterosorbent consisting of shungite rock of the same size and 20-50 percent by weight of silicon dioxide affects the adsorption of microorganisms, but in general, its sorption capacity is insufficient.

In addition, heat-treated shungite at 500-550 °C can purify liquids as a sorbent. But for this it is necessary to process raw materials at high temperatures.

KazNU scientists develop sorbents by mechanochemically activating shungite rocks of the domestic Koksuy field. As a result, sorbents have a nanostructure and improve their sorption properties due to the increase in surface area, porosity and pore size. «In this way, we can increase the efficiency of the process of cleaning the soil from oil residues,» said Erdos Kalimullaevich.

Nanotechnology is the production of nanoscale materials with special properties and their use in different directions. When the particle size of the material is less than 100 nanometers, their physical, chemical, mechanical and other properties are better than usual. Erdos Ongarbayev said he hoped





the project would improve the sorption properties of shungite samples to such a nanoscale.

- So far, we have obtained nanostructured materials by crushing shungite by mechanochemical activation, as well as by roasting with rice husk. On these materials we placed strains of microorganisms isolated from oil-contaminated soil and determined the degree of their destruction of oil, the value of which reached 70-80%. This work is carried

out on the basis of the Department of Chemical Physics and Materials Science and the Institute of Combustion Problems together with scientists from the Department of Microbiology of our university. The general grant project is intended for implementation in 2020-22. Therefore, next year the work on cleaning of truly contaminated soil samples will be started, - said the scientist.

The proposed project will allow to increase the mass of aboriginal oil-oxidizing



microorganisms and, accordingly, to obtain a sorbent that will increase the destruction of oil and oil products in the soil. As a result, microorganisms that multiply in the soil feed on the hydrocarbons in the oil and convert them into carbon dioxide and water. And sorbents on the surface further promote the growth of plants as fertilizers. Therefore, used sorbents do not need to be reassembled or recycled.

Sorbents based on shungite rocks of the Koksus field increase the destruction of oil and oil products in the soil. It is economically viable for the domestic oil industry.

This project is supported by the mining company «Koksus». The main goal is to expand the use of shungite in Kazakhstan. And this

company is ready to provide the necessary assistance in the implementation of the project. The scientific value of this research is high. Because it contributes to the acquisition of new information about the properties and structure of sorbents, the mechanism of sorption of oil and petroleum products.

The natural sorbent made of shungite at the Koksus deposit has the properties of coal and silicate adsorbents. That is why it has a high oil capacity. As foreign hydrocarbon-oxidizing microorganisms are not introduced into the soil, the natural biocenosis remains the same. This is an effective way to break down oil. The use of such a sorbent does not adversely affect the beneficial microbiota of oil-contaminated areas.

SOLAR ENERGY STORAGE IS A NEW DIRECTION

In today's world of technology, there are many ways to produce energy. There will be a warehouse at any production site. But so far there is no possibility to save the main product of the energy sector, ie electricity. In the future, large-scale power plants should focus on industrial energy storage and production of various power storage facilities. After all, the rapid development of renewable energy sources has made this task a key issue on the agenda.

No one can argue about the benefits of renewable energy sources. However, its widespread introduction and use has shown the need to save energy for later use. After all, the production of wind and solar energy is a «continuous» process. In many countries, energy consumption fluctuates according to the seasons. In this regard, it is important to master the technology of seasonal energy storage. Young scientists of Al-Farabi Kazakh National University have implemented «Technology of seasonal storage of solar

thermal energy in order to provide heat and hot water to high-rise buildings and residential areas.» Acting Associate Professor of Mechanics, PhD and Doctor of Engineering Madina Tungatarova told about the technology needed in the field of alternative energy.

- This project was started as part of Bakytzhan Akhmetov's doctoral and master's dissertations of Tannur Amanzholov, Zarina Turtayeva, Abzal Seitov. We have applied for funding under the World Bank's «Stimulation of Effective Innovative Projects» program. The





project was successfully selected and we received the necessary financial support for the implementation of the project for 3.5 years. The main idea of the project is to save solar energy in order to provide hot water and heat to homes. During the summer months, solar energy is released too much, but the time when it is really needed is the winter. Similarly, if we get a lot of solar energy during the day, people consume a lot of energy at night. Solar energy storage technology consists of two components: a short-term storage battery for hot water supply and an underground heat accumulator for long-term storage, - says the project manager.

Doctoral and undergraduate students carry out initial work during internships at the Technical University named after Sofia,

Bulgaria. In addition, on the basis of a grant «Newton - Al-Farabi» Bakytzhan Akhmetov traveled to the UK and contributed to the project. Madina Tungatarova believes that the innovative model of solar energy conservation will greatly benefit remote areas of the country.

- Even gas or coal delivery there is expensive. This technology is designed for small areas and cottage villages. After the start of the heating season in Almaty, it is impossible to walk in the yard. Because thermal power plants work intensively. Therefore, the air becomes very polluted. We are interested in what types of technologies are available in the world to solve this problem. For example, we learned that Canada has a similar technology for this project. Canada is geographically similar to our capital Nur-Sultan. At present, this technology

is fully implemented and working there. For example, in the case of a cottage town in Canada, 97% of it is heated by this technology. This is the result achieved in just three years. So, this is a technology that can be fully implemented.

According to the scientist, there are some problems with commercialization. This is because most of the necessary components, such as solar collectors and pumps, are imported. Therefore, the cost of solar energy storage technology can be expensive. However, given its contribution to human health and the environment, this will be a promising project, despite the fact that the payback period is seven years. It is known that respiratory diseases are more common in Almaty than in other regions. «Therefore, our project will be implemented at a decent level in the future,» he said.

- The program «Stimulation of effective innovative projects» is aimed at commercialization of the project. Therefore, the capacity of the project should be taken into account when conducting marketing analysis. This is not a simple thing to do with a ready-made device. It is necessary to calculate the amount of energy consumption of each facility. Accordingly, we choose the required number of solar collectors, the capacity of heat accumulators and short-term storage batteries. In our analysis, the payback period of the project was 10 to 15 years, depending on the capacity of the facility. During the project we developed this technology in the Agro-Bio

Center of KazNU. This center is located in the village of Baysyerke, Almaty region. Students of the Faculty of Biology at our university do experiments there. Therefore, for the purpose of commercialization, we installed this technology in a mosque in the village of Koksai, Almaty region. This facility was provided with hot water due to seasonal storage of solar energy, - said Madina Tungatarova.

Previously, there was an electric water heater. This device would fail when a large number of people gathered for Friday prayers every week. An innovative project of KazNU scientists has been working there for the last year. There were also a lot of positive comments about the technology.

- In order to save solar energy, we use phase-changing material, ie different types of paraffin, in short-term batteries. Paraffin is mainly in the solid phase. When paraffin is heated above the melting point, the process of transition from solid to liquid begins. Paraffin consumes a lot of energy in the process of transition from solid to liquid phase. We call that energy latent energy. As a result, it allows you to receive and store more energy than planned. That is the main reason why we call it an innovative project, - says the scientist.

In addition, on the basis of the grant «Newton - Al-Farabi» Bakytzhan Akhmetov experimented with the addition of nanoparticles of aluminum oxide to various types of paraffin. This also allows you to increase the performance of the battery.



Therefore, there is reason to believe that the main innovation of the project is to increase the efficiency of solar energy storage technology.

According to experts, the concrete plant in Shymkent is interested in innovative technologies. However, as it is a facility that requires a very large energy source, the amount of funds required for the project will be large. Basically, this technology is very effective in schools and greenhouses, mosques or similar institutions.

- Technology is developing rapidly around the world, but environmental problems have

not decreased. Intergovernmental memorandums and agreements aimed at reducing the amount of carbon dioxide released into the atmosphere have been signed. Therefore, I can say with confidence that the project «Technology of seasonal storage of solar energy to provide heat and hot water to high-rise buildings and residential areas» is very promising. However, due to the production of coal in the domestic market, gas and coal prices are relatively low. Therefore, the initial capital required to build a coal and gas-based heating system will be small. At the same time, the low solvency of the population



Temperature component and operating mode of SASTE technologies in the daytime in the Agrobiocenter



does not contribute to the development of innovative technologies based on the conservation of solar energy. However, we hope that as the social responsibility of every citizen increases, environmental projects will find support from the population, - said Madina Tungatarova.

According to experts, the Damu Entrepreneurship Support Fund currently has special programs aimed at alternative energy. However, it should be noted that the state does not fully finance the project, the fixed capital is borne by the customer. In the future, if local governments or the government provide interest-free or low-interest loans to citizens to protect the environment, we would be one step closer to solving

environmental problems. The project manager, Doctor of Engineering Madina Tungatarova summed up her opinion:

- This project was a project that brought together young researchers. The full participation of these specialists in the work through documentation, accounting, research has shown the social impact of this project. As a result, Zarina Turtayeva is studying for a doctorate in France through the Abai-Verne program. Bakytzhan Akhmetov continues his education at Nanyang Technical University in Singapore. Therefore, this project helped to strengthen our experience. I think that in the future such and other new technologies in the field of alternative energy will be rapidly developed in our country.

MICROALGAE WILL CHANGE THE WORLD INDUSTRY

In the future, the production of microalgae in the world will grow steadily every year. This is the forecast of Fututre Market Insights. This is due to the growing demand among consumers for organic, nutritious foods and biologically active additives (BAS). The company's research shows that by 2031 the market will reach 135 million US dollars. Another industry that accelerates the production of microalgae is agriculture. In this sector, the production of biological stimulants with the help of microorganisms is gaining momentum.

Now environmentally friendly, natural biologicals based on microalgae will be introduced into domestic production. The research project headed by the Dean of the Faculty of Biology, Professor, Academician of the National Academy of Sciences of the Republic of Kazakhstan Bolathan Zaya also works in this direction. The main novelty of this project, entitled «Development of biologically active additives and biostimulants for use in agriculture and food industry,

obtained on the basis of microalgae», is the development of safe biopreparations for many industries.

KNOW-HOW

According to the scientist, microalgae and cyanobacteria, which belong to the group of phototrophic microorganisms, are a source of many valuable biologically active



compounds. There is also great interest in the production of safe biologicals in the agricultural, medical, cosmetic and food industries. They are characterized by immunomodulatory, antioxidant, antimetastatic effect, which inhibits the development of cancer in humans and animals. Biologically active additives based on microalgae are natural, affordable, environmentally friendly preventive biological products. Such microorganisms do not cause adverse reactions and have no contraindications.

COMPETITIVE GS

The competitiveness of this project is determined by the special properties of the above microalgae and the advantages of their cultivation technology (cheap nutrient medium, sunlight, inexpensive equipment). The proposed project has no analogues in the country. Biotechnology of microalgae is well developed in the USA, Japan, India, Russia, China, the Czech Republic and other countries of the world. There are no enterprises in Kazakhstan that produce biologicals based on microalgae and other phototrophic microorganisms. The project has great commercial prospects and high potential for commercialization. Products made from microalgae are used in the agricultural sector, including poultry farms, pig farms,

livestock farms, fisheries, and the food industry, pharmacology, medicine.

Bolatkhan Kazykhanuly explained that the preparation of biostimulants and GMOs from microalgae is carried out in several stages. First of all, screening is carried out for the biomass productivity and accumulation of bioactive substances of newly isolated and collection strains of microalgae and cyanobacteria. To do this, the growth rate of newly isolated and collecting strains of phototrophic microorganisms, the growth of biomass and their ability to accumulate bioactive substances are studied.

- In order to obtain food and medical treatment-and-prophylactic biologics, the cells of selected strains of microalgae and cyanobacteria contain biologically active substances, such as amino acids, enzymes, pigments (carotene, phycocyanin, fucoxanthin), fatty acids, vitamins, polysaccharides, etc. biochemical analysis is performed. Optimization of conditions for the cultivation of strains of phototrophic microorganisms contributes to increased productivity. The next step is to assess the pathogenicity and toxicity of biological products based on highly productive microalgae and cyanobacteria. The biological effects of such biologicals will be determined and safety criteria in terms of pathogenicity and toxicity will be assessed, - said the project manager.

The biological activity of selected strains of cyanobacteria and microalgae is





determined to obtain immunomodulators. In the laboratory, the effect of therapeutic and prophylactic active complexes obtained on the basis of raw biomass of microalgae and cyanobacteria on the body of experimental animals is studied.

THE COMPOSITION IS NUTRITIOUS

According to the scientist, microalgae contain 50-70% of easily digestible protein

(up to 50% in meat and 15-17% in wheat), up to 30% lipids, more than 40% glycerin, 8-14% pigments, including carotene.

- And the concentration of vitamins B1, B2, B3, B6, B12, E, K, D is higher than in other plants or animals. Food microalgae are an indispensable source of proteins, essential amino acids, phytosterols, carbohydrates and vitamins. It contains a large amount of gamma-linolenic acid in polyunsaturated fatty acids. In addition, there are bioactive compounds and other useful compounds. They have unique biochemical and

physiological properties. It is also rich in pigments such as chlorophyll, alpha and beta - carotene, lycopene, lutein, zeaxanthin and astaxanthin, phycocyanin. It is often used in medicine, nutrition, nutrition and cosmetics due to its antioxidant and anti-cancer properties, - says Bolatkhan Kazykhanuly.

The project leader asked, «What is the focus of microalgae production in the world and what are the results?» He also answered our question.

PLACE IN THE WORLD MARKET

- For example, the report of the European Commission states that algae biomass, including macro and microalgae, accounts for 40% of the total market of biostimulants. Algae has become a popular raw material for many products in the pharmaceutical, chemical and food industries. For the past 50 years, GEA - Engineering for a Better World - has been supporting research and development and high-quality processing startups and algae producers that meet strict industry standards. Together with the customer, GEA has developed a special separation process for the commercial production of high-quality biomass from microalgae for the feed and food industries. Biotechnology of microalgae is well developed in the USA, Japan, India, the Russian Federation, China, the Czech Republic

and other countries of the world. The technology of production of food and medical biologicals is mainly developed in countries such as the United States, the Czech Republic, Japan, China and other countries around the world, - said the academician.

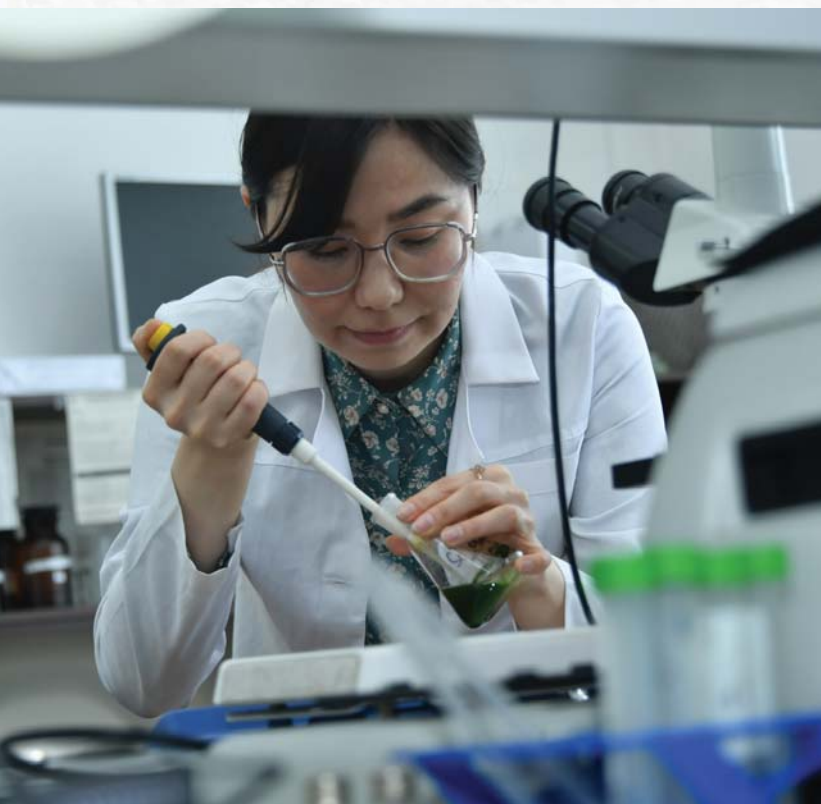
Recently, the demand for organic organic foods has increased in the consumer market. This encourages agricultural entities to reconsider the types of fertilizers. And the biostimulator prepared by KazNU specialists proved to be fully modern.

QUALITY ACCORDING TO THE STANDARD

According to Professor Bolathan Zayadan, a biostimulator based on microalgae is beneficial for agriculture. This is because the use of microalgae in animal husbandry as a source of protein, vitamins and other physiologically active substances builds immunity in animals to be able to withstand various diseases. First of all, it increases endurance due to vitamin deficiency, regulates metabolic processes.

- This will increase the volume and quality of products sold. Within the framework of this project and previous research in the field, the following patents and state standards were obtained on the basis of *Spirulina platensis* cyanobacteria: Gos. State standard for bread enriched with spirulina ST53281-1910-GP-01-2013, MPK A23K1 / 16, C12N





1/12. Development of a biologically active feed mixture to increase chicken egg production on the basis of selenium-enriched spirulina suspension. №0348.1 / 2013, MPK A23K1 / 16, C12N1 / 12. A selenium-enriched spirulina biomass-based feed supplement to increase the benefits of broiler chickens. №0347.1 / 2013 Patents were obtained. In addition, based on the obtained results, publications of scientific works (monographs, articles, textbooks) were published. This is evidence of the research work done by the research team on the topic of the proposed project, - said the project manager.

INCREASES RESISTANCE TO ABIOTIC STRESS

The scientist said that the biostimulatory activity of microalgae biomass extracts is due to the composition of primary metabolites, basic amino acids such as arginine and tryptophan, vitamins, osmolites called proline, glycine betaine and polysaccharides called -glucan.

- Interestingly, several strains of microalgae belonging to the families Charophyceae, Chlorophyceae, Trebouxiophyceae and Ulvophyceae were characterized by phytohormone-like activity. These include auxins, cytokinins, gibberrellins, abscisic acid and brassinosteroids. Natural phytohormones in microalgae are important factors in improving plant growth, productivity and the immune response. In particular, it can be considered as an opportunity to increase protection against abiotic stress. In addition, the use of these potential agents can reduce the harmful effects of abiotic stress, such as salinity and drought, - says Professor B. Zayadan.

«WE CAN INTRODUCE IN DOMESTIC PRODUCTION»

According to Bolatkhan Kazykhanuly, the use of phototrophic microorganisms for the production of food and medicines is a



requirement of today. Because such microorganisms can be used to make new dietary supplements and immunostimulants. There is an opportunity to obtain new biologicals by conducting applied research in this area.

- In the case of Kazakhstan, there are no obstacles to the technological implementation of our project. If we get the appropriate funding, our team is ready to start production

of a test batch of this biological product. And to sell the finished product, you need the support of commercial companies. This is due to the fact that only a few scientific works on the biotechnological aspects of the use of phototrophic microorganisms are known in our country, in particular, the technology of mass cultivation for the use of some active strains of microalgae as feed additives in laboratory and semi-industrial conditions.

GIVES A TONE TO THE INDUSTRY

Research in the field of industrial cultivation of microalgae began in the 60s and 70s of the last century.

- However, even today, despite the achievements in the development of phototrophic biotechnology, more than 30 thousand species of microalgae known to science have not been fully studied. Further development of economic aspects of microalgae biotechnology will affect a number of areas: pharmacologically active drugs, cosmetics and dietary products, cell engineering, environmental remediation technology, etc. Microalgae are safe and a source of many valuable compounds. Therefore, it is of great interest in the agricultural, medical, cosmetic and food industries. They have immunomodulatory, antioxidant, antimetastatic effect, inhibiting the development of cancer in humans and animals. Biologically active supplements based on these organisms are natural, affordable, environmentally friendly preventive biological products. It does not cause adverse reactions, there are no contraindications, - says the project manager.

Microalgae are known for their various biological actions, such as antibacterial, antifungal, cytotoxic, immunosuppressive, anti-allergic properties and antiviral activity.

It should be noted that biostimulants based on microalgae biomass are a valuable tool, especially in the context of «Organic Agriculture», where natural resources are allowed.

According to Bolatkhan Kazykhanuly, it is economically viable to obtain biologically active additives based on microalgae.

- Because they do not need expensive equipment and nutrients to grow them. Growth and enrichment of crops is carried out in a liquid nutrient medium containing mineral salts. Microalgae cultures grow in Tamia and 04 standard nutrient media with very low salinity. Strains of cyanobacteria BG-11, Zarruk and Gromov are grown in liquid medium under artificial lighting. It is planned to carry out aeration with the help of BEYO air compressor. Distribution and storage of new axenic cultures is carried out in accordance with standard methods.

In general, the composition of standard nutrient media used for the cultivation of microalgae is closely related to the physiological characteristics of growing conditions.



A UNIVERSAL PRODUCT THAT HAS CHANGED PRODUCTION

Scientists of the Faculty of Physics and Technology of Al-Farabi Kazakh National University are implementing the project «Organization of the production of a wide range of carbon nanostructured materials.» Nanomaterials are a new topic today. Due to the wide range of applications, it is dominated by interest and demand in the world. And what are the goals of our scientists through the implementation of this project? What is the effectiveness of this project? Today, with the participation of the project manager Daniyar Ismailov, we would like to introduce readers to this research work.

“Our main goal is to launch low-cost efficient production of carbon nanostructures (fullerenes) to create quality products with improved composition and properties. Carbon nanoscale molecular structures are called fullerenes. They have a general formula C_n . Here n usually takes values of 60 or 70. It has special physical and chemical properties,” Daniyar Ismailov said. He is a candidate of technical sciences, PhD and a specialist of the

National Open Nanotechnology Laboratory at our university.

According to the young scientist, fullerenes can be used in various fields. Especially in the mining industry of Kazakhstan, oil and gas, metallurgy and geological-mineralogical industry, construction companies and electrical engineering, as well as pharmaceuticals, etc. areas. You know what carbon is. Basically, solid material, you can





take diamonds as an example. Carbon nanomaterials include fullerenes (C₆₀, C₇₀), graphenes and graphene oxide.

WHAT IS FULLERENE?

Fullerene is a new material of great interest in the two-correlation system and in the scientific community. This is the third stable molecular structure of carbon known today. It can be spherical, elliptical, tubular or

annular. It was discovered by accident in 1985. This is a new structure, very stable carbon molecules. In fact, they are known as the third stable molecular form of carbon after diamond and graphite.

Fullerenes developed as a result of experiments with carbon molecules. Conducting research on the basis of these materials and continuing them on a regular basis will improve modern technologies for the production of useful materials for the future. The properties of fullerenes are special,



especially the lubricating properties. Gives a weak intermolecular force on lubrication. Its molecules can condense to form a solid with stable and weak bonds. This solid is known as fullerite. If we bring the fullerenes to a very low temperature, we see that they are able to sublimate without losing the ball name. Its molecules are very electronic and form bonds with electron-donating atoms.

STRENGTHENS THE STRUCTURE OF THE PRODUCT

«We can see and touch micromaterials, but nanomaterials are different. We work with them at the level of DNA, atoms, nuclei, so we see it under a microscope. Their structure is different. Much better, stronger. In short,



it helps to increase the properties of any material and, consequently, its quality. May not be interesting as a raw material. It is used in cement, paints, biomedicines, electronics, etc. When added, its properties are strengthened. For example, ordinary, existing cement can be punctured by precipitation. And the product with nanomaterials does not absorb water. Because of their small size,

they are compact and durable. This means that the enriched products used in the construction will last a long time due to their high quality and strength," Daniyar Ismailov said. Therefore, the composition and quality of the product with the addition of nanomaterials will be enriched. This project is worth it.

Thus, nanomaterials, in particular: graphene,



carbon nanotubes and fullerenes, due to their excellent electrical properties, make electronic devices promising everywhere, in the existing industry, increasing its service life and efficiency. For example, if you add to the production of capacitors, current collectors, batteries and sensors, their quality will increase, and their service life will be extended. The cost of such devices is also much cheaper than imported products, as spare parts can be

found and serviced. As a local product, you can quickly replace or upgrade both the device and the interface update.

The scientist noted another property of fullerenes: it can also be used as a fat additive.

- Take, for example, a car tire. Due to the constant rotation, some parts of the car have to be replaced from time to time. This is because the metal wears out when it comes in contact with each other and wears out over

time. And if we add a nanomaterial-level additive to that oil, for example, the metal is lubricated and its small holes are closed. As a result, the service life of tires and spare parts will be extended, - said Daniyar Ismailov.

Specialists of the National Open Nanotechnology Laboratory improved the technology of obtaining fullerenes in the laboratory and obtained raw materials. «Fulleren's shape is like a soccer ball. At its edges is a carbon atom. There are many types of fullerenes: C60, C70, C80, C90. The numbers here indicate the number of edges in the fullerene. This material has a wide range of applications. For example, you may have heard of carbon nanotubes. These tubes are made of the primary product of carbon - graphene, «said the young scientist.

Carbon is made up of atoms that form a hexagonal crystal lattice. And graphene is a layer of this lattice with a single atom thickness. Therefore, its first special feature is that it is the thinnest material. Graphene is 300 thousand times thinner than a sheet of paper. Nevertheless, it is one of the strongest materials. Because the bonds between carbon atoms are strong. Now, when those atoms are formed into a ball, a fullerene is produced.

- As for the technology of fullerene production. With the help of special equipment in the laboratory, we burn a graphite rod and get ash from it. The process is carried out in a vacuum and we use an inert gas - helium. Ash also contains carbon. It is porous and micromaterial. And we produce a single nanoscale material from it. As mentioned above, it is not the ash itself that is important, but its carbon nanotubes, graphene and fullerene. At the second level, with the help of solvents, we clean the ash and separate the substances. As a result, after several chemical stages, the finished product - fullerene is released, - says Mr. Daniyar.

The product is currently on the market. «But the pandemic has also affected our plans,» he said, adding that raw materials are still being sourced from neighboring countries. Currently, there are requests from Russian manufacturers. Since the domestic market is not yet fully ready to use such products, the export of fullerene would be more profitable. The first steps have been taken for this. For example, the scientist said that he had received proposals from Moscow and Tomsk for the use of construction materials, but did not hide his hopes for the future of the project.



PINE AND ELM WASTE ARE RECYCLABLE

Today, the Faculty of Chemistry and Chemical Technology of Al-Farabi Kazakh National University is implementing several projects that stand out among the world's innovative technologies. When you see the activity and enthusiasm of young scientists working on these projects, you need a glass, you feel warm. You believe in the future of Kazakhstan's science. Sometimes you think that if the same research was conducted abroad, investors who noticed its value, efficiency and benefits would invest in it and try to commercialize it in the market.

There are also projects in our country, but it is not a secret that they are few. We talked to Meruert Nazhipovna, the head of the project «Obtaining fibrous composite materials by electrospinning and making electrodes for supercapacitors based on them.»

WOOD CHIPS ARE A CHEAP RAW MATERIAL

This project can be a priority for the efficient use of natural resources, including water,

geology, processing, new materials and technologies, safe products and structures. The idea of the project is to obtain composite materials by the method of electrospinning with the required properties, using them as electrodes for supercapacitors.

- We set a goal to develop the synthesis of composite materials of the required length, diameter and porous lignin fibers with a variety of nanoparticles and on their basis to create high-capacity electrodes for supercapacitors. Thus, we study the conditions for the synthesis of lignin from wood waste, and work out the





synthesis of fibrous composite materials by electrospinning. In particular, we are working on the design of the device, determining the distance between the polymer, solvent, electrodes, selecting and studying the magnitude of the voltage depending on the type and size of the obtained fibrous composite materials, «Meruert Nazhipovna told us.

Scientists around the world are now using any polymer to obtain different fibers. They often use ready-made lignin for such work. It will be expensive. “Initially, we wanted to dispose of various wastes. What’s more now - a

lot of sawdust. We cannot say that all the waste from construction and furniture production is processed or recycled. So we decided not to buy lignin, but to get it from sawdust. We chose pine and elm chips for it. For example, we also ordered ready-to-use lignin for our project in order to compare its composition and properties. We paid for it in advance, 3-4 months have passed and we haven’t received it yet. We ordered it abroad. It was supposed to come from China or Europe, but we don’t know yet. You see, it is difficult for the finished product to come on its own, so it would be great

if we could produce it ourselves in the future, ”said the young scientist.

WHAT IS LIGNIN?

Lignin is a complex three-dimensional linear polymer that ranks second only to cellulose. Chemically lignin is a mixture of aromatic polymers of appropriate structure. It is obtained from biomass sources. The composition, quality, formula, chemical and physical characteristics of lignin depend on the source of biomass. The advantage of lignin is that it is an environmentally friendly product, which is both cheap and affordable.

ABILITY TO MAKE CAPACITORS AND BATTERIES

According to Meruert Nazhipovna, the process of synthesis of lignin fiber composite materials by electrospinning allows to obtain various modified and dimensional materials. Polymer precursors are usually used as a basis for the production of nanofibers. “In our work, lignin, which replaces expensive polymers, is synthesized from unclassified wood chips. Fibrous composite materials are synthesized by introducing various nanoparticles into primary precursors. They determine the further application of the obtained material (for example, carbon nanotubes must be added to the polymer

fibers to obtain a conductive material, etc.). The obtained composite material is sent for processing if necessary. For example, it is sent for incineration in the presence of carbon or inorganic nanoparticles, «said Meruert Nazhipovna.

In addition, the project provides for the production of composites based on them by electrospinning and working out the mode of synthesis of nanoparticles of the required length, diameter and porosity. When conducting a comprehensive study in the field of synthesis of fibrous composite materials, their physicochemical, ie mechanical, catalytic, electrical, etc. It is planned to determine the properties and at the same time predict the structure. The obtained materials are used to make fibrous composite materials and energy storage devices. For example, they can be used to make capacitors and batteries. Clearly, comprehensive research in the field of production of lignin nanoparticles and composites based on them and the synthesis of fibrous composite materials will allow the creation of energy-saving devices, capacitors and batteries.

NOVELTY OF THE PROJECT

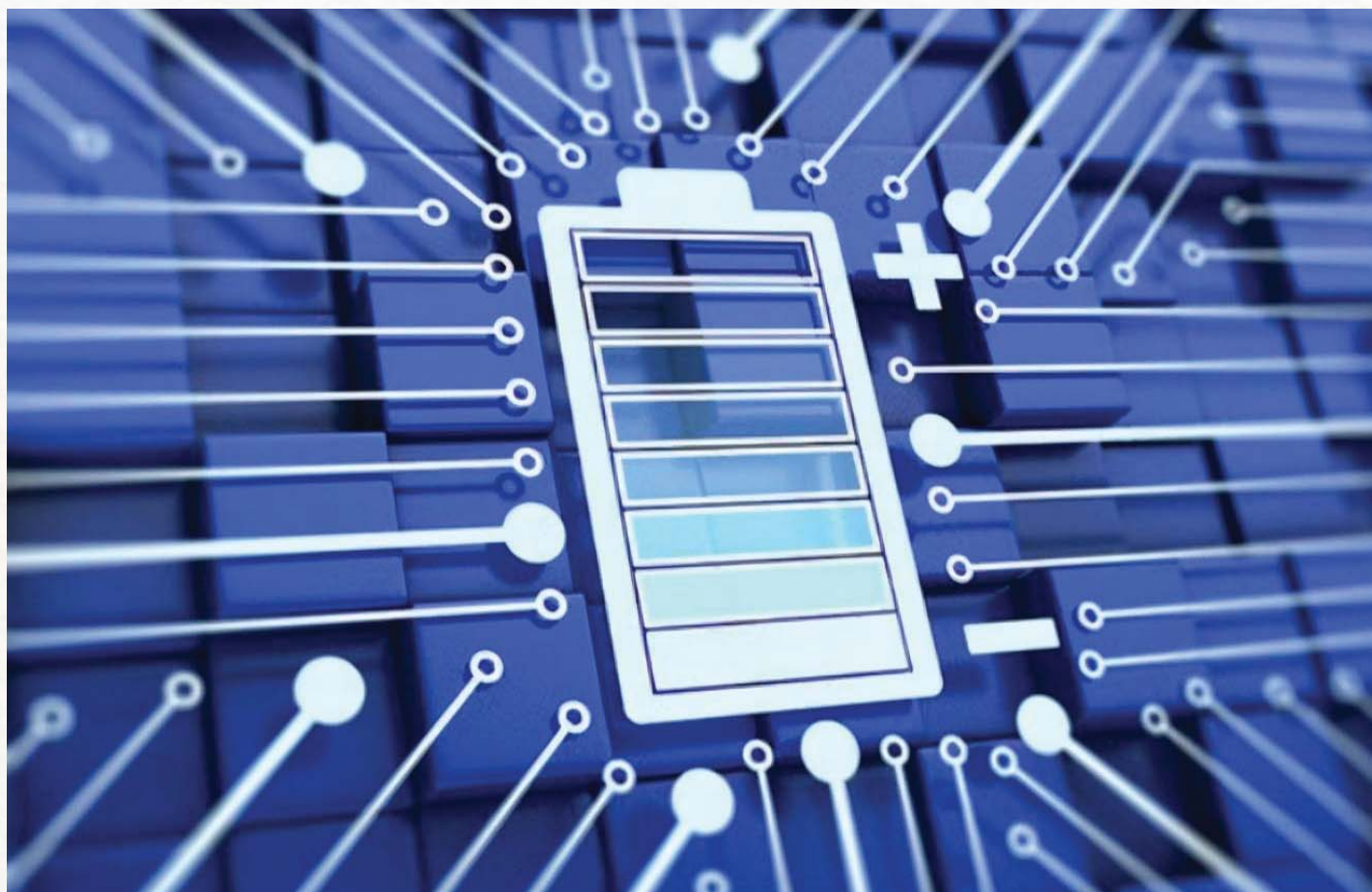
Now let’s talk about the novelty of this work. It is well-known that any research work is new. For the first time, young scientists intend to obtain lignin fibers from unclassified wood



chips by electrospinning. Wood waste and shavings are used as raw materials. The research is worth it. Polyacrylonitrile (PAN) is commonly used to obtain fibers. Its cost is very expensive and its removal requires additional material costs. The main difference from previous studies is that the synthesis of lignin from wood waste leads to the production of nanoparticles by electrospinning in order to form structures with the required physical and chemical properties.

Experiments are also being carried out to

make electrodes for supercapacitors with high specific properties. In the project, lignin is synthesized from unclassified wood chips by the organosolv method. Synthesized lignin is used to make nanoparticles. Unlike the known methods of lignin extraction and the method of obtaining cheap electrically formed fibers, this method of lignin synthesis allows to obtain continuous fibers with a nanoscale diameter. Therefore, this method is cost-effective and simple, and does not take much time.





SUMMARY

If the project is implemented, first of all, it will be possible to enter the world high-tech market by the method of synthesis of fibrous composite materials by electrospinning to obtain new products for various functional purposes. Secondly, prerequisites will be created to increase the competitiveness of the country's economy. Third, the results of the research can be used by companies specializing in the development of new nanomaterials with improved mechanical, electrical and thermophysical properties, as well as companies engaged in the production of power supplies, nanoelectronic devices, and biosensors.

This year, Meruert Najipovna trained at

Eskisehir Technical University in Turkey in the field of nanotechnology. «The state supports young scientists and allocates millions from the budget. Young people who go abroad should gain in-depth experience and enrich their professional skills. Isn't it a great opportunity to get acquainted with modern advanced technologies, to see how new projects and developments related to your research work are created and implemented? When I go to exchange experiences, I spend all my attention and enthusiasm on education and professional development, I do not want to waste my time. I travel around the country only on weekends, the rest of the time I will be in the research area of the university, «said Meruert Nazhipovna.

AIR QUALITY ANALYSIS



The Faculty of Medicine and Health of Al-Farabi Kazakh National University has a new form of research that requires medical staff and health professionals. Thus, the main task is to respond to public needs. Employees of the Research Laboratory of Health and the Environment at the Faculty are engaged in the study of the impact of environmental factors and factors on human health.

There are many results achieved in the field of public health through the study of occupational stress and respiratory diseases in the population. However, priority is given to the analysis of air quality in the work area, where certain types of production and technological processes take place. Laboratory staff published a number of works based on in-depth mathematical analysis and assessment of workplace air quality in 2020-21.

The laboratory staff made a comparative analysis of the mass concentration of PM_{2.5} particles in the air during the production of metal products at the plant of metal structures. As a result, this year the analytical work of scientists was published in the journal Occupational and Environmental Medicine. According to Denis Vinnikov, head of the Health and Environment Research Laboratory, the research object includes four production processes: plasma cutting, machine tool making, welding and assembly of metal structures. In particular, it has been proved that metal aerosols are released the most during plasma cutting. In this process, the maximum concentration per minute was 8,551, and the geometric mean of all samples was 1,727 mg / m³. Such high levels of metal aerosols require monitoring of respiratory and cardiovascular diseases among workers.

- This work was continued in another study. KazNU scientists measured the level of nitrogen monoxide (NO) at the plant and

performed spirometry. Nitrogen monoxide can be considered a marker of inflammation. The highest concentrations of this marker were detected in welders, not in plasma cutting operators. Therefore, additional research is needed, - says the head of the laboratory.

The staff of the research laboratory studied the harmful effects of aerosols from burning coal on shashlik cooks. The results of the special expert work were published in the Journal Of Exposure Science And Environmental Epidemiology. The results of the analysis showed that the concentration of PM_{2.5} particles in the air at the barbecue area was very high. Experts unanimously conclude that chefs who cook kebabs are more likely to suffer from respiratory and cardiovascular diseases.

National Hydrometeorological Service «Kazhydromet» is an official organization that regularly monitors air pollution in the country. For many years, Kazhydromet has been determining the total number of all PM particles found in the air, and only recently has it been monitoring PM_{2.5} particles. However, only five of the 16 stations in Almaty have been mobilized for this purpose. This is not enough to see the full picture.

The World Health Organization does not conduct such research on our country. Therefore, the complex relationships between emissions into the air in the largest cities in Kazakhstan should be studied scientifically.



Scientists should also pay attention to the chemical interactions between meteorology and the atmosphere.

According to D. Vinnikov, the lack of data hinders the creation of an effective program aimed at assessing the current state of the environment and risk prevention.

- Therefore, the cities of Kazakhstan need a comprehensive analysis of air composition using modern research methods and modeling tools. This study identifies the main sources of PM_{2.5} emissions in Almaty and Nur-Sultan. The project also uses the latest scientifically proven areas, including chemical analysis and multivariate factor analysis (PMF). Including these two cities, the population is over 3 million. This figure excludes tourists and visitors to the city. The work in the research laboratory of KazNU is not limited to hygienic work. For the first time in Kazakhstan, the project staff conducted population studies (published in the International Journal of COPD) to determine the risk of obstructive chronic lung disease in the performance of their professional duties, - he said.

As a result of the analysis, laboratory experts found that working in places where dust, steam, gas and smoke are emitted increases the risk of obstructive chronic lung disease by 1.71 times.

- This indicator does not take into account the main factors that cause this disease, such as smoking, physical activity, age and sex and

socio-economic status. The staff of the research laboratory does a lot of work, mainly in the field of air pollution in the workplace. However, there are other studies in the field of occupational medicine and respiratory pathology, - says Denis Vinnikov.

For example, currently the laboratory staff is involved in the following research projects: Association for the Study of Respiratory Health and the professional activities of firefighters; Conduct a population study on the prevalence of obstructive chronic lung disease among the population of Almaty and the risk of contracting the disease due to the performance of professional duties; Systematic review of occupational factors for the occurrence of respiratory diseases in the framework of the working group of the European Respiratory Society and the Thoracic Respiratory Society; Systematic review and meta-analysis of the efficacy and safety of cytosine for the treatment of tobacco dependence; Study of exposure to PM₁₀ floating particles in «clean» workplaces in winter with polluted air as a result of burning solid fuels; Monitoring of air pollution with PM_{2.5} floating particles due to the heating season and solid fuel combustion in Almaty, etc.

Thus, a new scientific direction - medicine and health care - is successfully developing at Al-Farabi Kazakh National University. It also contributes to scientific and innovative activities and the transformation of November into a research university.



CONTENT

Innovative projects of KazNU

Zhanseit TUYMEBAEV. Thirty advanced projects – the gift of scientists to the treasure for independence	3
KazNU remote sound center	6
Nanosatellite launched into space on a scientific mission	12
Eastern river: Ridder fire scientists do space analysis	17
TOURISMKAZ – technological trend	21
SuperMap provided by smart-solutions	26
Efficient lamp based on nanotechnology	31
Markizat Myrzabekova. Cheap price, light - light mobile phone batteries are effective for consumers	36
Jinalys Room adapted to new conditions	41
Digital railway model	46
«Competition» in Balkash: economy V/S ecology	51
Kazakh scientist prepares anti-virus tins	54
OMSsystem – analysis system in kazakh	60
Biofuel producers	65
Bioplastic bacteria	70
A hologram that does not allow artificial products	75
Equipment for purchasing «clean coal»	91
«Black soldier» waste-free technology	96
From complex ether to drug production	100
A special method of getting synthesis from medical waste	105
All in one: auxiliary for teaching electro-magnetic phenomena	109
A unique method for detecting air pollutants	113
Protects sturgeon from bacterial diseases	117
An innovative method of diagnosing depression	122
A product that will «revolutionize» the market of sweets	126
A natural mineral that cleanses the soil of oil	131
Solar energy storage is a new direction	136
Microalgae will change the world industry	141
A universal product that has changed production	148
Pine and elm waste are recyclable	154
Air quality analysis	159

Innovative projects of KazNU



Editor-in-chief: Zhanseit TUYMEBAYEV

Drafting Working Group:

Kanshayim Bidaulet

Gulnar Zhumabaikyzy

Camilla Duisen

Kairzhan Torezhan

Gulzat Nurmoldakyzy

Olzhas Adilgaziev

Designer and layout: Talgat Kirshibaev

Proofreader: Kulyash Kadyrbaeva

Photo: Marat Zhunisbekovich

Date of acceptance for collection 25.10.2021 Publication date 02.12.2021
HeadsetDS Garamond. Format 70x10 1/16. Volume 10.25 pages
Offset paper. Distributed by 1000 part.

