

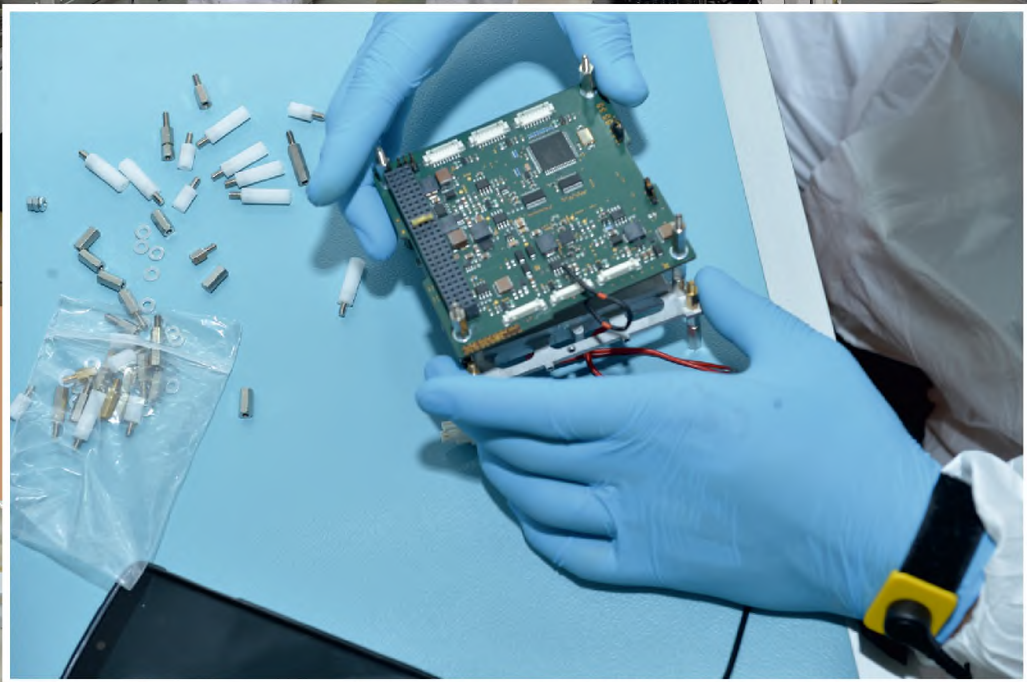


INNOVATIVE TECHNOLOGIES AND HIGH-TECH PRODUCTS OF AL-FARABI KAZAKH NATIONAL UNIVERSITY

Part 2

Almaty 2023





A photograph of a large greenhouse with a glass and metal frame. Inside, there are several rows of plants growing in white bags. A person wearing a white lab coat is standing in the foreground, looking at the plants. The background shows more rows of plants and the structure of the greenhouse.

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Almaty 2021



NEW GENERATION POWER SUPPLIES

Priority area: Energy and mechanical engineering.

The aim of the project: development of new generation storage batteries based on nanomaterials.

Know-how: Graphene can rightfully be called a revolutionary material of the XXI century. This type of carbon compound is the thinnest, strongest, and has the highest electrical conductivity. The development of a new generation battery pack based on graphene is 77% cheaper than lithium counterparts, twice as light in weight, and thanks to the unique electrical conductive properties of graphene, it can be fully charged in just 8 minutes, and this charge is enough for 1000 kilometers of an electric vehicle.

Relevance and novelty: at present, potential buyers of electric vehicles are often frightened by the prospect of a rather small car mileage from one charge and too long battery charging process.

Graphene batteries will have a tremendous impact on all areas of daily life. For example, the specific capacity of a lithium-ion battery currently in use is 200 W / h per 1 kg of weight. A graphene battery of the same weight has a specific capacity of 1000 W / h. Obviously, the graphene battery installed, for example, in the Tesla Model S, is capable of increasing the range of an electric vehicle from 334 km to 1013 km on a single charge. Among other things, these batteries can be recharged in less than 10 minutes. The most modern mass-produced electric vehicles with lithium batteries require several hours to charge, while the charge is barely 300 kilometers. Compared to this, the new graphene-polymer batteries look like a revolutionary miracle source, completely eliminating the disadvantages of traditional lithium-ion batteries.

Practical significance: the use of carbon nanomaterial, in particular graphene, has a wide range, since graphene easily conducts heat, generates electricity, and is able to change its properties in combination with other materials - even the smallest helium atoms can intersect in it, thereby creating a premium in batteries for various types of transport, in batteries of phones and smartphones. The use of graphene will make it possible to increase the efficiency and extend the life of their battery.

Expected results: it is planned to develop and implement prototypes of batteries based on graphene structures.

Object of implementation: graphene-based batteries and batteries.

Prospects for implementation: due to its unique properties, the use of graphene in various directions, in particular as a battery and a battery, makes it a promising and effective material that has a number of advantages over solid-state predecessors. The additional benefits associated with the presence of graphene in the electrodes can be beneficial, even if the efficiency is not that high. The global graphene battery market is expected to reach \$ 115 million by 2022, increasing

by an average of 38.4% over the forecast period with a market with a revenue of about 38%.

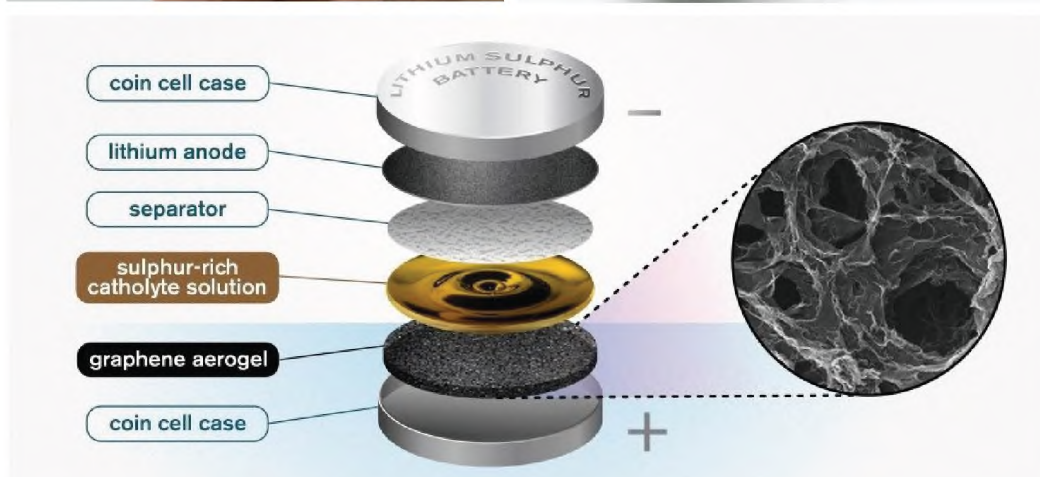
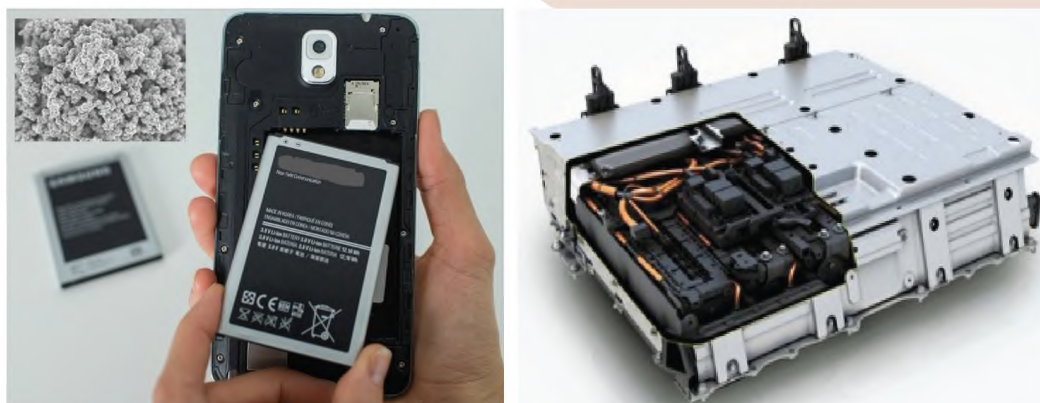
Consumers: car enthusiasts, battery factories, service companies for the repair of smartphones and phones.

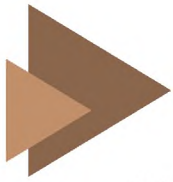
Competitiveness (Technology Advantages) and Commercialization of the Project: The advantage of the technology is that this kind of batteries and batteries based on graphene are much more efficient due to the possibility of fast charging and recharging, thereby increasing their service life. In Kazakhstan, at the moment, there is still no production of batteries and batteries based on graphene, there are analogues with other additives. Having developed the technology of such a charge source, there is a unique opportunity to enter the international market for the production of power supplies based on carbon nanomaterials and freely compete both in the local and international markets.

Investment amount: 20 million tenge.

Availability of documents of title: Patent of the RK No. 26247 “Method for producing graphene and graphene-like materials”.

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COMBINED SENSORS WITH A WIDE RANGE OF APPLICATION

Priority area: Geology, mining and processing of mineral and hydrocarbon raw materials, new materials, technology, safe products and structures.

The aim of the project: development of nanomaterial-based and conventional sensors for a wide range of applications.

Know-how: creation of sensors, nanomaterial-based sensors and conventional electronic devices with remote control that have no analogues in Kazakhstan.

Relevance and novelty: at the moment there are a large number of different types of sensors, sensors on various conductors, which provide stability at the time of their operation. But not every sensor and sensor is stable and can last a long time due to the nature of their material from which they are created. The proposed technology implies the use of a coating based on nanomaterials, which have unique properties, making the sensors more efficient, thereby increasing their service life. Also, in addition to this, work is underway to manufacture complex solutions for sensors and measuring instruments that have a wide range of applications in various industries. A comprehensive solution implies the development of an interface for controlling electronic devices via a computer, tablet and smartphone over remote distances, as well as the development of the combined sensors themselves, i.e. electronics.

Practical significance: these electronic devices: sensors, measuring devices that connect remotely, it is possible to apply: in schools as laboratory lessons in the course “Physics”; in greenhouses, to control the temperature of humidity both in the soil and in the greenhouse itself; for household needs: as a measurement of water temperature, humidity, gas leakage in a room.


Expected results: during the implementation of the project, it is planned to develop and introduce prototypes of sensors and measuring instruments that are connected remotely.

Object of implementation: gas sensor (CO, CO₂), temperature sensor based on nanomaterials, voltmeter-ammeter, humidity sensor based on nanomaterials, UV sensor.

Prospects for implementation: due to their unique electrical properties, the use of nanomaterials, in particular graphenes, carbon nanotubes, fullerenes as electronic devices, is promising almost everywhere, in various fields in terms of service life and their efficiency. The cost of such sensors in comparison with imported ones is much cheaper, due to easy access to spare parts and their maintenance, at any time a quick and effective replacement or revision of both the device itself and the interface update is possible.

Consumers: the main consumers of such measuring devices to remote areas almost everywhere where it is necessary to control temperature, humidity, emission of various types of gases, control of UV radiation.

Competitiveness (Technology Advantages) and Commercialization of the Project: materials from which electronic devices will be created are readily available on the market, and ready-made electronic devices controlled remotely are effective, due to their quality and price, will be much better than their imported counterparts, thereby making them competitive in the local market.

Investment amount: 15 million tenge. 

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CRYSTALLOCHEMICAL DESIGN OF THE NEW ALKALI AND RARE EARTH-BASED BORATE PHOSPHORS

Priority area: Research in the field of natural sciences.

The aim of the project: to prepare new efficient phosphors using complex alkaline-rare earth borate matrices $\text{NaBaR}(\text{BO}_3)_2$, $\text{KCaR}(\text{BO}_3)_2$, $\text{KSrR}(\text{BO}_3)_2$, $\text{K}_7\text{CaR}_2(\text{B}_5\text{O}_{10})_3$ (where R = Y or Sc) based on an integrated approach, including crystallochemical design, synthesis and investigation the optical properties.

Know-how: According to the purpose of this project, it is planned to develop luminescent materials based on compounds of complex borates in the form of powders. Borate compounds are characterized by high chemical and mechanical stability and a short edge of UV absorption. Hence, it can be assumed that, along with excellent optical characteristics, the luminescent materials developed in this project will be promising phosphors and will be able to compete with world famous market phosphors.

Relevance and novelty: The relevance of the project is due to the need to create new luminescent materials for the applied areas of resource-saving energy. A whole set of families of new borate compounds containing I, II, and III valence cations will be studied. The luminescent characteristics of the proposed compounds, as well as their dependence on the composition and preparation conditions, will be systematically studied.

Practical significance: The practical aspect of the project is the creation of a prototype of a phosphor for use in light-emitting diodes.

Expected results:

- Optimum synthesis temperatures and chemical composition of new luminescent compounds based on crystalline matrices $\text{NaBaR}(\text{BO}_3)_2$, $\text{KCaR}(\text{BO}_3)_2$, $\text{KSrR}(\text{BO}_3)_2$, $\text{K}_7\text{CaR}_2(\text{B}_5\text{O}_{10})_3$ (R-REE) will be determined;
- the features of energy transitions determining luminescence will be determined, including quenching characteristics, decay time, luminescence yield;
- chromaticity diagrams will be obtained for the synthesized phosphor samples;
- As an applied result, we plan to manufacture and patent a prototype of a luminescent material suitable for use in modern optical devices.

Object of implementation: luminescent materials based on compounds of complex borates in the form of powders.

Prospects for implementation: The resulting phosphors will compete with world famous market phosphors. This will also allow laying the scientific foundations for the production of luminescent materials based on the rare-earth raw materials of Kazakhstan, which will further lead to a reduction in the cost of phosphors based on the studied borates.

Consumers: manufacturers of lighting technology.

Competitiveness (Technology Advantages) and Commercialization of the Project: The control of the process of obtaining new matrices based on borates doped with REE ions will make it possible to obtain new efficient luminescent materials. This will have a significant impact on the development of technologies for the production of phosphors and their commercialization. New luminescent materials of borates can form the basis of devices for various functional purposes. Thus, we should expect demand for project results from the R&D departments of companies specializing in the production of such devices.

Investment amount: 70 million tenge

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Figure 1. $K_7CaNd_2(B_5O_{10})_3$ crystal grown from $K_2O-B_2O_3-CaF_2$ flux

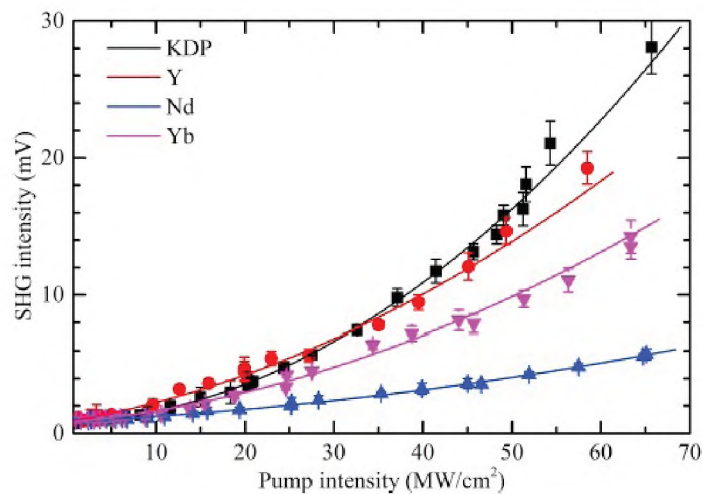


Figure 2. Generation of SHG fraction 50-100 μm (a) $K_7CaY_2(B_5O_{10})_3$, (b) $K_7CaYb_2(B_5O_{10})_3$, (c) $K_7CaNd_2(B_5O_{10})_3$, (d) KDP



OXYMETHYLATION TECHNOLOGY OF UNSATURATED COMPOUNDS

Priority area: Rational use of natural resources.

The aim of the project: commercialization of technology for obtaining products with high added value for industry, agriculture, medicine and ecology.

Know-how: obtaining compounds with a wide spectrum of action.

Relevance and novelty: the relevance of the project lies in the import substitution of technologies for the production of rubber, flotation reagents, plant protection products, intensifiers of phytoremediation technology for cleaning soil from pollutants, synthetic fragrances and medicinal substances. The novelty of the proposed technology lies in the simultaneous production of products exhibiting a wide range of biological and surface activity.

Practical significance: flotation reagents of the oxane series obtained by this technology in combination with industrial reagents allow to increase the degree of recovery and improve the quality of copper and lead concentrate by 4-6%. The consumption of flotation reagents in the copper-lead concentrate selection cycle for flotation reagents using this technology is 30% less than for industrial oxal. The calculated economic effect from the use of flotation reagents of the oxane series for ore with a poor copper grade is 0.9-1.1\$ / per ton of ore.

Oxane derivatives with a radical from C14 to C20, when immobilized with maleic anhydride, reduces the pour point of oil from the Kumkol field by 12-15°C at a concentration of 5 ppm. Derivatives of oxane, 1,3-dioxane and 1,3-diols obtained by this technology are synthetic fragrant substances, stimulate the growth of cultivated and wild-growing plants, increase their growth and mass parameters, enhance the phytoremediation activity of plants and intensify the process of cleaning the land from POPs by 30 -40%.

This technology also allows the production of industrially significant “Oksal” blowing agents, monomers – isoprene, phenoprene and further synthetic rubbers.

Expected results: production of highly effective flotation reagents, plant growth regulators and phytoremediation technology intensifiers.

Object of implementation: oxane derivatives.

Prospects for implementation: increasing the extraction of minerals from depleted deposits, reducing the cost of transporting oil through pipelines, increasing the efficiency of agricultural crops production, cleaning contaminated areas using phytoremediation technology.

Consumers: subsoil users, agriculture, environmental services.

Competitiveness (Technology Advantages) and Commercialization of the Project: transfer and implementation of technology at the enterprises of a business partner and subsequent receipt of deductions from profits, joint participation with business partners in the competition for the commercialization of technologies of JSC “Science Foundation”.

Investment amount: 350 million tenge

Availability of documents of title: Innovation patent of the RK No. 21101
“Method for processing polymetallic copper-lead-zinc ore”

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Fig. 1. Pricing scheme



Fig. 2. Flotation



HIGH ENERGY DENSITY HYBRID SUPERCAPACITORS BASED ON IODIDE ELECTROLYTE AND NANOPOROUS CARBON ELECTRODES

Priority area: Rational use of natural resources, including water resources, geology, processing, new materials and technologies, safe products and structures.

The aim of the project: research and development of a new hybrid capacitor based on a high-power redox electrode based on a carbon / iodide-based double-layer (EDL) electrode for application in advanced energy storage technologies.

Know-how: methods for obtaining materials with unique characteristics of nanoporous structure and composition.

Relevance and novelty: to study the correlation between the pore size and discharge capacity at the positive electrode from different carbon templates. Development of optimized hybrid electrochemical capacitors assembled with a positive (battery) electrode and a negative (EDL) electrode made of porous carbon materials.

Practical significance: lies in the development of a new hybrid capacitor based on a high-power redox electrode for use in advanced energy storage technologies.

Expected results: development of a prototype of an energy storage system with increased specific energy and capacity.


Object of implementation: electrochemical supercapacitors.

Prospects for implementation: Successful implementation of the project will create high value-added and innovative products for the modernization of the energy sector, engineering and electronics.

Consumers: machine-building and instrument-making enterprises, power distribution networks.

Competitiveness (Technology Advantages) and Commercialization of the Project: the project looks competitive because its implementation uses original methods that reduce the cost of the product and / or improve its performance.

Availability of contracts, agreements with production and business: Cooperation agreement with ICC Research LLP.

Investment amount: 70 million tenge. 

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Figure 1. Supercapacitors presented at EXPO-2017

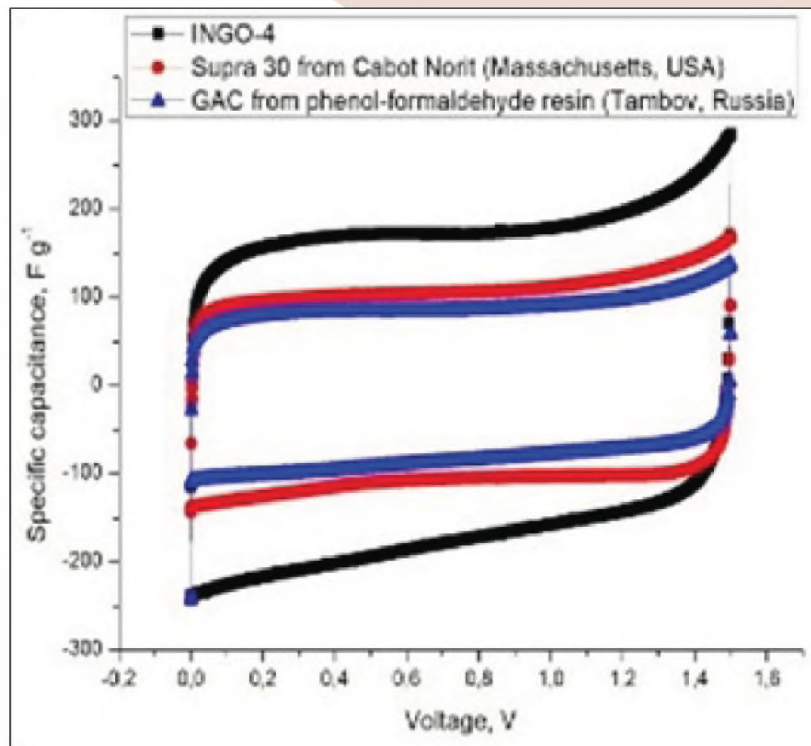
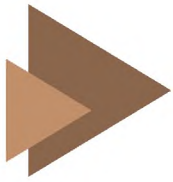


Figure 2. Voltammetric characteristics of supercapacitor elements



DEVELOPMENT OF ZERO AND ONE-DIMENSIONAL PHOTOCATALYSTS FOR THE PRODUCTION OF HYDROGEN

Priority area: Energy and Mechanical Engineering.

The aim of the project: is to create cheap and efficient photocatalysts with a high specific surface area for the production of hydrogen by photocatalytic splitting of water, a mixture of water with organic alcohols and electrolytes.

Know-how: photocatalysts are presented in the form of 0D particles with photocatalytic properties and composite 1D structures consisting of carbon microfibers with photocatalytic metal nanoparticles obtained by electrospinning techniques to increase the amount of the released hydrogen in gaseous mixture in course of photocatalytic reaction.

Relevance and novelty: one of the most promising and environmentally friendly methods of hydrogen production is the photocatalytic splitting of water under the influence of sunlight using semiconductor materials. The successful development of this industry is the synthesis of semiconductor photocatalysts in the form of nanodisperse powders and films, as well as the search for ways to change their most important characteristics, in particular, particle size and surface morphology.

The novelty of the proposed project lies in the formation of micro and nano-sized polymer fibers with photocatalytic particles evenly distributed along the fiber. This increases the specific surface area of the photocatalyst, which directly affects the reaction rate, improves the electrical conductivity of the catalyst, allows the formation of carbon particles to form more active sites, increases hydrogen production and prevents agglomeration of photocatalyst particles, which reduces their efficiency. In addition, doping with metal particles help to improve the redox reaction that takes place during the absorption of light.

Expected results: The main expected result is the development of the hydrogen industry in Kazakhstan, in particular, the development of methods for obtaining environmentally friendly hydrogen from renewable sources by photocatalytic splitting of water using “green” technologies by synthesized 1D photocatalysts. In addition, hydrogen as a fuel has a number of indisputable advantages over existing fuels (high heat of combustion, environmentally friendly raw materials).

Object of implementation: photocatalysts.

Prospects for implementation: production and storage of hydrogen is the “top” topic of the world scientific publications, however, currently the production of hydrogen by photocatalytic methods is at the stage of laboratory research.

Consumers: energy sector and the population of Kazakhstan.

Competitiveness (Technology Advantages) and Commercialization of the Project: The advantage of technology is the use of renewable and the most com-

mon resource on the planet - water, which is able to decompose into hydrogen and oxygen under the influence of sunlight. The competitiveness of the project is associated with the production of nanostructured materials with enhanced physical and chemical properties, which has a direct impact on the increase in hydrogen consumption in the process of photocatalytic decomposition of water mixtures.

Investment amount: \$165 353.

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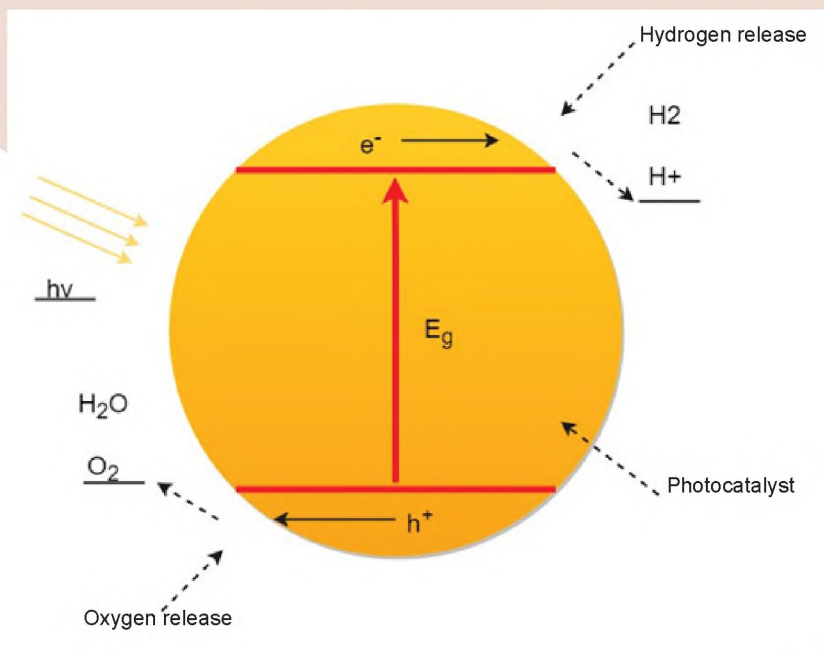


Figure 1. Illustration of the mechanism of photocatalytic splitting of water with the release of hydrogen

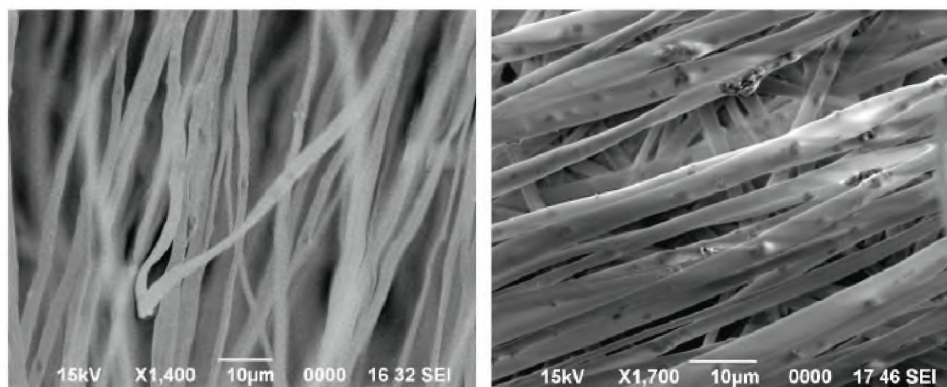


Figure 2. SEM images of photocatalytic fibers based on polyacrylonitrile and strontium titanate



HYBRID ELECTRODES FOR ULTRAFAST ENERGY STORAGE SYSTEMS

Priority area: Energy and Mechanical Engineering.

The aim of the project: development and research of fundamental basics of function of hybrid electrodes based on MXene material with high specific double-layer capacitance (condenser material) and fast Faradaic formation added (intercalation material for batteries).

Know-how: Optimized method of formation of hybrid electrode with high content (up to 70%) of intercalation component, which allows energy density to be increased substantially.

Relevance and novelty: Novelty of the research consists on the development of an electrode for Li and Na ion batteries based on MXene binder. Substitution of standard binder, which acts as “ballast” in an electrode for electrochemically active MXene material allows overall electrode capacitance to get increased.

Investigation in this way with following inception into industry in the first place will open up opportunity for the production of Kazakhstan made lithium-ion batteries, which in turn will be contributing to development alternative energy, in particular, AstanaSolar company, and in the will lead to growth of the image of the government with ecologically developed energy system.

In addition, the results of the research must critically affect scientific field of technology of energy storage because of the absence of sufficient information base about hybrid electrodes/devices and must have substantial scientific influence.


Expected results: expected results of the project are based on receiving hybrid electrode, consisting of intercalation material (Red/Ox) and material with non-faradaic type of energy storage, and on understanding the impact of both separated mechanisms and their synergy on specific energy density and power of hybrid electrode (hybrid device).

Object of implementation: hybrid electrode, consisting of intercalation material ($\text{NaTi}_2(\text{PO}_4)$, $\text{Na}_3\text{V}_2(\text{PO}_4)_3$), and non-faradaic type of energy storage (MXene).

Prospects for implementation: resulting hybrid electrode, can be incepted into production as an anode for sodium-ion batteries based on aqueous electrolytes with appropriate selection of a cathode material. In addition, the results of the research must critically affect scientific field of technology of energy storage because of the absence of sufficient information base about hybrid electrodes/devices and must have substantial scientific influence.

Consumers: “Kazatomprom” JCS, “OxTec”, “Astanasolar”, any organizations, that works in the field of battery production, especially in production of sodium ion batteries based on aqueous electrolytes.

Competitiveness (Technology Advantages) and Commercialization of the Project: developed method of making hybrid electrode will be lying on usage of abundant element of the Earth’s crust, which will have a huge impact on the price of full battery. In the comparison with commercial lithium-ion battery, where rare and expensive lithium salts are used, sodium-ion batteries will be more effective in term of economics.

Investment amount: 54 million tenge. 

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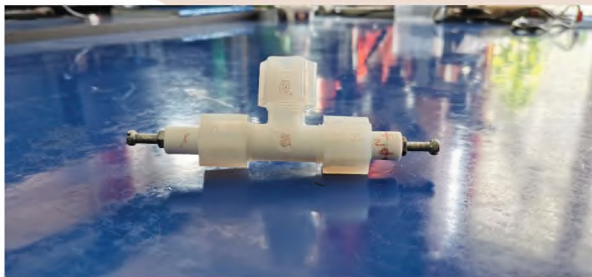


Figure 1. Prototype of battery for electrochemical investigation based on anode MXene material

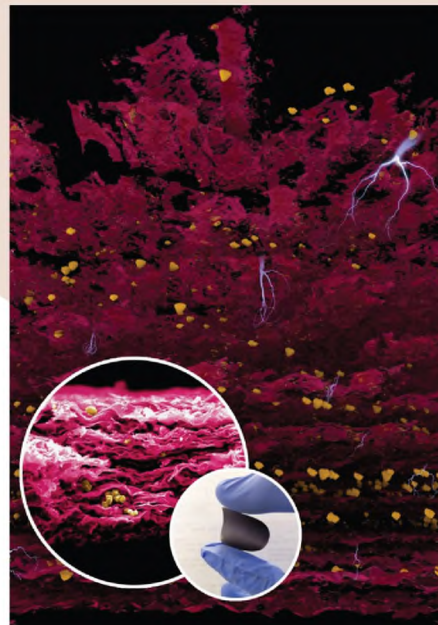


Figure 2. Concept of hybrid electrode based on MXene



SCIENTIFIC BASIS OF PRODUCTION OF THE ESTERS CARBONIC ACIDS FROM PETROLEUM PRODUCTS

Priority area: Geology, production and processing of mineral and hydrocarbon raw materials, new materials, technology, safe products and structures.

The aim of the project: development of scientific foundations of the metal complex hydroalkoxycarbonylation of C₄-C₁₀ refinery olefins used for the synthesis of practically valuable carboxylic acid esters – biologically active medicines, fragrances, solvents, etc.

Know-how: the developed effective one-stage method for producing esters of carboxylic acids is more economical, environmentally more harmless and, in comparison with existing industrial methods for producing esters, ensures the production of target products of higher quality (in terms of the content of impurities). The cost of producing esters using the new method is 2-4 times lower than the cost of producing them using existing industrial methods.

Relevance and novelty: the results of the project can contribute to the creation of Kazakhstan production of fragrances and medicines based on esters of carboxylic acids.

Practical significance: there is no production of fragrances in Kazakhstan, 100% of the required amount of the need for synthetic fragrances is imported from near and far abroad. In this regard, research in the development of economical and perfect new technologies for the production of aromatic substances of medicines and intermediates for their synthesis is very relevant.

Expected results: a new method for producing esters of carboxylic acids. Effective metal complex catalysts for the hydroalkoxycarbonylation reaction of C₄-C₁₀ olefins. Organization of production of aromatic substances based on carboxylic acid esters.

Object of implementation: an effective one-stage method for producing esters of carboxylic acids.

Prospects for implementation: upon completion of the project, it is expected to obtain optimal parameters for the synthesis of a number of esters of carboxylic acids, which can be used in organizing the production of aromatic substances.

Consumers: petrochemical, pharmaceutical and national economic industries of the Republic of Kazakhstan.

Competitiveness (Technology Advantages) and Commercialization of the Project: the innovativeness and competitiveness of the expected results of the project is determined by the use of metal-compound catalysts with phosphorus-containing ligands for the synthesis of valuable esters of carboxylic acids from olefins of process gases of oil refinery. It should be noted that phosphorus compounds are extremely important ligands in many catalytic systems based on metal

complexes. The metal complex catalysts developed by the authors allow the synthesis of target compounds under mild conditions: carbon monoxide pressure is not higher than 20 atm, temperature is not higher than 100 °C. The advantage of the developed method for obtaining esters of carboxylic acids from olefins of process gases of oil refinery is the relative availability of the initial reagents (oil refining olefins, carbon monoxide, alcohols), one-stage process and high environmental friendliness.

The developed method for producing esters of carboxylic acids is more economical, environmentally friendly and, in comparison with existing methods for producing esters, ensures the production of target products of higher quality (in terms of the content of impurities). The cost of producing esters using the new method is 2-4 times lower than the cost of producing them using existing industrial methods.

Availability of documents of title:

- Innovative patent PK No. 31304 “Method of obtaining l-menthisovalerate”.
- PK patent for utility model No. 2191 “Effective catalyst for the reaction of hydroethoxycarbonylation of octene-1”).

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Fig. 1. Autoclave unit for the reaction of hydroalkoxycarbonylation of olefins



Fig. 2. Carrying out experiments



MICROBIAL ENHANCED OIL RECOVERY

Priority area: Rational use of natural resources.

The aim of the project: to enhance oil recovery using environmentally friendly technologies.

Know-how: Microbial enhanced oil recovery (MEOR) is a promising strategy to increase oil productivity in mature oilfields, like those located in West Kazakhstan.

Relevance and novelty: The problem of oil recovery is becoming very relevant, primarily being associated with a progressive decline in oil production in a long-term operation of the current deposits and a decrease in the rate of input of new large fields development. Kazakhstan is currently experiencing a period of late-stage development. Oil fields under waterflooding have reached a high water cut ranging from 80 to 90%, while a large volume of undeveloped oil reserves (up to 60–70%) are located in deep oil reservoir formations. In addition, most deposits of Kazakhstan are characterized by high viscosity oils and complex geological structures.

Practical significance: the development of this technology will allow significantly enhance oil recovery from reservoirs already developed, in which the traditional methods to extract remaining oil reserves is already impossible.

Expected results: enhanced oil recovery in the field by stimulating local microorganisms.

Object of implementation: insecticides with a high content of nicotine and nicotinic acid.

Prospects for implementation: microorganisms that increase oil recovery of formations.

Consumers: oil producing companies, enterprises for the production of petroleum products.

Competitiveness (Technology Advantages) and Commercialization of the Project:

- improving oil fields productivity;
- increasing the total oil production and the term of effective operation of wells and fields;
- the MEOR set up is less expensive, because the injected bacteria and nutrients are inexpensive;
- reduced of the operations downtime;
- low energy input requirement for microbes to produce MEOR agents;
- MEOR is environmentally friendly, because microbial products are biodegradable;

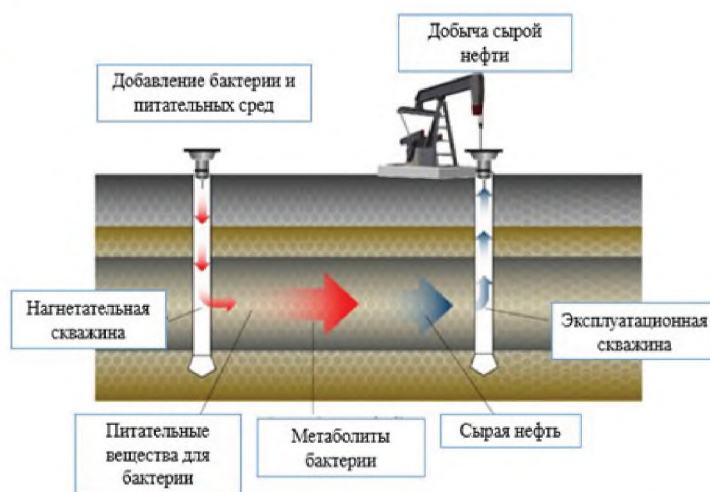
– increasing the viscosity of the produced water due to biomass and soluble biopolymers, metabolic products of microorganisms.

Availability of contracts, agreements with production and business:
Agreement on cooperation with KazMunayGas Engineering LLP.

Investment amount: 90 million teng (when developing technology), 300 million teng (when commercializing).

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Микробиологический метод повышения нефтеотдачи





TECHNOLOGY FOR APPLICATION OF MICROORGANISMS WITH GROWTH STIMULATING AND FUNGICIDAL ACTIVITIES TO INCREASE YIELD OF AGRICULTURAL CROPS

Priority area: Life Science.

The aim of the project: development of a technology to use microorganisms which produce biologically active substances that protect plants from phytopathogens and increase the productivity of agricultural crops.

Know-how: technologies will differ in their complexity of action: increase the productivity of plants, suppress the development of phytopathogens, improve the mineral nutrition of plants, and contribute to an increase in soil fertility.

Relevance and novelty: there is an established opinion that it is promising to use not only microbial single-species populations in agrobiotechnology, but their associations or consortia. Multicomponent systems will be created in the soil, reproducing optimal natural agrophytocenoses and ensuring high stability of agriculture.

Practical significance: for the first time, new technologies will be suggested for the use of domestic strains with agronomically useful properties, adapted to the root secretions of agricultural plants in Kazakhstan and unpretentious to local conditions of existence.

Expected results: the results of scientific research carried out under the project will be published in highly cited scientific journals of Elsevier publishing house, such as: Microbiological Research, Biological Control, Applied Soil Ecology, Soil Biology and Biochemistry.

Object of implementation: the technology to use new strains of microorganisms isolated from soil samples of the Almaty region in the practice of plant agriculture, ecological agriculture, biocontrol over the development of diseases.

Prospects for implementation: the prospect of creating microbial biological products, the variety and spectrum of action of which should be actively replenished and expanded with a sharp decrease in toxicity and negative impact on humans, plants and the environment has a particular value. When creating microbial drugs of complex action, more attention should be paid to the development of technology for their production and use. In this regard, the prospect of organizing regional low-tonnage industries is obvious.

Technologies using multifunctional microorganisms can find application in various sectors of the national economy: production of agricultural products; restoring of land fertility and in stopping the poisoning of nature from chemical fertilizers and pesticides; production of enzymatic fertilizers, feed and food supplements; processing organic waste; wastewater treatment and solving other issues.

Consumers: various agricultural farms, phytosanitary and environmental services.

Competitiveness (Technology Advantages) and Commercialization of the Project: the use of natural unmodified microorganisms that can be antagonists of phytopathogenic fungi and bacteria, as well as microorganisms associated with plants and having a positive effect on their growth and increasing resistance due to the synthesis of various metabolites.

Investment amount: 60 million tenge

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Figure 1. Growth-stimulating activity of microorganisms



Figure 2. Field experiments (before treatment with a biological product)



Figure 3. Field experiments (after treatment with a biological product)



PRODUCTION OF ADSORBENTS FOR PURIFICATION OF VEGETABLE OILS BASED ON THE DOMESTIC MINERAL RAW MATERIALS

Priority area: Food industry, vegetable oils, fat and oil products.

The aim of the project: production of bleaching clay for the purification of vegetable oils from domestic raw materials, import substitution.

Know-how: the availability of local raw materials, the use of reagents produced in the country and the simplicity of the technological scheme of production will make it possible to produce high-quality bleaching clay with a lower cost compared to foreign samples.

Relevance and novelty: due to the great demand for vegetable oils, both domestically and abroad, the government has taken a course to increase their production. Currently, domestic enterprises operate only at 50-60% of their capacities, which is associated with the purchase of oil seeds by neighbors - China and Uzbekistan. In conditions of tough competition, there is an urgent need to improve technology and use local raw materials and materials to reduce the cost of production. Moreover, at present all the additives, adsorbents and catalysts required for the processing and production of fat and oil products are completely imported.

Practical significance: it consists in the creation of domestic production of adsorbents that are in demand in the production of edible vegetable oils and fat-and-oil products based on them. The total demand in the country is about 3,000 tons per year, and taking into account the needs of the nearest Central Asian neighbors – about 5,000 tons/year.

Expected results: at the first stage, we consider it expedient to determine the volume of bleaching clay production at 500-1000 t / year. At this stage, one should consider the possibility of making changes or additions to the proposed production technology based on the results of pilot tests of bleaching clay in the process of refining various vegetable oils in the country and abroad, as well as conducting an advertising campaign and forming a real portfolio of orders. At the second stage, it is possible to reach the real production volumes.


Object of implementation: technology of obtaining adsorbents (bleached clays) for the purification of vegetable oils.

Prospects for implementation: reduction of import purchases and promotion of products to the external market.

Consumers: more than 200 domestic producers of vegetable oils.

Competitiveness (Technology Advantages) and Commercialization of the Project: enlarged laboratory tests have shown that the bleaching clay developed by the authors at a lower cost is not inferior to the best foreign samples.

Availability of contracts, agreements with production and business: since 2014, a memorandum of cooperation with the “Maslo-Del” company has been in effect.

Investment amount: 430 million tenge. 

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ORGANIZATION OF THE PILOT PRODUCTION OF LOW-PERCENTAGE PLATINUM CATALYSTS FOR HYDROGENATION OF VEGETABLE OILS

Priority area: Food industry, vegetable oils, fat and oil products.

The aim of the project: production of low-percentage (0.2% Pt) platinum catalysts for hydrogenation of vegetable oils for solid fat and oil products, import substitution.

Know-how: there is no production of platinum catalysts for the hydrogenation of vegetable oils in the world due to the high cost of Pt. As a result of the studies carried out, a low-percentage platinum catalyst has been created, which has a high selectivity and activity and is reusable (2-times), which makes it no more expensive than a nickel catalyst.

Relevance and novelty: the process of hydrogenation of vegetable oils is very important and relevant in the production of high quality edible fats. This process is the basis for the production of edible margarines. Unhydrogenated fats deteriorate quickly, oxidation occurs due to double bonds, they go rancid and have an unpleasant odor and taste. The use of hydrogenation slows down these processes and thus allows cheap oils to be converted into valuable solid fats.

As metabolic and epidemiological studies show, trans-isomers of fatty acids are not assimilated by our body. Their accumulation in the body affects the ratio of low and high density lipoproteins and thereby contributes to an increase in the total amount of cholesterol in the blood, a decrease in immunity, and also destroys the stable enzymatic and membrane work of cells. This leads to diabetes and cardiovascular disease.

In accordance with the Technical Regulations of the Customs Union 024/2011, from 01.01.2018, the standard for the content of trans-isomers in oil and fat products was not more than 2.0%. In this regard, the development and production of effective and selective catalysts for the hydrogenation of vegetable oils, providing a low content of trans isomers in fat and oil products is very important.

Practical significance: the use of the proposed catalyst will make it possible to obtain fat and oil products that meet international standards (with a content of at least 2.0% trans isomers, no more than 30-33% saturated fatty acids, and without the addition of palm oil, reducing the risk of cardiovascular disease, atherosclerosis and diabetes.

Expected results: the organization of the above mentioned production of bleaching clay will make it possible to create a pilot production of low-percentage platinum catalysts for the hydrogenation of vegetable oils on its basis. Activated bentonite and diatomite can be used as a carrier for the catalyst.

Laboratory and pilot tests of the catalyst have shown its high selectivity and activity. The need for a catalyst in the domestic market is still 20 tons per year, taking into account the needs of the Central Asian region, it will be about 50 tons per year.

Object of implementation: technology for obtaining low-percentage platinum catalysts for the hydrogenation of vegetable oils.

Consumers: manufacturers of solid fat and oil products (“Maslo-Del”, “Efko-Almaty” companies, Karaganda margarine plant company).

Competitiveness (Technology Advantages) and Commercialization of the Project: laboratory and pilot tests have shown that the developed catalysts make it possible to obtain fat and oil products that meet the strictest international standards.

Availability of titles of protection:

– PK patent for invention No. 30102 “Catalyst for hydrogenation of vegetable oils”;

– PK patent for invention No. 32608 “Method for hydrogenation of vegetable oils”;

– PK patent for utility model No. 4919 “Method for hydrogenation of vegetable oils”;

– PK patent for utility model No. 4930 “Catalyst for hydrogenation of vegetable oils”.

Availability of contracts, agreements with production and business: Memorandum of cooperation with the company “Maslo-Del” since 2014.

Investment amount: 250 million tenge.

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INTEGRATED PROCESSING OF WASTE OF THE TOBACCO INDUSTRY FOR THE PURPOSE OF OBTAINING PP – VITAMIN, BIOLOGICALLY ACTIVE HUMUS AND COMPLETE PROTEIN

Priority area: Rational use of natural resources, including water resources, geology, processing, new materials and technologies, safe products and structures.

The aim of the project: the creation of a technology for a post-editing system of the Kazakh language with high-quality machine translation, adapted to the peculiarities of the language.

Know-how: process development using a plant operating at high flows of extractant, which allows to achieve high speed and selectivity of the process. In addition, the developed means will combine both an insecticidal effect due to nicotine and a growth-stimulating effect due to nicotinic acid.

Relevance and novelty: plant growth regulators (PGR) not produced in Kazakhstan, the entire volume consumed made up of imported drugs. Kazakhstan imports PPP from 14 countries of the world (Russia, Germany, Korea, USA, India, etc.).

Nicotine obtained from natural raw materials is in demand in the production of alternative methods of tobacco consumption, such as e-cigarette; also, nicotine can potentially use in medicine as an anesthetic and in the therapy of Alzheimer's disease, as an insecticide for plant protection.

Practical significance: it expected to create new environmentally friendly agricultural products that are not inferior in consumer properties to foreign counterparts. In addition, work with such an innovative technology will significantly increase the competence of the engineering and scientific personnel involved in the project. The proposed project, in addition to chemistry, affects such areas as mechanical engineering (directly working and, if necessary, modifying supercritical equipment for the specific needs of the project), biotechnology and plant protection (testing the effectiveness of the obtained BAS complex and determining its optimal dosage for processing plant crops).

Expected results: the project will result in:

- Promising raw materials have identified.
- Launch of the existing laboratory equipment, purchase and installation of new laboratory equipment.
- Developed and adapted analytical methods for controlling the content of substances in the feedstock and preparations obtained by synthesis.
- Physical and chemical studies of the obtained preparations carried out.
- Technologies for isolating BAB complexes from plants have developed.
- Tests of herbal preparations in laboratory conditions carried out.
- Received certificates of field tests of drugs and laboratory and technological regulations of the developed tools.

– Developed and adapted analytical methods for quality control of raw materials for SCF extraction.

The most important socio-economic indicator will be the development in Kazakhstan of ecologically safe highly effective herbal preparations, herbicides, vitamin complexes for agriculture, new energy-saving sub- and supercritical technologies for processing secondary raw materials of agricultural production, ensuring minimal greenhouse gas emissions and restoring degraded soils that meet the requirements “green economy.

Object of implementation: insecticides with a high content of nicotine and nicotinic acid.

Prospects for implementation: the use of tobacco as a source of nicotine in the interests of both medicine and agriculture will help maintain a steady demand for the products of these farms. In addition, the obtained BAS complexes can become a valuable export raw material, both for the production of e-cigarette, as well as an effective natural insecticide and the basis for the production of medicines.

The development of domestic agrochemistry will allow not only to solve the problem of import substitution and food security, but also to make money on its export. The report of the “Eurasian Economic Union” noted that the share of imported pesticides in Kazakhstan is on average about 88%.

Consumers: agricultural producers.

Competitiveness (Technology Advantages) and Commercialization of the Project:

- Available raw materials;
- Product safety in environmental terms (the insecticide is extracted from plant materials and is further oxidized from nicotine to nicotinic acid);
- Organization of an engineering center for the development of installations for industrial extraction;
- Full-fledged maintenance and modernization of manufactured installations.

Availability of documents of title: Patent for utility model No. 4165 “Method for extracting nicotine from tobacco and tobacco waste”.

Availability of contracts, agreements with production and business: AIM LAB LLP.

Investment amount: 75 million tenge.

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Figure 1. Installation for supercritical fluid extraction Thar 1000



ORGANIZATION OF PILOT LOW-CAPACITY PRODUCTION OF MEDICINAL PREPARATIONS

Priority area: Geology, production and processing of mineral and hydrocarbon raw materials, new materials, technology, safe products and structures.

The aim of the project: organization of a pilot low-tonnage production of drugs “Novovalidol”, “Ethyl ester of α -bromisovaleric acid”, “Corvalol-K”, “Salicylic acid”, “Aspirin” and “p-Aminosalicylic acid”.

Know-how: the proposed new technology for obtaining ethyl ester of α -bromisovaleric acid (EEBIA) (and on the basis of the latter Corvalol-K) is based on a new effective method for producing EEBIA from isobutylene, carbon monoxide, ethanol and bromine developed by the authors of the project. The quality of the target product obtained using the new technology is higher (contains less impurities), and the production cost is 2-3 times lower than the production cost for the existing four-stage industrial EEBIA production method.

The second direction of the project - a new technology for producing hydroxyaromatic acids in Kazakhstan is being developed only by the authors of the project. The novelty of the proposed research is the development of “phenolate-free” methods of obtaining hydroxyaromatic acids and their derivatives, excluding the stage of preparation of intermediate metal phenolates.

Relevance and novelty: Novovalidol - an antispasmodic (vasodilator) medicine, an analogue of the widely used medicine “Validol”, has a calming effect on the central nervous system, also has a moderate reflex vasodilator effect; used for mild attacks of angina pectoris, neuroses, hysteria.

Ethyl ester of α -bromisovaleric acid - has sedative and antispasmodic properties, in large doses has a mild hypnotic effect, is an integral part of the medicine Corvalol-K; can be used for the preparation of other medicines.

Corvalol-K (similar in composition and action to the medicine Corvalol and Valocordin) is a sedative and antispasmodic medicine. It is used for neuroses and increased irritability, with not pronounced spasms of the coronary vessels, tachycardia, insomnia, in the early stages of hypertension, with intestinal spasms.

Salicylic acid and Aspirin have antiseptic properties and are used as a component of external medicines of antiseptic and antifungal action in ointments, pastes, alcohol solutions.

p-Aminosalicylic acid (PASA) has bacteriostatic activity against Mycobacterium tuberculosis and belongs to the main anti-tuberculosis medicine.

Practical significance: the implementation of the project will make it possible to contribute to the solution of the acute problem of the formation of the pharmaceutical industry in the Republic of Kazakhstan. Currently, due to the weak development of the pharmaceutical industry, Kazakhstan is forced to import up to 95% medicines.

Expected results: the project will result in:

- technologies for low-tonnage mini-production of drugs;
- technical documentation of small-scale mini-plants for the production of drugs;
- operating low-tonnage mini-plants for the production of drugs;

– updated and approved by the Ministry of Health of the Republic of Kazakhstan normative and technical documentation.

Object of implementation: medicines “Novovalidol”, “Ethyl ether of a-bromisovaleric acid”, “Corvalol-K”, “Salicylic acid”, “Aspirin” and “p-Aminosalicylic acid”.

Prospects for implementation: manufactured medicines are widely consumed by the population.

Consumers: Kazakhstan and all neighboring countries.

Competitiveness (Technology Advantages) and Commercialization of the Project: Medicines have higher quality indicators in comparison with their counterparts obtained by traditional technologies:

– the cost of production of medicines using new technologies is 2-4 times lower than the cost of producing their analogues using currently existing technologies.

– high quality indicators and low cost of medicines make them highly competitive in terms of export.

Availability of titles of protection:

– Innovative patent of the Republic of Kazakhstan No. 25471. “Method for producing ethyl ether”;

– Innovative patent of the Republic of Kazakhstan No. 29961. “Method for producing 4-methyl-2-hydroxybenzoic acid”;

– Innovative patent of the Republic of Kazakhstan No. 29962. “Method for producing 5-methyl-2-hydroxybenzoic acid”;


– Innovative patent RK No. 231304. “Method for obtaining 1-menthilizovalerate”;

– RK patent for utility model No. 1624. “Method for producing 5-chloro-2-hydroxybenzoic acid”;

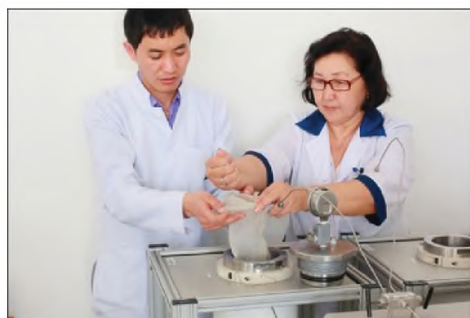
– Patent of the Republic of Kazakhstan for utility model No. 2190. “Method for producing 2-hydroxybenzoic acid and its methyl- and chlorine-substituted derivatives”;

– Patent of the Republic of Kazakhstan for utility model No. 2191. “Effective catalyst for the reaction of hydroethoxycarbonylation of octene-1”.

Availability of contracts, agreements with production and business: Agreement on cooperation with the pharmaceutical company Sultan LLP.

Investment amount: 300 million tenge. 

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INDUSTRIAL RELEASE OF HIGH-PERFORMANCE DOMESTIC TINCTURE “LIMONIDIN” OF PLANT ORIGIN

Priority area: Development of the pharmaceutical industry in the Republic of Kazakhstan.

The aim of the project: industrial production of a highly efficient locally produced medicinal preparation in the form of a tincture “Limonidin” with anti-inflammatory and antimicrobial mode of action.

Know-how: a unique, environmentally friendly, biologically safe preparation of plant origin with a high therapeutic effect, obtained on the basis of industrially significant wild-growing plant raw materials in Kazakhstan. Tincture “Limonidin” does not cause allergic and cumulative reactions in the body and improves its immune status.

Relevance and novelty: the level of production of own medicinal preparations recommended by WHO to ensure the strategic security of each state should be at least 20%, in Kazakhstan this figure ranges from 7 to 10%. The production of new original local medicinal preparations based on local medicinal plant raw materials is an extremely urgent task.

Practical significance:

- is produced of local, self-renewable, industrially significant wild-growing medicinal plant raw materials;
- promising as a monotherapy for “catarrhal” forms of lesions of the gastrointestinal tract (GIT);
- effective in the treatment of diarrhea and dental diseases;
- can be used for long-term therapy due to the absence of side effects.

Expected results: Tincture “Limonidin” was registered by the Ministry of Healthcare of the Republic of Kazakhstan in 2007 (recommended for use in medicine and for the industrial production on the basis of fully completed clinical trials for the treatment of diseases of the gastrointestinal tract (esophagitis, gastritis, duodenitis) and introduced into the State Register of medicinal preparations of Kazakhstan.

In 2011, the Research Institute of Cardiology and Internal Diseases of the Ministry of Healthcare of the Republic of Kazakhstan conducted a post-registration test of the “Limonidin” tincture and showed its effectiveness for treatment of patients with antibiotic-associated diarrhea caused by eradication therapy for *Helicobacter pylori* associated diseases of the stomach and duodenum. Re-registration in the Republic of Kazakhstan (TAD RK 42-2058-11 “Tincture”Limonidin”, RK-MP-5 No. 010141).

Object of introduction: tincture “Limonidin” of plant origin.

Prospects for implementation: for the first time in Kazakhstan in an industrial environment, an original highly effective import-substituting produced locally tincture “Limonidin” will be obtained, which, as shown by the full range of its clinical trials, can be used as an anti-inflammatory and antimicrobial drug available for the population of Kazakhstan for the treatment of a number of diseases of the gastrointestinal tract. It is an immunomodulatory, cytoprotective and antidiarrheal agent that does not cause allergies and cumulative reactions in the body.

Consumers: population of the Republic of Kazakhstan.

Competitiveness (technology advantages) and commercialization of the project: The needs of the Republic of Kazakhstan for new, environmentally friendly, import-substituting produced locally tinctures of anti-inflammatory and antimicrobial action of plant origin are high due to their acute shortage due to their absence in the pharmaceutical market of Kazakhstan. Tincture “Limonidin” is obtained according to a rationally developed, economically and environmentally sound technological scheme from plants containing a unique set of biologically active substances - polyphenols, polysaccharides and unsaturated higher carboxylic acids, which are the most effective natural antioxidants, the whole set of amino acids, including all essential ones, a wide range of vitamins and essential trace elements.

Availability of titles of protection:

– Provisional patent of the Republic of Kazakhstan, No. 17339 “Method of obtaining tincture from the roots of *Limonium gmelinii*”.

– Provisional patent of the Republic of Kazakhstan, No. 19031 “Tincture from the roots of *Limonium gmelinii* with anti-inflammatory activity.”

Investment amount: 50 million tenge.

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RELEASE OF DISINFECTANT DETERGENTS TO PREVENT THE SPREAD OF COVID-19 CORONAVIRUS INFECTION

Priority area: Life and Health Sciences.

The aim of the project: release of disinfectant detergents to prevent the spread of COVID-19 coronavirus infection.

Know-how: The project provides for the organization of the disinfectants based on sodium hypochlorite production. Highly stable oxide-ruthenium titanium anodes will use in the unit for the sodium hypochlorite production. The economical production technology was tested for several years at the Almatygorvodokanal water treatment facilities.

Relevance and novelty: today, in connection with the COVID-19 pandemic, there is an acute problem of organizing high level disinfection with universal substances for clinical diagnostic laboratories, residential premises, medical organizations, treatment rooms and other public and residential places. Now there are a lot of different disinfectants, but in most cases they are multicomponent. In this regard, the simple production of disinfectants based on local raw materials is especially important.

One of the most versatile, affordable, cost-effective substances is sodium hypochlorite. Sodium hypochlorite (NaOCl) is a solution obtained by the interaction of chlorine with a solution of sodium hydroxide. It has bactericidal and sporicidal effect. Surfactants with high antimicrobial activity are proposed to increase wetting action, to reduce the toxic, hyperallergenic and irritating properties of hypochlorite. It is proposed to add surfactants with high antimicrobial activity, in particular cationic surfactants. Quaternary ammonium compounds (QAC) are widely used from cationic surfactants. Quaternary ammonium compounds (QAC) are molecular organic compounds of pentavalent nitrogen.

Novelty and Uniqueness. We offer domestically products that will simultaneously disinfect and clean the surface. Our production aren't require additional surface washing after processing.

In case of raw material difficulties, electrode is developed by the team can be used in the oxide-ruthenium titanium anodes production. Electrodes are obtained from shungite, apricot pits and walnut shells. Shungite is secondary carbon-mineral raw material. Shungite is generated after polymetallic ores processing (East Kazakhstan). Apricot pits and walnut shells are formed in large quantities in the production of dried apricots, juices, grains in the southern regions of Kazakhstan and in the neighboring countries of the Central Asian region. In this case, the electrode will be very cheap and, despite frequent replacement, its use will be economically viable.

Practical significance: the implementation of the project will allow the development of disinfecting detergents domestic production. And it contribute to the fight against the spread of coronavirus infection.

Expected results:

- organization of own disinfectants production;
- design and creation of an original design electrolyser;
- obtaining certificates of conformity for produced products;
- reaching the disinfectant production capacity of 100 liters in 1 work shift;
- marketing, increasing the range and production volumes of products.

Object of implementation: Surface disinfectant (2% NaOCl); Disinfection spray (0,5% NaOCl); Hand disinfectant (0,05% NaOCl).

Prospects for implementation: the developed disinfecting detergents will have a significant impact in preventing the spread of viral diseases by treating various surfaces.

Consumers: housing and communal services, medical centres, public organizations.

Competitiveness (Technology Advantages) and Commercialization of the Project: the project has high commercial potential due to the high demand for disinfectants during the COVID-19 pandemic. The advantage lies in the use of own patented developments. The advantage is using of highly stable oxide-ruthenium titanium anodes, which are 15-20% cheaper than their counterparts. It significantly reduces the cost of sodium hypochlorite production.

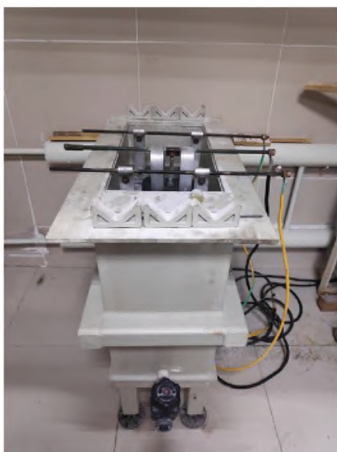
Availability of titles of protection:

- Patent No. 29953 “Method for electrode production”;
- Patent No. 31781 “Method for preliminary preparation of the titanium plates surface during the regeneration of ORTA anodes”.

Availability of contracts, agreements with production and business: negotiations with production and business will be held after receiving the Certificates of Conformity for produced products.

Investment amount: 73 460 USD (20 000 USD – ICESCO, 53 460 USD – Al-Farabi KazNU).

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CREATION OF A SCALABLE INFORMATION SYSTEM OF THE ENTERPRISE USING BIG DATA

Priority area: Information, telecommunication and space technologies.

The aim of the project: development of a microservice architecture based on Asp.Net Core and Angular Technologies, an information system for digitalization of enterprise activities using big data processing technologies (NoSQL, MongoDB, ApacheSpark).

Know-how: scalable fault-tolerant information system of enterprise digitalization with Big Data processing.

Relevance and novelty: in the developed scalable and fault-tolerant system of enterprise digitalization, the openness of the microservice architecture, scalability, a high level of independence of the functional subsystems of the complex, maintenance, practical development and application open up fundamentally new possibilities of distributed functioning for enterprises of the Republic of Kazakhstan.

Practical significance: The scalable fault-tolerant information system proposed in this project is intended for the digitalization of enterprises' activities. It is a set of new programs aimed at automating and managing various types of enterprise activities based on a process approach, which allows systematically developing each area of activity to organize work to support software developments by employees of information departments of this enterprise.

Object of implementation: scalable fault-tolerant information system of enterprise digitalization with control and optimization of the passage of documents while ensuring the security and protection of information.

Prospects for implementation: the proposed project will make a significant contribution to ensuring the scalability and fault tolerance of the activities of institutions and enterprises of the Republic of Kazakhstan. In addition, international cooperation, participation in the implementation of the project by leading foreign scientists from Great Britain, the creation of a scalable fault-tolerant information environment with digitalization of the enterprise's activities will allow the development of international scientific relations in compliance with all conditions of security and confidentiality of information.

Consumers: institutions and enterprises of the Republic of Kazakhstan for digitalization of online and offline activities, scientific and educational environment, preparation of graduates for future production activities in modern conditions.

Expected results:

- development of architecture and efficient algorithms to ensure scalability and fault tolerance;
- analysis of the processing of big data of administrative activities using NoSQL, MongoDB;

- development of a subsystem of administrative personnel work of an enterprise according to the architecture of the system;
- development of methods and algorithms to ensure protection against DDOS attacks;
- ensuring protection and secure data transmission, fault tolerance algorithms;
- checking the creation of routes and their optimization;
- big data processing and storage in a system with ApacheSpark and MongoDB.

Competitiveness (Technology Advantages) and Commercialization of the Project: creation of an effective enterprise digitalization system using new information technologies Asp.Net Core and Angular Technologies, Big Data processing technologies (NoSQL, MongoDB, ApacheSpark).

Investment amount: \$159 432.

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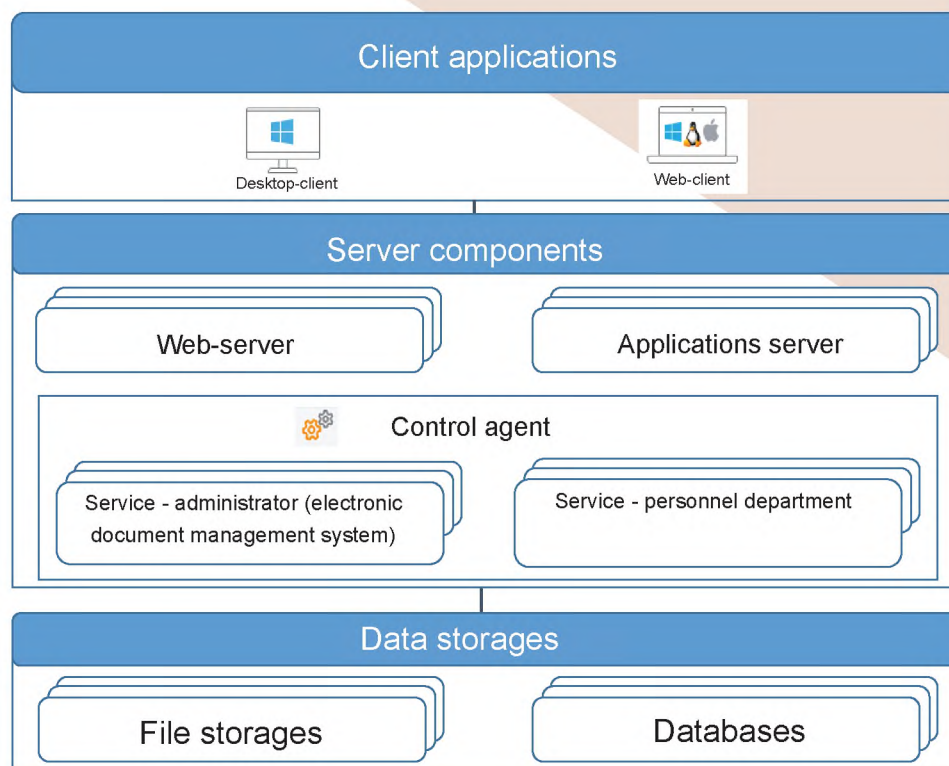


Figure. 1. Enterprise information system architecture



MECHANISMS OF IMMUNOPATHOLOGICAL CHANGES IN COVID-19

Priority area: SARS CoV-2 (COVID-19) and other potentially pandemic infectious agents.

The aim of the project: justification of a personalized approach to the tactics of managing a patient with COVID-19 based on the study of differences in the sub / population composition and functional state of lymphocytes depending on the severity of the clinical course.

Know-how: in-depth study of the functional state of the immune system, the reaction of effector and regulatory cells in the dynamics of the infectious process. The study of the cytokine profile of cells involved in the immune response (in other words, their functional state) will help identify predictors of unfavorable scenarios for the development of the disease and find ways of treatment and / or prevention.

Relevance and novelty: the data accumulated to date on the immunopathogenesis of COVID-19 shows that the course and outcomes of the disease depend on the consistency of the T-cell response to SARSCoV-2. A malfunction of the interferon system and killer populations (T-killers and natural killers) at the stage of initiation of the immune response determines whether the infectious process will go along the path of self-restriction and self-resolution or along the path of uncontrolled systemic inflammation with damage to its own tissues (up to death), accompanied by depletion of effector lymphocyte clones with the formation (in case of recovery) of prolonged lymphopenia and a pronounced secondary immunodeficiency state.

Practical significance: in any infection, the study of limited, self-resolving infection provides insight into immunopathogenesis and effective treatment options.

Expected results: due to the study of the CD profile of peripheral blood lymphocytes of COVID-19 patients in the dynamics of the infectious process in mild, moderate, severe and extreme cases (with the development of ARDS), their functional profile, namely, differences in the expression of activation markers and intracellular cytokines in lymphocytes in the dynamics of the infectious process in different variants of the course and outcomes, comparisons of the amplitude of cytotoxic activity of killers by the content of perforin in various killer subpopulations in the context of clinical manifestations will be:

- Described the clinical and immunological features of the course of COVID-19 in people;
- Described variants of the development of immunopathological events that determine the nature of the course and outcomes of COVID-19 in people.

Object of implementation: practical health care.

Prospects for implementation: the study of the intracellular content of cytokines and the functional state ultimately ensure the elimination of the virus and recovery in both mild to moderate and severe and extremely severe COVID-19.

Consumers: patients, doctors.

Competitiveness (Technology Advantages) and Commercialization of the Project: prognostic immunological criteria for the rapid progression of organ and system damage in COVID-19 for the choice of treatment tactics and prevention of complications and unfavorable outcomes of patients.

Availability of titles of protection: copyright certificates will be issued, articles will be published in leading republican and international publications, methodological and practical scientific publications (manuals, monographs) will be issued.

Availability of contracts, agreements with production and business: collaboration with the Federal State Budgetary Scientific Institution «Research Institute of Vaccines and Serums named after I.I. Mechnikov», National Scientific Center for Especially Dangerous Infections named after Masgut Aikimbaev, Scientific Center for Obstetrics, Gynecology and Perinatology.

Investment amount: 54 million tenge. 

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CLINICAL AND IMMUNOLOGICAL CHARACTERISTICS OF SARS-COV-2-ASSOCIATED IMMUNOPATHOLOGY AND THEIR CONSEQUENCES (POSTCOVID)

Priority area: SARS-Cov-2 (COVID-19) and other potentially pandemic pathogens.

The aim of the project: substantiation of a personalized approach to the treatment and management tactics of a COVID-19 patient based on the study of options for the development of SARS-Cov-2 associated immunopathology with damage to various organs and systems, depending on the nature and severity of the clinical course.

Know-how: prognostic immunological criteria for the rapid progression of organ and system damage in post-COVID-19 syndromes (macrophage hyperactivation syndrome, thrombosis and thromboembolism) for the choice of treatment tactics and prevention of complications and unfavorable outcomes of patients based on the analysis of the data obtained.

Relevance and novelty: infection caused by SARS-Cov-2 triggers the development of various autoimmune and auto-inflammatory syndromes, including pediatric inflammatory multisystem syndrome (PIMS) or multisystem inflammatory syndrome (MIS-C). These complications are unusual in nature, sharply differing in relatively high frequency and a number of features in the clinical course and outcomes from those described in other viral and autoimmune diseases. In some cases, such consequences are more severe than the course of COVID19 itself. Understanding the features of the development of the immune response to SARS-Cov-2 and the reasons for the development of immune deviations will make it possible to predict not only the likelihood of complications and adverse consequences for each individual, but also to build a diagnostic and treatment strategy in general to prevent them.

Practical significance: for any infection, the study of a limited, self-resolving infection provides an understanding of immunopathogenesis and ways of effective treatment.

Expected results: differences in the expression of activation markers and intracellular cytokines in lymphocytes in the dynamics of the infectious process in asymptomatic mild, moderate, severe and extremely severe course (with the development of ARDS and/or macrophage activation syndrome), with complications from the respiratory, cardiovascular systems, liver and kidneys, central nervous system, as well as SARS-CoV-2-associated vasculitis, DCTD-similar syndromes, multisystem inflammatory syndrome will be presented, «cytokine storm» with the development of multisystem lesions and multiple organ failure. Prognostic immu-

nological criteria for the rapid progression of organ and system damage in COVID-19 will be developed to select treatment tactics and prevent complications and adverse patient outcomes.


Object of implementation: practical health care.

Prospects for implementation: deviations of the immune response can be realized in a number of immunopathological conditions affecting the course and outcome of COVID-19: the development of hemophagocytic syndrome, macrophage hyperactivation syndrome with the development of multisystem lesions, lesions of individual organs and systems, thrombosis in the late post-COVID-19 period.

Consumers: patients, doctors.

Competitiveness (Technology Advantages) and Commercialization of the Project: prognostic immunological criteria and the likelihood of complications and undesirable consequences of COVID-19 for the choice of treatment tactics and prevention of complications and adverse outcomes.

Availability of titles of protection: copyright certificates will be issued, articles will be published in leading republican and international publications, methodological and practical scientific publications (manuals, monographs) will be issued.

Investment amount: 65 million tenge 

Availability of contracts, agreements with production and business: collaboration with the Federal State Budgetary Scientific Institution «Research Institute of Vaccines and Serums named after I.I. Mechnikov», National Scientific Center for Especially Dangerous Infections named after Masgut Aikimbaev, Scientific Center for Obstetrics, Gynecology and Perinatology.

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DEVELOPMENT OF ANALYSIS METHODS, MATERIALS AND EQUIPMENT FOR ECONOMICALLY EFFECTIVE “GREEN” ENVIRONMENTAL MONITORING

Priority area: Rational use of natural resources, including water resources, geology, processing, new materials and technologies, safe products and structures.

The aim of the project: development of new methods of analysis, materials and equipment for cost-effective “green” environmental monitoring.

Know-how: cost-effective “green” environmental monitoring.

Relevance and novelty: solid phase microextraction (SPME) is the most promising green sample preparation method, combining extraction, concentration and purification in one step. Despite the advantages of SPME, its widespread use in commercial laboratories is limited by an insufficient combination of cost-effectiveness and accuracy of available techniques. In this project, using the developed computer models, the use of SPME under vacuum, as well as coatings based on metal-organic framework structures, the accuracy of the determination of organic compounds in environmental objects has been increased, cost-effective methods of analysis and inexpensive new equipment for SPME at different attitudes and automation of vacuum SPME have been developed.

Practical significance: The developed computer models can be used to improve the accuracy of the developed SPME-based methods, as well as to reduce the time and financial costs of development, and are also important for improving the quality and efficiency of environmental monitoring, especially in conditions of insufficient funding. The results of using the methodology for monitoring the level of air pollution in Almaty, incl. during the strict quarantine in March-April 2020, they confirmed that the main sources of air pollution with benzene and toluene during the heating season are coal combustion at CHPPs and in the private sector, the importance of transferring Almaty CHPP-2 to gas was noted. The published article became the most cited Kazakhstan article of 2020 in the Web of Science database and entered the Top 0.1% of the most cited articles in the world.

Object of implementation:


- 6 new analysis methods for identifying priority pollutants in the air, water and soil;
- optimized technology of fiber production for SPME based on metal-organic framework structures MOF-199 (Fig. 1);
- a method for modifying an autosampler for automating a vacuum SPME;
- air sampling system at different attitudes using SPME for unmanned aerial vehicles (Fig. 2).

Prospects for implementation: the introduction of the developed methods will reduce the cost of environmental monitoring and/or increase the number of analyzed samples, analytes, the amount of data collected and the effectiveness of monitoring. The introduction of equipment for the automation of vacuum SPME

will reduce the cost of analysis and increase the productivity of laboratories. A device for SPME at different attitudes will allow studying the space-time distribution of volatile organic compounds with minimal costs.

Consumers: developers of analysis methods, environmental analytical laboratories, manufacturers and distributors of analytical equipment.

Competitiveness (Technology Advantages) and Commercialization of the Project: lower cost of analysis (up to 10 times) due to minimal costs for materials and equipment, and due to automation; almost complete absence of emissions of toxic compounds into the environment and toxic waste; comparable accuracy and detection limits.

Investment amount: 50 million tenge. 

Availability of documents of title: Patent of the Republic of Kazakhstan for useful model No. 5944 “Sampler for automatic solid-phase microextraction of organic compounds at different attitudes, attached to an aircraft”.

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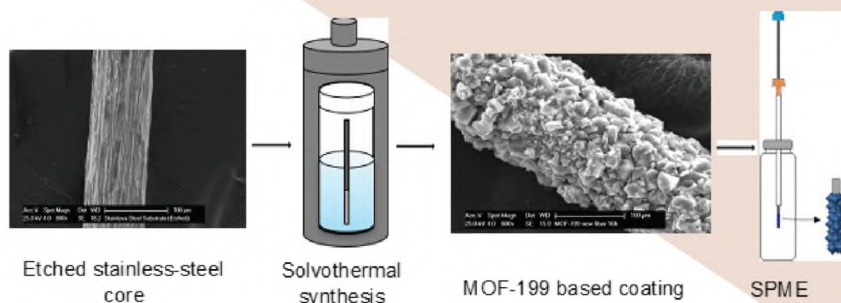


Figure 1. Scheme for the preparation of SPME fibers based on the MOF-199 organometallic framework

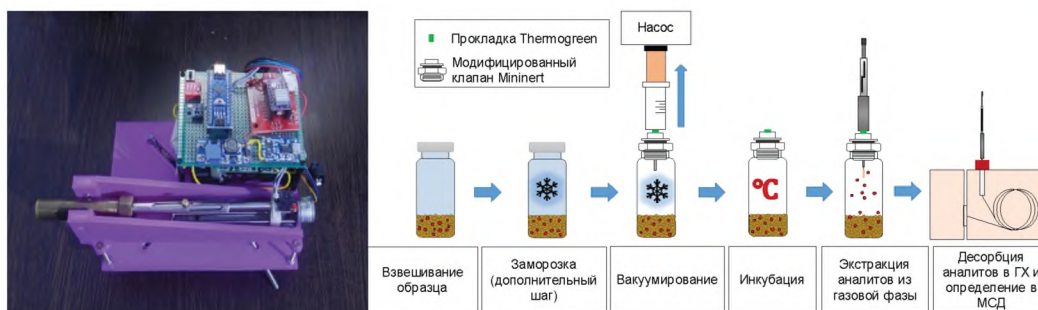


Figure 2. Prototype air sampling system at various altitudes using solid-phase microextraction for unmanned aerial vehicles

Figure 3. Schematic diagram of the procedure for the determination of organic compounds in soil by GC-MS in combination with vacuum vapor-phase solid-phase microextraction



CONTINUOUS MONITORING OF THE NEUTRON COMPONENT OF SPACE RADIATION FOR FORECASTING SPACE WEATHER

Priority area: Scientific research in the field of natural sciences.

The aim of the project: study of the influence of solar activity on the magnetosphere and atmosphere of the Earth (space weather).

Know-how: continuous monitoring of near-Earth space by measuring the main parameters of space weather using neutron supermonitors to ensure the safety of aircraft flights in space and in the upper atmosphere.

Relevance and novelty: By now, a lot of evidence has been accumulated that the variability of solar activity (SA) and cosmic ray (CR) fluxes has an important effect on various processes in the Earth's atmosphere, including the formation of the global climate and changes in the thickness of the ozone layer.

As evidence of the influence of CRs on climate, one can cite, for example, numerous paleoclimatic reconstructions showing a correlation between variations in CR fluxes and changes in global temperature, the coincidence of periods of abnormal cooling with periods of abnormally low solar activity (for example, during the Maunder minimum), a recently discovered correlation between changes in solar activity and temperature in Siberia that have taken place over the past 700 years (the temperature was determined by studying ice in the core of glaciers), etc.

Practical significance: complex diagnostics and forecast of the state of near-earth space for identifying and predicting periods, which are dangerous for the functioning of spacecraft, navigation and communication systems.


Object of implementation: neutron monitor, specialized software.

Prospects for implementation: the problem of space weather is associated with a wide range of tasks of both economic and defense importance, while the degree of impact of space weather increases with the introduction of microprocessor technology and nanotechnology into everyday life.

Consumers: international scientific community in the field of astrophysics and astronomy, organizations related to the launch of satellites into space.

Competitiveness (Technology Advantages) and Commercialization of the Project: is determined by the use of new methods, tools, research apparatus. A modern approach is used to study and analyze the state of near-earth space.

Expected results: continuous monitoring of the intensity of cosmic rays will be carried out on the 6NM-64 neutron monitor located in the cosmic ray laboratory of Al-Farabi KazNU (950 m above sea level), updating the database on neutron monitors.

Investment amount: 30 million tenge. 
Contact information: n.saduyev@physics.kz.

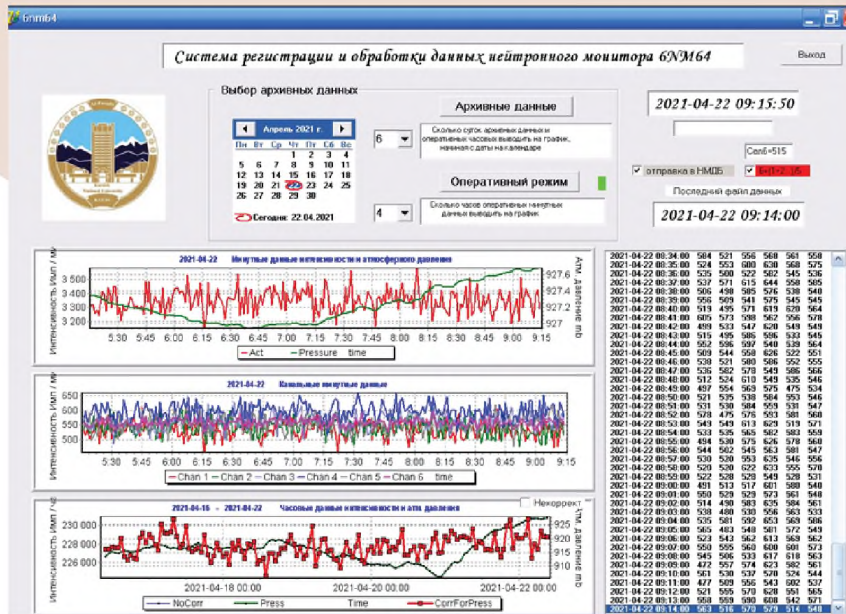


Figure 1. The interface of the system for registration and processing of data of the neutron supermonitor



Figure 2. 6NM-64 Neutron Supermonitor



DEVELOPMENT OF AN AUTOMATIC SYSTEM FOR DETERMINING THE MOISTURE RESERVE IN SNOW AND SOIL MOISTURE BY THE NEUTRON COMPONENT OF SPACE RADIATION

Priority area: Scientific research in the field of natural sciences.

The aim of the project: is an experimental and theoretical study of the interaction of cosmic radiation neutron fluxes with soil and snow.

Know-how: the method is implemented using simple detectors; characterized by a weak manifestation of interfering factors, an absence of isotope sources (using the neutron component of cosmic radiation), ease calibration and a possibility of automation of measurements.

Relevance and novelty: One of the promising areas in the field of hydrology and meteorology is the method of measuring hydrological parameters by the absorption of various components of cosmic radiation. The essence of this method consists in automatic remote measurement of hydrological parameters by a system of cosmic radiation detectors. The data obtained with the help of this system will make it possible to obtain the necessary information expressly, differentially, layer by layer, regardless of the state of aggregation of the medium in the test substance.

Practical significance: the practical significance of the project lies in the development of a method for remote determination of moisture reserves in snow and soil moisture in order to predict the runoff of mountain rivers (data on forecasting the runoff of mountain rivers can be used to organize flood control measures and to optimize the operation of hydraulic structures), a short-term forecast of the likelihood of avalanches.

Object of implementation: neutron counters, recording system, software.

Prospects for implementation: the information obtained in the future will make it possible to efficiently control the automatic valves of irrigation systems for optimal irrigation of crops, predict the flow of mountain rivers, avalanche danger, optimize the operating mode of pumped storage systems.

Consumers: Ministry of Agriculture of the Republic of Kazakhstan, Ministry of Emergency Situations, agricultural sector, etc.

Competitiveness (Technology Advantages) and Commercialization of the Project: original technique for determining moisture content, automation of data acquisition and analysis.

Expected results: the expected results of the project will be:

- search for a relationship between moisture content in soil and snow with a change in flux;
- cosmic radiation neutrons;
- creation of a remote automated system for measuring;

- hydrological and meteorological parameters;
- development of software and mathematical support for solving hydrological and meteorological problems.

Availability of documents of title: Patent of the RK No. 5797 “A device with micropower nodes of an electronic path for measuring moisture content in snow and soil moisture in an automatic mode using cosmic radiation neutrons”.

Investment amount: 70 million tenge.

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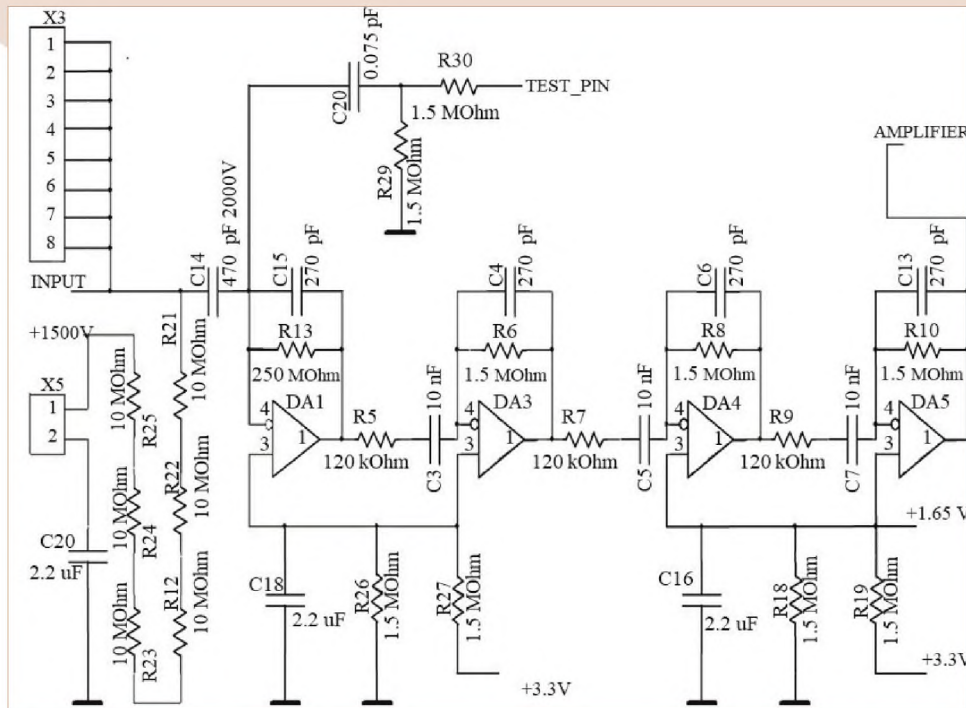


Figure 1. Schematic diagram of the used amplifier



Figure 2. Neutron detector



PRODUCTION OF COST-EFFECTIVE SOLAR CELLS WITH PLANAR CONCENTRATOR

Priority area: Power engineering and machine building.

The aim of the project: organization of pilot production of solar panels with planar concentrators for further scale-up with attraction of investments. Obtaining of an international patent is also a goal of this project.

Know-how: We have know-how. The technology has no analogues in Kazakhstan and in the world, is protected by a patent of the Republic of Kazakhstan for invention, there is a possibility of international patenting.

Relevance and novelty: At present, a significant reduction in the carbon footprint and the cost of silicon solar cells is possible only through the use of inexpensive concentrators. The novelty of the innovative development lies in the original design, which simplifies the technology of the planar concentrator production.

Practical significance: low volume of domestic production and high share of imports in the green energy market shows the practical importance of producing our own competitive products.

The innovative design of solar panels with a planar concentrator will allow us to reduce the need for expensive consumable material, silicon, by more than two times. 2 times less. While maintaining the capacity and efficiency, it will reduce the cost of production by up to 30%.

The low cost allows us to compete not only in the domestic but also in the global solar cell market.

Sales of licenses for production can the sale of production licenses can make a significant part of revenues.

Expected results: projected volume of pilot production is 1 MW per year with further increase up to 1000 MW per year.

Object of implementation: pilot production of economical solar panels with planar concentrators.

Prospects for implementation: organization of pilot production of economical solar panels with planar concentrators for further scale-up with attraction of investments and entering the world market. Creation of new jobs. Obtaining of the international patent.

Consumers: wholesale buyers, specialized companies.


Competitiveness (Technology Advantages) and Commercialization of the Project: availability of innovative component of the offered product, which provides low cost at high quality, is the main key of product competitiveness.

Main competitive advantages:

- Availability of Kazakhstani patent and possibility of international patenting;
- Low cost of production;
- Reducing the need for consumables by 2 times and reducing production costs by 30%.

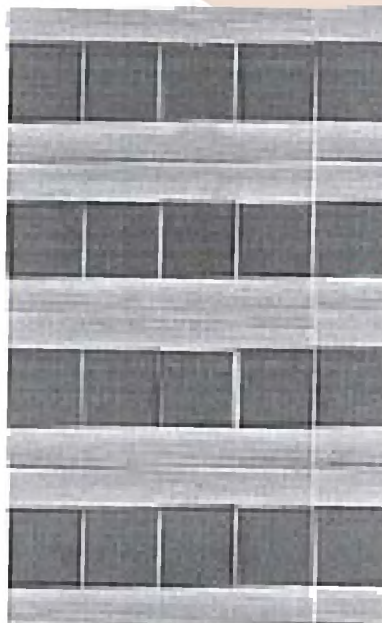
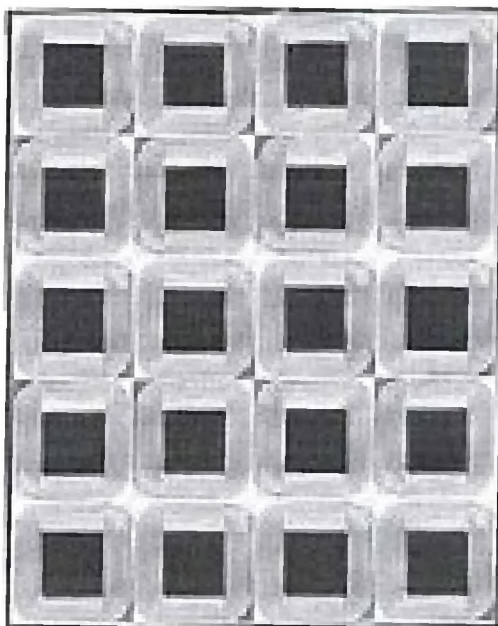
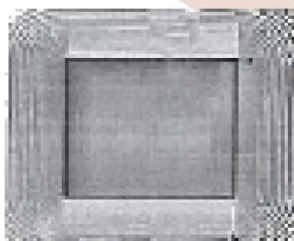
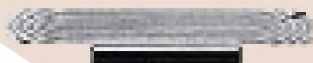
Availability of titles of protection: Patent No. 33562 “Planar concentrated silicon solar panel”.

Availability of contracts, agreements with production and business: none.

Investment amount: 400 million tenge. 

Output volume: pilot production volume is 1 MW per year, with further increase up to 1000 MW per year.

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MULTILINGUAL NEURAL MACHINE TRANSLATION OF TÜRKIC LANGUAGES

Priority area: Information, telecommunication and space technologies.

The aim of the project: Development and research of new computational technologies for processing Türkic languages based on a new computational model of the morphology of Türkic languages developed by the authors, CSE (complete set of endings) - a model based on complete sets of endings, multi-lingual neural machine translation technology for Türkic languages, creation of prototypes of language resources (dictionaries and corpora), programs for processing texts of Türkic languages based on the CSE-model of morphology, prototypes of neural machine translation of Türkic languages.

Know-how: the use of a new computational model of the morphology of the Türkic languages developed by the authors, a CSE-model based on complete sets of endings.

Relevance and novelty: Research on the processing of Türkic languages (NLP - natural languages processing), including machine translation of Türkic languages, has not been sufficiently researched. In connection with the development of ties among the Türkic world and the global task set by President Tokayev “to turn the Türkic world into one of the most important economic and cultural regions of the 21st century”, the interaction of the Türkic languages is an urgent task. The Türkic civilization has the right to be equal among equals.

The novelty of the proposed project lies in the development of new computational technologies for processing Türkic languages based on a new computational CSE-model of the morphology of Türkic languages developed by the authors. This technology is aimed at linguists: a tabular (relational) CSE model of the morphology of a new language, relational computational data models (decision tables) for each NLP problem are prepared and then universal NLP problem processing programs are used.

Practical significance: The practical significance of the project lies in the creation of universal programs for processing agglutinative Türkic languages, the creation of a technology for creating linguistic resources (mono- and bilingual corpora, dictionaries) and neural program models of machine translation.

Expected results:

- development of new parallel corpora for pairs of languages of the Türkic group;
- development of new technologies for neural machine translation for Türkic languages using the latest transfer learning technologies;
- development of new technologies for adaptation of neural machine translation domains for Türkic languages;

- development of new computational models for the segmentation of the texts of each Türkic language;
- development of new linguistic resources (dictionaries of stems, dictionaries of endings, dictionaries of word-formation affixes, dictionaries of stop words) of the Türkic languages.

Object of implementation: new technologies for machine processing of texts in Türkic languages (linguistic resources in the form of dictionaries, corpora and word processing programs) based on the CSE-model of morphology, prototypes of program models of neural machine translation.

Prospects for implementation: prototypes of language resources, programs for processing texts of Türkic languages based on the CSE-model of morphology, programs for neural machine translation.

Consumers: state structures for ensuring the development of computerization of Türkic languages, universities, research structures, commercial structures in the field of natural language processing (NLP).

Competitiveness (Technology Advantages) and Commercialization of the Project: The advantages of the proposed processing technology of Türkic languages based on a new computational model of the morphology of Türkic languages, CSE-model of morphology, is to create a technology for computerization of Türkic languages, focused on linguists: a tabular (relational) CSE-model of the morphology of a new language, relational computational data models (tables solutions) for each NLP problem and then use generic NLP problem handlers. This will allow more efficient computerization of the Türkic languages. This is also supported by the authors' strategy of presenting their results and products as open source, freely usable under the Creative Common Licenses (CC Attribution - Share Alike) license.

Investment amount: 64 mln. tenge. 

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RESEARCH AND DEVELOPMENT OF THE POST-EDITING SYSTEM OF KAZAKH LANGUAGE IN MACHINE TRANSLATION

Priority area: Information, telecommunication and space technologies, scientific research in the field of natural science.

The aim of the project: the creation of a technology for a post-editing system of the Kazakh language with high-quality machine translation, adapted to the peculiarities of the language.

Know-how: the developed models and systems will be based on the developed modern approaches to natural language processing and artificial intelligence.

Relevance and novelty: “Post-editing machine translation,” which in the modern translation industry is denoted by the English abbreviation PEMT (Post Editing Machine Translation) or MTPE (Machine Translation Post Editing), reflects the new demanded competence in the translation industry and, accordingly, new technological solutions in this area. Post-editing includes fixing the machine translation output to ensure high quality. The concept of post-editing is related to the concept of pre-editing. In the process of translating text using machine translation, the best results can be obtained by first editing the source text, for example, applying the principles of controlled language, and then post-editing the machine output. It differs from editing, which refers to the process of enhancing the human-generated text. Performance and volume estimates are moving targets anyway, as advances in machine translation, largely driven by the post-edited text being returned to its engines, will mean that the more post-editing, the better the machine translation quality.

Practical significance: the results of the project will be a contribution to the development of science and technology in the field of post-editing machine translation in general, and in particular, in the field of post-editing machine translation of the Kazakh language, as well as a contribution to the development of the technological basis of systems for understanding the Kazakh language and humanoid robots with the Kazakh language. In various fields of activity, they will provide scientific and socio-economic benefits.

Expected results: the development of a prototype of a post-editing system for the Kazakh language (for examples of a specific area) in machine translation.

Object of implementation: machine translation post-editing technology.

Prospects for implementation: the possibility of implementation on various mobile platforms (IOS \ Android).

Consumers: all segments of the population of Kazakhstan, government agencies and business organizations, users-researchers (both in the field of information and linguistics), developers, suppliers, etc.

Competitiveness (Technology Advantages) and Commercialization of the Project: The fundamental difference between the project ideas and existing ana-

logues such as Google Translate, Microsoft Translator is the open nature of its source codes as a free / open system that allows researchers and developers to use them to develop directions of machine translation. Funding the project will allow obtaining the results of research in the field of machine translation of Kazakh language at the level of the most modern achievements in the field of numerical linguistics of the Kazakh language.

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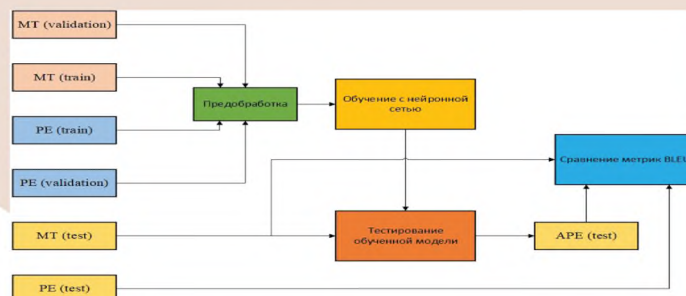


Figure 1. Stages of the automatic post-editing algorithm of the Light post-editing module

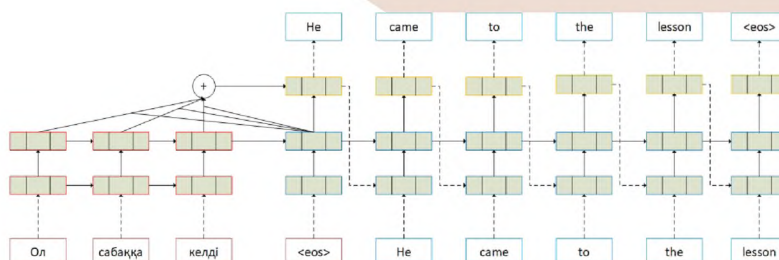
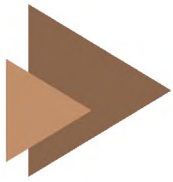


Figure 2. OpenNMT a complete set of libraries for training and deploying neural machine translation models



Figure 3. Model of the problem of unknown words in post-editing of machine



DEVELOPMENT OF A SYSTEM FOR THEMATIC MACHINE TRANSLATION FROM KAZAKH INTO ENGLISH OR RUSSIAN (AND VICE VERSA) BASED ON THE APERTIUM PLATFORM

Priority area: Information, telecommunication and space technologies.

The aim of the project: development of a system for thematic machine translation from Kazakh into English or Russian (and vice versa) using the Apertium machine translation platform.

Know-how: consists in the development of new linguistic resources, software tools for thematic machine translation of English-Kazakh or Kazakh-Russian language pairs, focused on a specific subject area, for example, oil and gas, construction, etc.

Relevance and novelty: creation of new linguistic data (dictionaries and rules) for thematic machine translation of the English-Kazakh or Kazakh-Russian language pairs, the novelty of which lies in the fact that they are created as thematic linguistic resources; development of new Anglo-Kazakh or Kazakh-Russian thematic parallel corpora; development of new patterns (templates) of recognition for various thematic classes of proper names based on the apparatus of regular expressions for the English-Kazakh or Kazakh-Russian language pairs; deployment and evaluation of a system of thematic machine translation of Kazakh-English or Kazakh-Russian language pairs in an interactive translation prediction scenario.

Practical significance: the practical significance of the project lies in the creation of linguistic resources, software tools for thematic machine translation of the English-Kazakh or Kazakh-Russian language pairs, taking into account the peculiarities of these languages and the field of application.


Expected results: prototypes of the system for thematic machine translation of the English-Kazakh or Kazakh-Russian language pairs on the Apertium machine translation platform.

Object of implementation: technology of subject machine translation of English-Kazakh or Kazakh-Russian language pairs on the Apertium machine translation platform.

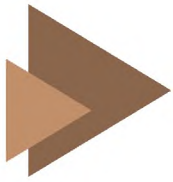
Prospects for implementation: prototypes of the system of thematic machine translation of the English-Kazakh or Kazakh-Russian language pairs on the Apertium machine translation platform.

Consumers: state structures for ensuring the development of computerization of Türkic languages, universities, research structures, commercial structures in the field of natural language processing (NLP).

Competitiveness (Technology Advantages) and Commercialization of the Project: The advantage of the proposed technology of thematic machine translation of English-Kazakh or Kazakh-Russian language pairs on the Apertium machine translation platform is to create thematic machine translation focused on a specific subject area, for example, oil and gas, construction, etc.

Investment amount: 80 mln. tenge. 

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DEVELOPMENT OF A SYSTEM FOR THEMATIC NEURAL MACHINE TRANSLATION OF THE KAZAKH LANGUAGE

Priority area: Information, telecommunication and space technologies.

The aim of the project: development of a system for thematic neural machine translation of the Kazakh language, focused on a specific subject area.

Know-how: is to develop new linguistic resources, software tools for thematic neural machine translation of the Kazakh language.

Relevance and novelty: creation of new linguistic resources (dictionaries), parallel corpora for thematic neural machine translation of the Kazakh language, the novelty of which lies in the fact that they are created as thematic linguistic resources for a specific subject area; creation of new technologies for preprocessing processing of Kazakh corpora on the basis of a new model of the morphology of agglutinative languages proposed by the author – CSE (complete set of endings) model.

Practical significance: the practical significance of the project lies in the creation of linguistic resources, software tools for thematic neural machine translation of the Kazakh language.

Expected results: prototypes of a system for thematic neural machine translation of the Kazakh language.

Object of implementation: technology of thematic neural machine translation of the Kazakh language into English or Russian (and vice versa).

Prospects for implementation: prototypes of a system for thematic neural machine translation of the Kazakh language.

Consumers: state structures for ensuring the development of computerization of Türkic languages, universities, research structures, commercial structures in the field of natural language processing (NLP).

Competitiveness (Technology Advantages) and Commercialization of the Project: The advantage of the proposed technology of thematic neural machine translation of the Kazakh language is to create thematic neural machine translation focused on a specific subject area of activity, for example, oil and gas, construction, etc.

Investment amount: 60 mln. tenge. 

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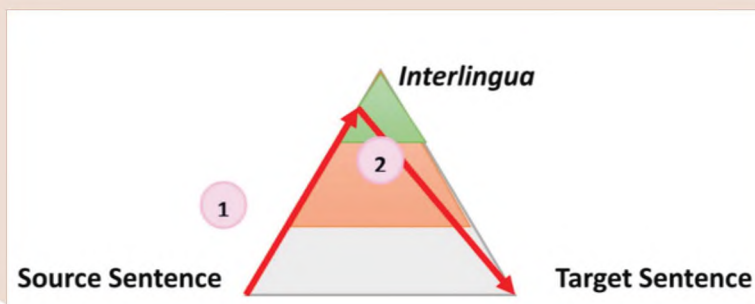


Figure 1. 1-phase ENCODER (encryption) of the text of the source language into semantic vector representation; 2-phase DECODER (decryption) of vector representation into the text of the target language

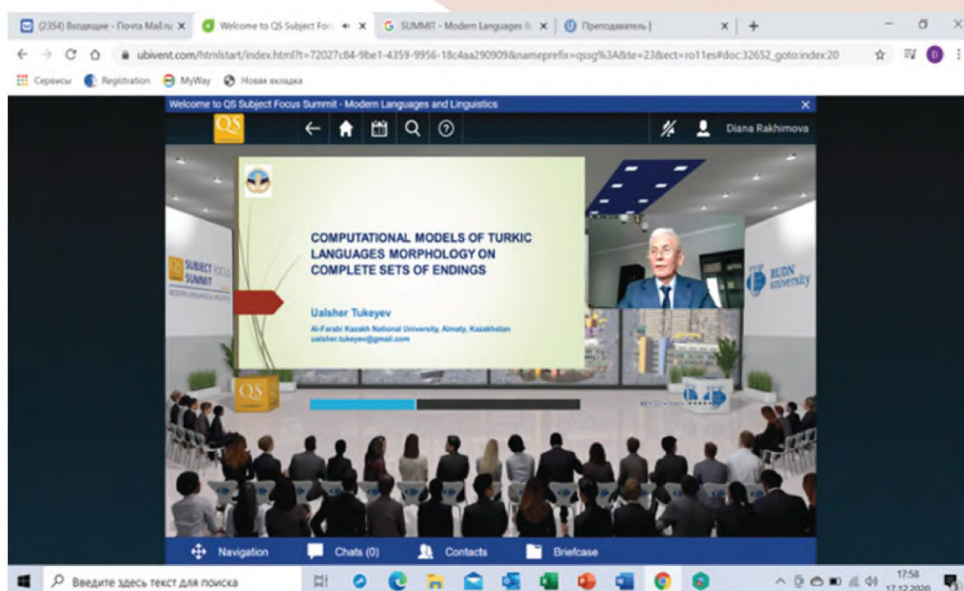
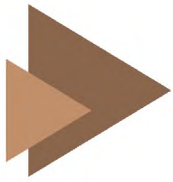


Figure 2. Report at the conference on the topic: “Development of a system for thematic neural machine translation of the Kazakh language”



DEVELOPMENT OF MODELS, ALGORITHMS FOR SEMANTIC ANALYSIS TO IDENTIFY EXTREMIST CONTENT IN WEB RESOURCES AND CREATION THE TOOL FOR CYBER FORENSICS

Priority area: national security and defense.

The aim of the project: to develop and study of models, algorithms and software for semantic data analysis to detect extremist content on web resources, methods for identifying participating users and algorithms for graphical visualization of contacts, creation and research of models for analyzing cryptocurrency transactions in Darkoin payment systems and their adaptations to identify sources of funding, development of cyber-forensic equipment to combat extremism.

Relevance and novelty: a software module for collecting and analyzing web content for identifying EO (extremist orientation), a corpus of texts in the Kazakh language for teaching and testing machine methods for identifying texts with EO, a model for semantic analysis of EO texts, a morphological analyzer, a database of keywords, a set of features for teaching and testing machine methods for identifying EO texts.

Practical significance: significance of the project results semantic analysis of web resource data in Kazakh and Russian to determine the optimal set of features for machine learning methods for detecting texts of extremist content, algorithms, methods for identifying participating users, methods for creating and implementing payload for computing devices and remote access to devices, cyber-investigation algorithms for systems such as Darkcoin, characterized by innovative structural models, and methods for analyzing transaction graphs and topologies, as well as the development of a method for searching for transaction data using artificial neural networks, where the public recognizes shadow objects from a large amount of information.

Expected results:

- Software module for collecting and analyzing web content to identify extremist orientations (EO);
- Corpus of texts in the Kazakh language for training and testing machine methods for detecting EO texts;
- Model of semantic analysis of EO texts;
- morphological analyzer;
- - keyword database, a set of symbols for teaching and testing machine methods for identifying EO texts;
- Methods for analyzing audio and video messages for the purpose of determining the EO;


– Adaptation of machine learning methods for determining EO in texts in the Kazakh language.

Object of implementation: for authorized bodies ensuring national security of the Republic of Kazakhstan.

Prospects for implementation: ensuring information security in social networks and providing a tool for automatic identification and identification of extremist web resources.

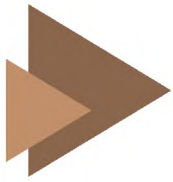
Consumers: fundamental results can be used by the world scientific community, applied results in the form of methodology, algorithms, patents and prototypes can be used by authorized bodies for information security, critical infrastructure, and combating internet extremism.

Competitiveness (Technology Advantages) and Commercialization of the Project: the results obtained can be used to ensure security in the social network.

Investment amount: 52 million tenge. 

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ASSESSMENT OF THE IMPACT OF THE FUNCTIONING OF TPP AND NPP ON THE ENVIRONMENT BY METHODS OF MATHEMATICAL MODELING

Priority area: Energy and mechanical engineering.

The aim of the project: creation of a set of programs to assess the impact of thermal emissions from the heat and power complex on the air and water environment. Based on mathematical and computer modeling, real assessments of the impact of thermal power plants and nuclear power plants on the environment, monitoring of the environmental situation, and a forecast of further developments in real time will be obtained.

Know-how: application of mathematical modeling methods to assess the impact of the operation of TPP and NPP on the environment.

Relevance and novelty:

- modeling the thermal load of water basins at various operating capacities of TPPs and NPPs;
- modeling of the technogenic impact of thermal power plants on the air environment of the region of their location;
- modeling the impact of a cooling reservoir and thermal emissions into the lower layers of the atmosphere on the ecological state of the areas where TPPs and NPPs are located.

Practical significance: development of practically applicable mathematical models and reliable algorithms for numerical modeling.

Object of implementation: a set of programs for assessing the impact of thermal emissions from a heat and power complex on the air and water environment.

Prospects for implementation: technogenic impact of thermal and nuclear power plants on the aquatic environment of the region of their location in real time under non-stationary meteorological conditions.


Consumers: design organizations, energy complex organizations, research institutes, environmental services.

Competitiveness (Technology Advantages) and Commercialization of the Project: a complex of programs that has no analogue.

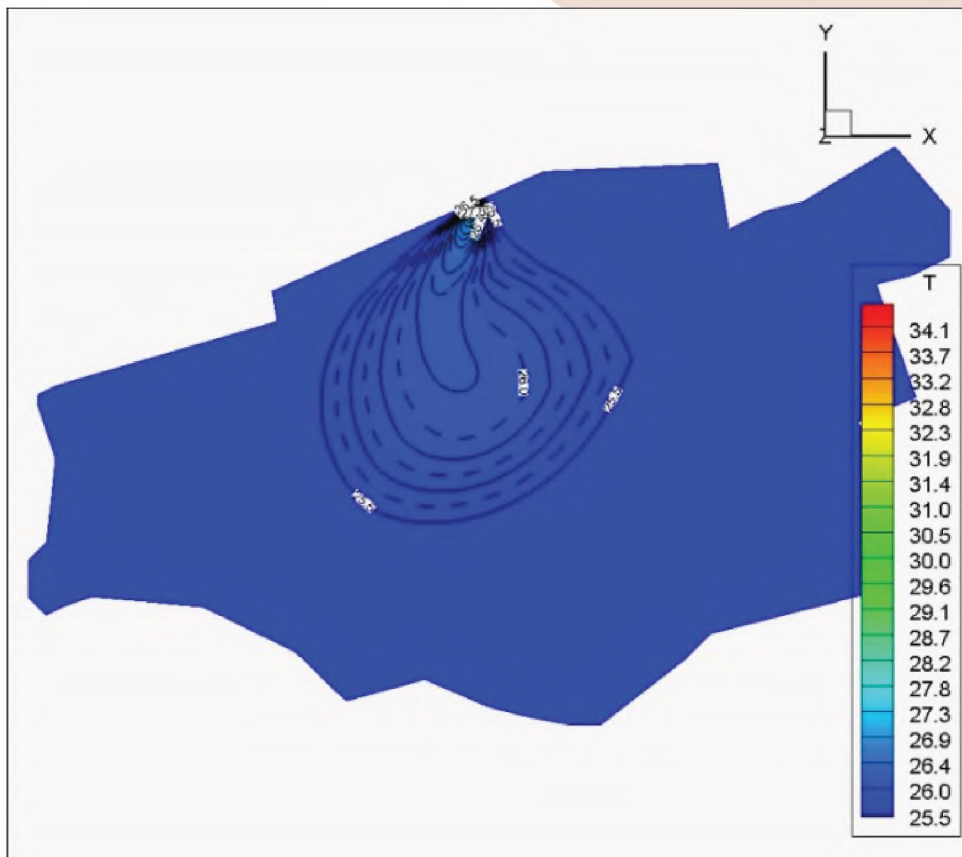
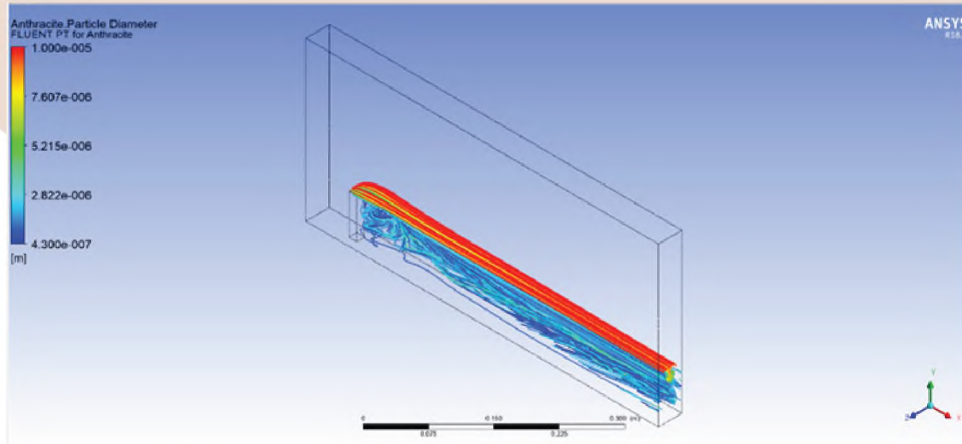
Expected results:

- modeling of the thermal effect on water basins at various operating capacities of TPPs and NPPs was carried out;
- modeling of the technogenic impact of thermal power plants on the air in the region of their location was carried out;

– the simulation of the impact of the cooling reservoir and thermal emissions into the lower layers of the atmosphere on the ecological state of the regions where TPPs and NPPs are located was carried out.

Investment amount: 18 million tenge. 

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MODELING THE CONSEQUENCES OF HYDRAULIC ACCIDENTS, FLOOD ZONES AND IMPURITIES TRANSFER IN THE DAM BREAKTHROUGH IN A COMPLEX SYSTEM OF RIVERS AND CANALS

Priority area: Energy and mechanical engineering.

The aim of the project: development of an expert system for eliminating the consequences of hydraulic accidents, currents, waves, transport of impurities during a dam break in a complex system of rivers and canals by methods of mathematical modeling. Predictive modeling and assessment of resistance to high pressures and the influence of negative factors on the stability, strength and bearing capacity of the dam, taking into account the real topography.

Know-how: application of mathematical modeling methods to eliminate the consequences of hydraulic accidents, currents, waves, transport of impurities during a dam break in a complex system of rivers and canals.

Relevance and novelty:

- simulation of a dam break taking into account the intensively changing free surface in real time;
- modeling of various architectural hydraulic structures in order to assess their resistance to high pressures and the effects of negative factors on the stability, strength and bearing capacity of the dam, taking into account the real terrain;
- modeling of various architectural hydraulic structures in order to assess their resistance to high pressures during mudflows containing large solid objects and taking into account the terrain.

Practical significance: development of practically applicable mathematical models and reliable algorithms for numerical modeling.

Object of implementation: an expert system for eliminating the consequences of hydraulic accidents, currents, waves, transport of impurities during a dam breakthrough in a complex system of rivers and canals using methods of mathematical modeling.

Prospects for implementation: forecasting the consequences of hydraulic accidents, flooding zones and transport of impurities during a dam break in a complex system of rivers and canals in real time.

Consumers: committees for water resources and emergency situations, akimats, environmental organizations and other interested enterprises.

Competitiveness (Technology Advantages) and Commercialization of the Project: a complex of programs that has no analogue.

Expected results:

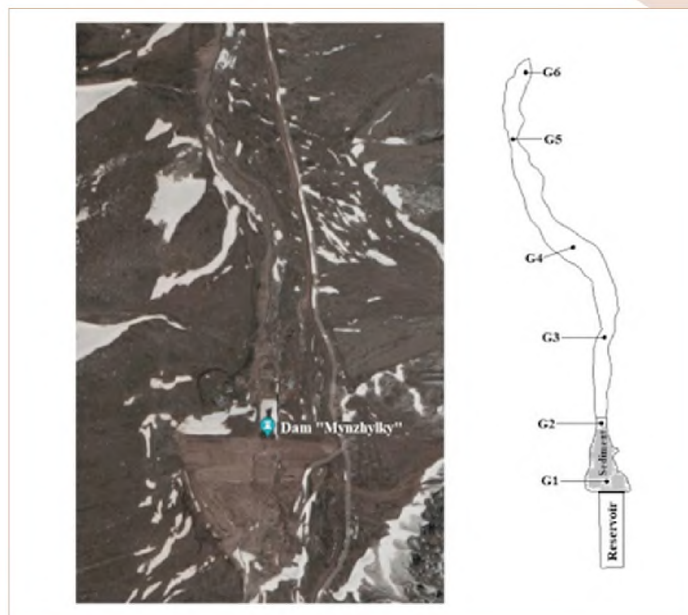
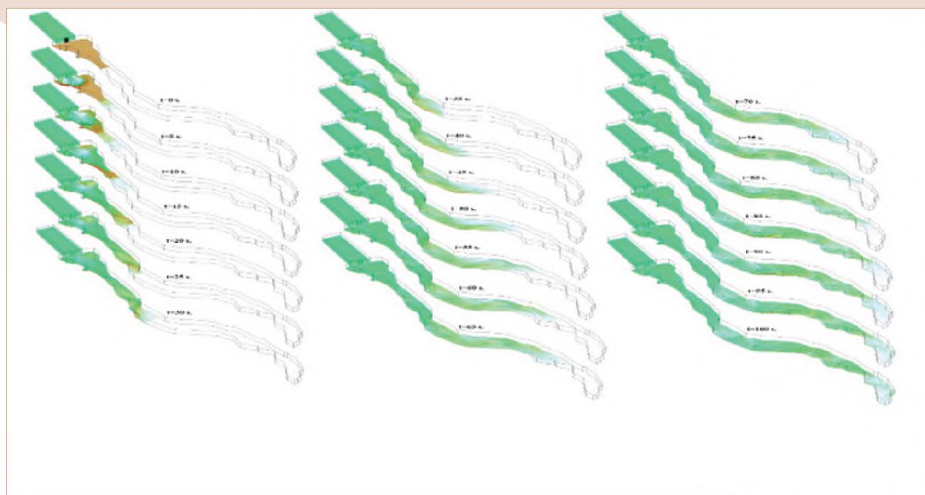
- modeling of the dam break was carried out taking into account the intensively changing free surface in real time;

– modeling of various architectural hydraulic structures was carried out in order to assess their resistance to high pressures and the effects of negative factors on the stability, strength and bearing capacity of the dam, taking into account the real terrain;

– modeling of various architectural hydraulic structures was carried out in order to assess their resistance to high pressures during mudflows containing large solid objects and taking into account the terrain.

Investment amount: 27 million tenge.

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ASSESSMENT OF THE INFLUENCE OF THERMAL AND POLLUTING EMISSIONS FROM TPP AND NPP ON THE ENVIRONMENT OF THE ADJACENT TERRITORY BY METHODS OF MATHEMATICAL MODELING

Priority area: Energy and mechanical engineering.

The aim of the project: development of an expert system for assessing pollution of the environment and adjacent territory from the activities of thermal and nuclear power plants by methods of mathematical modeling.

Know-how: application of mathematical modeling methods to assess the pollution of the environment and the adjacent territory from the activities of thermal and nuclear power plants.

Relevance and novelty:

- modeling of thermal impact on water basins at different operating capacities of TPPs and NPPs;
- modeling the technogenic impact of thermal power plants on the air in the region of their location;
- modeling the propagation of dust and ash particles in the lower layers of the atmosphere as a result of the operation of thermal power plants and assessing the ecological state of the surrounding areas.

Practical significance: development of practically applicable mathematical models and reliable algorithms for numerical modeling.

Object of implementation: expert system for assessing pollution of the environment and the adjacent territory from the activities of TPP and NPP by methods of mathematical modeling.


Prospects for implementation: research is aimed at studying the technogenic impact of thermal and nuclear power plants on the aquatic environment of the region in real time under non-stationary meteorological conditions.

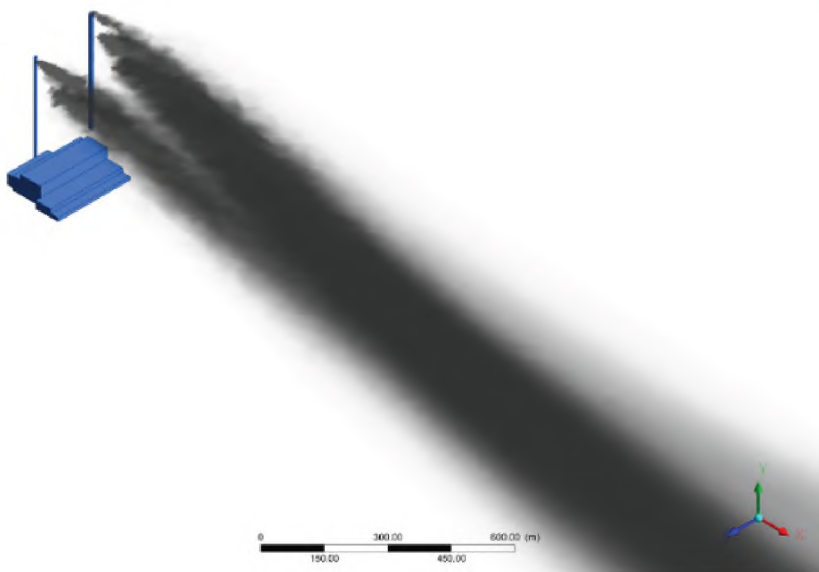
Consumers: design organizations, energy complex organizations, research institutes, environmental services.

Competitiveness (Technology Advantages) and Commercialization of the Project: a complex of programs that has no analogue.

Expected results:

- modeling of the thermal effect on water basins at different operating capacities of TPPs and NPPs was carried out;
- modeling of the technogenic impact of thermal power plants on the air in the region of their location was carried out;
- modeling of the propagation of dust and ash particles in the lower layers of the atmosphere as a result of the operation of thermal power plants and an assessment of the ecological state of the surrounding areas were carried out.

Investment amount: 30 million tenge. 
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DEVELOPMENT OF A TECHNOLOGICAL PLATFORM FOR VIRTUAL LEARNING BASED ON APPROACHES OF ARTIFICIAL INTELLIGENCE

Priority area: Research in the field of education and science.

The aim of the project: research of algorithms and implementation of the technological platform of a virtual distance learning system using artificial intelligence (AI), creating a flexible online platform for computerized adaptive-blended learning based on the VLTPU (Virtual Learning Technology Platform at the University) portal, expanding the capabilities of developed virtual assistants, development of an interface for intelligent control of gestures of human-computer interaction.

Know-how: development and implementation of a technological platform for virtual learning within the framework of E-Learning using electronic resources based on artificial intelligence, and which is an affordable product for widespread use in the educational market of the Republic of Kazakhstan.

Relevance and novelty: A distinctive feature of the project is the creation of online learning software and educational environments of a new generation using artificial intelligence based on the developed and operating product “Virtual learning technology platform at the university VLTPU” will make it possible to organize distance-virtual learning at a high technological level, to conduct adaptive and blended learning using a complete software package necessary for this. Attracting highly qualified specialists will create a competitive product in the global education market.

Practical significance: consists of:

- development of a technological platform for virtual learning, which can be applied in all educational institutions as the main platform or using its elements;
- using the interface of intelligent gesture control in human-computer interaction, which implements the principle of the availability of quality education, inclusive learning, social mobility and reducing socio-economic differentiation in society;
- the possibility of organizing virtual learning with a full range of educational services in emergency situations and conditions.

Expected results:

- development of a specialized portal as a platform for a virtual distance learning system and a competitive software product and a tool that provides a distance and virtual educational environment within the framework of e-Learning;
- software development using the basic algorithm of artificial intelligence, the interface for intelligent control of gestures of human-computer interaction in teaching;
- introduction of a technological platform for a virtual distance educational environment within the framework of E-Learning.

Object of implementation: process of a virtual distance learning system using artificial intelligence (AI).

Prospects for implementation: the developed technological platform for virtual learning within the framework of E-learning will be implemented in higher educational institutions (Kazakhstan and Bulgaria), the educational environment of which will be an information and educational space using artificial intelligence technologies.

Consumers: institutions of higher professional education of the Republic of Kazakhstan.

Competitiveness (Technology Advantages) and Commercialization of the Project: the project is focused on the creation of an innovative competitive technological product, it is planned to effectively use the financial, production and labor potential.

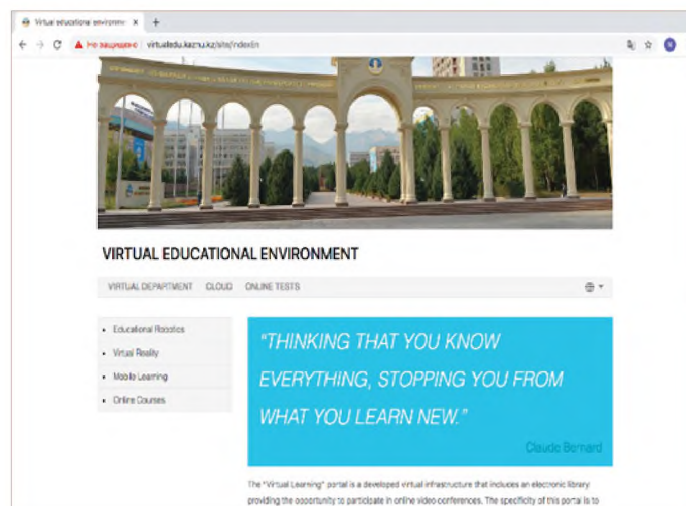
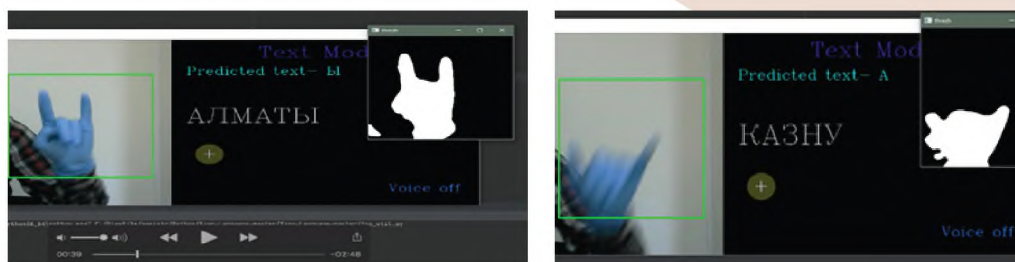
The project will be commercialized by transferring the developed technology, bringing the developed innovative products and the results of research activities to the market.

Availability of documents of title:

– Copyright certificate No. 16051 “TopTaskerGeo virtual distance learning system”.

Investment amount: 44.9 million tenge.

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DEVELOPMENT ACTIVE KNOWLEDGE CONTROL SYSTEM FOR AUTOMATING OF CONSTRUCTION OF PARALLEL PROCESSING PROGRAMS

Priority area: Information, telecommunication and space technologies, scientific research in the field of natural science.

The aim of the project:

- creation of approaches to automating the design, study and practical application of large-scale mathematical models and parallel algorithms in fluid filtration problems and unstructured data processing problems;
- creation of a software package that provides such automation;
- investigation of the developed approaches and complex in the design of numerical models of nonequilibrium filtration of multicomponent fluid (composite model) taking into account heat/mass transfer processes for complex areas (cracks, faults) using three-dimensional unstructured grids, as well as effective algorithms and models for processing weakly structured text data based on modern technologies in the field of machine learning to obtain new information and knowledge from unstructured sources.

Know-how: application of the concept of active knowledge to solve numerical problems of filtering and processing of weakly structured knowledge.

Relevance and novelty: automation of the development, research and application of large-scale numerical models and algorithms for data processing is based on the creation of universal tools for the presentation of knowledge in various subject areas.

Practical significance: the practical significance of the development of a software package is determined by the relevance for the tasks of science and industry of the problem of automation of the development, research and application of large-scale numerical models and algorithms for data processing.

Expected results:

– A prototype of a software package has been developed to automate the design, study and practical application of large-scale mathematical models and parallel algorithms in fluid filtration problems and unstructured data processing problems.

– Algorithms and programs have been developed that implement numerical models of nonequilibrium filtration of multicomponent fluid (composite model) taking into account heat/mass transfer processes, algorithms for constructing unstructured grids, as well as algorithms and models for processing weakly structured text data based on modern machine learning technologies to obtain new information and knowledge from unstructured sources.

Object of implementation: active knowledge control system.

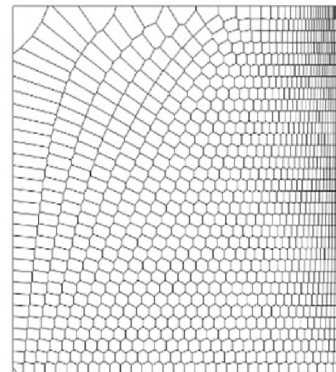
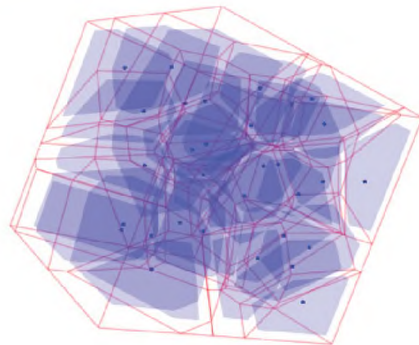
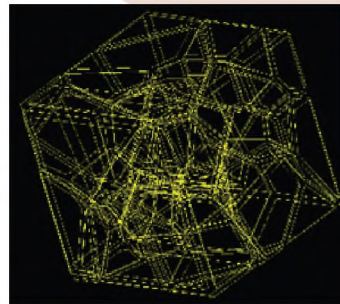
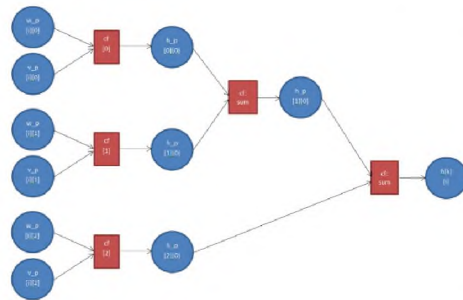
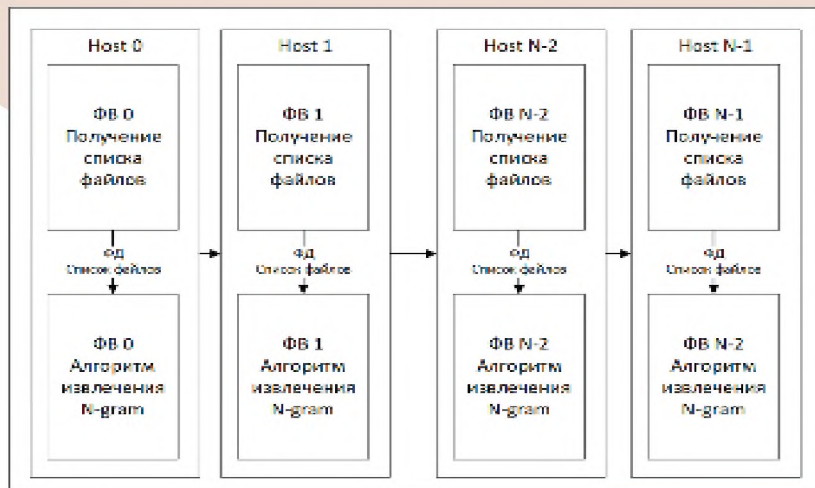
Prospects for implementation: the results of the project can be implemented in oil producing companies.

Consumers: specialized research groups, experimental and industrial research centers, production companies of the oil and gas industry.

Competitiveness (Technology Advantages) and Commercialization of the Project: lower cost compared to industrial systems.

Investment amount: 60 million tenge

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CREATION OF HIGH-PERFORMANCE INTELLIGENT TECHNOLOGIES OF ANALYSIS AND DECISION-MAKING FOR THE «LOGISTICS-AGGLOMERATION SYSTEM»

Priority area: Information, telecommunication and space technologies.

The aim of the project: solution of a set of scientific problems associated with the creation of a software system for collecting, analytical processing of data and automated development of control solutions for the development of agglomerations in Kazakhstan, including the solution of related logistic problems.

Know-how: automation of the development of models and the accumulation and application of data processing algorithms according to the developed computational models.

Relevance and novelty: lies in the complex formulation of the problem of optimization of agglomeration and logistics processes in Kazakhstan and its solution based on the creation of a software package that combines modern approaches to the development of intelligent software: formal representation of knowledge about the subject area in an active form in the form of partial axiomatic theories, analytics big data, machine learning, automation of accumulation and use of expert knowledge.

Practical significance: a prototype of a cloud system for solving problems of collecting, intelligent processing of data and developing control solutions based on mathematical and software tools for building models in subject areas, setting problems and outputting solutions on these models.

Expected results:

- sociological and psychological research to build a model of consumer behavior, as well as analysis of factors affecting consumer behavior and socio-psychological analysis to predict the economic behavior of consumers;
- algorithms for collecting and analyzing data required to build models of processes in logistics and the development of agglomerations;
- the architecture of the software system and the prototype of the system, including services for collecting and analyzing data, an environment for the development and application of computational models;
- a model of the interaction of logistics processes in the development of an agglomeration and the adaptation of the Sulpiter model to the specifics of Kazakhstan;
- methods of syntactic analysis of texts in Russian to fill in the ontology for the selected subject area;
- methods of distributed collection, storage and preprocessing of texts, including in the Kazakh language;
- Algorithm and module of a virtual fitting room, which use artificial intelligence, which makes it possible to identify information from a photograph that is necessary to determine the anthropometric data of a person, the development of services for the presentation and application of knowledge about algorithms and computational procedures;

- a prototype of an environment for online development of computational models and an algorithm for deriving the optimal solution for recursive computational models with predicates;

- a prototype of an intelligent chatbot using the DeepPavlov library on academic topics;


- an approach to the automatic expansion of the formal description of the subject area in the form of a computational model based on the combination of knowledge represented by many other computational models semantically related to the original computational model;

- an approach to automatic adaptation of computational models. In the form of a web service, a pipeline for analyzing texts in the Kazakh language is implemented, which works like a SaaS.

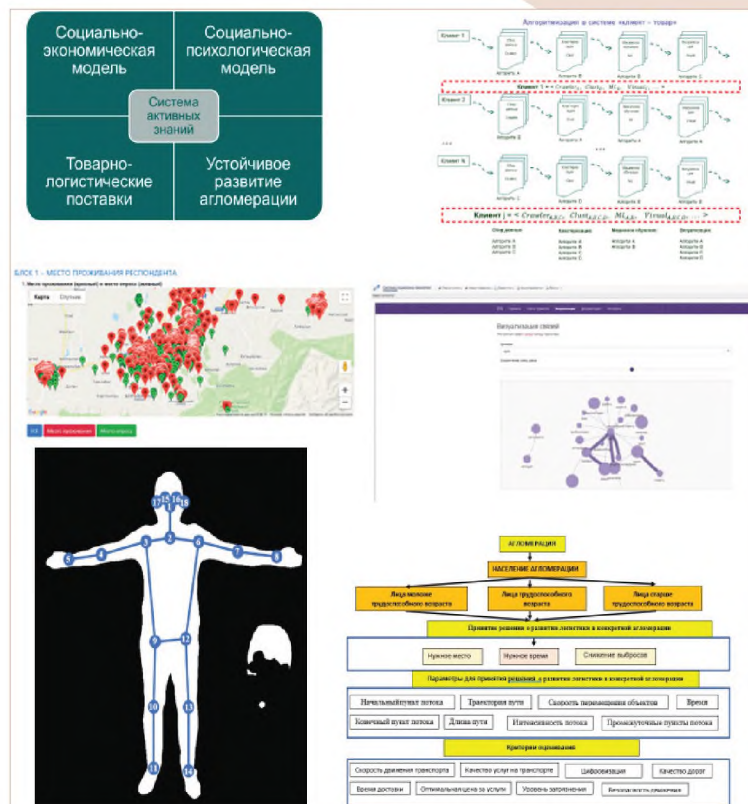
Object of implementation: an information system for collecting, analytical data processing and automated support for developing recommendations for making management decisions on the development of agglomerations in Kazakhstan.

Prospects for implementation: the results of the project can be used in the analysis of data on the development of agglomeration and e-commerce.

Consumers: akimats, online stores, companies whose work is related to making managerial decisions on the development of agglomerations in the Republic of Kazakhstan.

Investment amount: 280 million tenge. 

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DEVELOPMENT OF A LIBRARY OF PARALLEL ROUTINES FOR SUPERCOMPUTERS IN THE FIELD OF PETROLEUM GEOPHYSICS

Priority area: Information and telecommunication technologies.

The aim of the project: Development of a pilot version of the library of parallel numerical routines as a means of automating the creation of large parallel numerical models for supercomputers to solve problems in the field of petroleum geophysics and other applied fields.

Know-how: application of axiomatic theories and fragmented programming technology to the problems of petroleum geophysics.

Relevance and novelty: the relevance of the work is determined by the need to improve the performance and quality of parallel programming of large numerical models for execution on distributed (including heterogeneous) computing systems. The complexity and scientific novelty of the proposed works lies in the fact that the system software of parallel computing should actually be not a programming system, but a system for implementing axiomatic theories in numerical modeling.


Practical significance: The developed technologies and software components can be applied to solve practical problems of modeling hydrodynamic processes in oil and gas reservoirs.

Object of implementation: library of parallel programs.

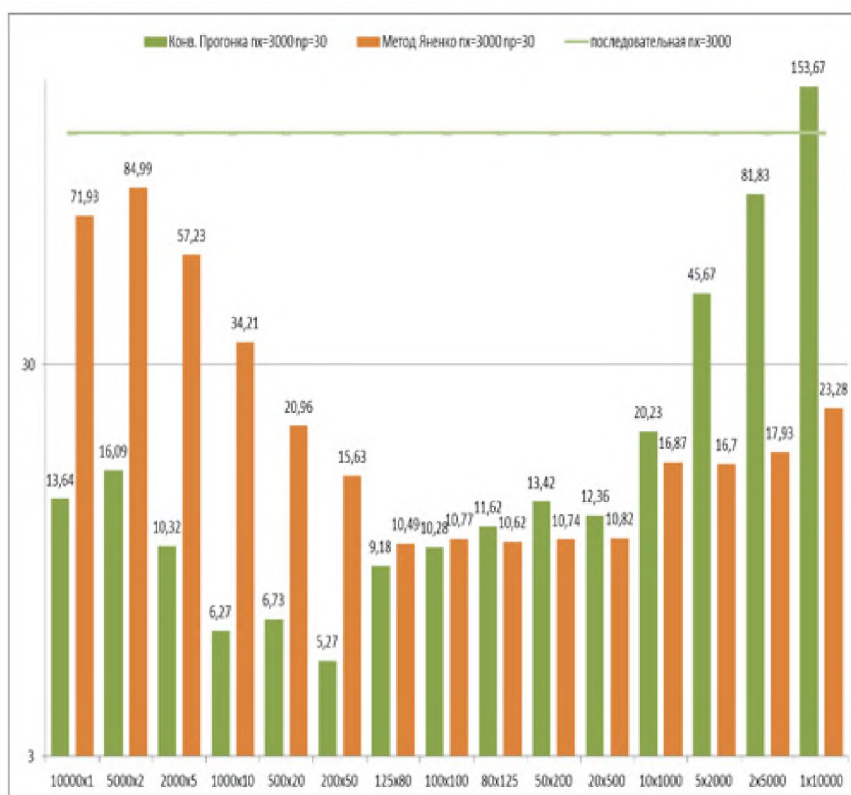
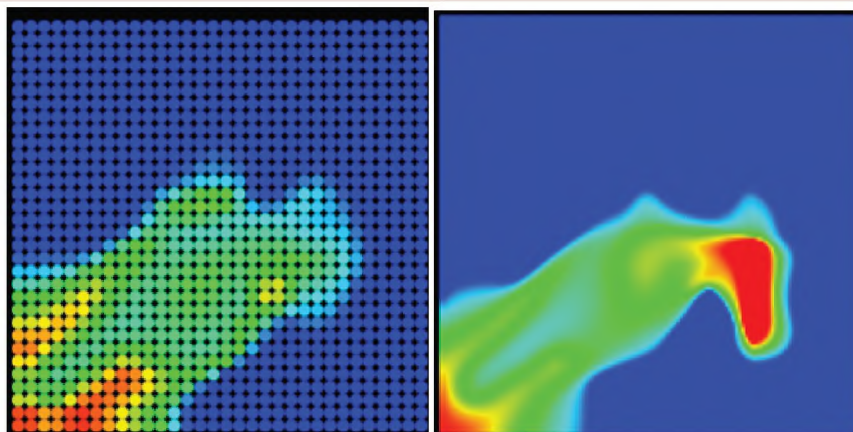
Prospects for implementation: the results of the project can be implemented in oil producing companies.

Consumers: Potential consumers are specialized research groups, experimental and industrial research centers, production companies of the oil and gas industry.

Competitiveness (Technology Advantages) and Commercialization of the Project: lower cost compared to industrial systems.

Investment amount: 39.5 million tenge. 

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DEVELOPMENT OF METHODS FOR AUTOMATIC EXTRACTION OF GEOSPATIAL OBJECTS FROM HETEROGENEOUS SOURCES FOR INFORMATION SUPPLY OF GEOINFORMATION SYSTEMS

Priority area: Information, communication and space technologies.

The aim of the project: development of methods for automatic extraction of geospatial objects and related nonspatial attributes from heterogeneous open data sources, namely from textual web tables.

Know-how: The dominant entity-based approach to information retrieval in modern research has serious limitations, this project will use an attribute-based approach to geospatial data extraction.

Relevance and novelty: While standardized data format and data access protocols such as Web Feature Service (WFS) may allow end users to access heterogeneous data stored in different formats from different sources, it still takes a lot time consuming and inefficient due to lack of semantics. Therefore, for this project, one of the main tasks is also the implementation of the required parallel algorithms for processing unstructured data. It is planned to set up a cluster complex consisting of 10 or more computers for this task. The novelty of this project lies in the use of an attribute-based approach to the extraction of geospatial data.

Practical significance: the results of the project can be applied in the field of high-performance distributed computing, as well as intelligent decision support systems.

Expected results:


- development of intelligent methods for extracting data from text tables;
- development of methods and technologies for automatic extraction of geospatial objects from heterogeneous sources for information support of geographic information systems;
- development of methods for semantic interpretation of geodata;
- development of web services for parsing and extracting geospatial information that will be available to potential users, the scientific community and the general public;
- development of technology for automatic extraction of geo-information from text tables on the Web.

Object of implementation: prototyping a software product based on the developed technology and creating web services for parsing and extracting geospatial information from websites in the domains “Tourism”, “Emergencies”.

Prospects for implementation: web services for parsing and extracting geospatial information will be developed, which will be available to potential users, the scientific community and the general public. The target consumers of the results obtained are specialized research groups, information and analytical centers.

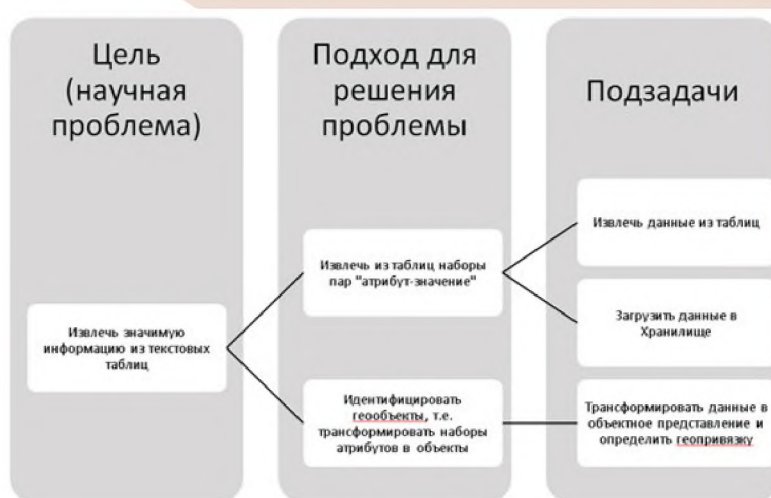
Consumers: companies whose work is related to the provision of travel services, marketing, analytical information processing, government agencies, emergency departments, etc.

Competitiveness (Technology Advantages) and Commercialization of the Project: the results of the project will be patentable and commercializable. The results obtained are necessary for the work of specialized research groups, information and analogous centers, as well as possible demand from a company whose work is related to the provision of tourism services, marketing, processing analytical information, government agencies, emergency departments, etc.

Investment amount: 63.6 million tenge. 

Availability of contracts, agreements with production and business: Agreement with the Organization Federal Research Center for Information and Computing Technologies of the Siberian Branch of the Russian Academy of Sciences (Novosibirsk) for the provision of third-party services under the project. Agreement on making a partnership contribution with TOO NovoTek Group.

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Research sequence



Sequence of stages for extracting data from tables



DEVELOPMENT OF INTELLECTUAL HIGH-PERFORMANCE INFORMATION- ANALYTICAL SEARCH SYSTEM FOR PROCESSING LOW-STRUCTURED DATA

Priority area: Information and telecommunication technologies.

The aim of the project: Improving the quality of decision-making by the user based on the analysis of consolidated and cleared of information noise information extracted automatically from heterogeneous open sources.

Relevance and novelty: a toolkit will be created for the analysis of semi-structured large data, which will serve as a basis for the further development of high-performance intelligent technologies in Kazakhstan.

Practical significance: improving the quality of decision-making by the user based on the analysis of information consolidated and cleared of information noise.

Expected results:


- creation of the architecture of the knowledge extraction system;
- development of methods for distributed high-performance collection, storage and preprocessing of data;
- creation of an information extraction model based on ontologies and machine learning methods;
- development of a decision-making model using decision trees;
- development of mechanisms for integrating storage sources of the extracted data with data processing and analysis tools based on the modified Mapreduce system and Spark technology;
- development of a prototype of a recommendation service based on the obtained knowledge base;
- development of a web application for visualizing emergencies.

Object of implementation: Prototyping a software product based on the developed technology and creating web services for parsing and extracting geospatial information from websites in the domains “Tourism”, “Emergencies”.

Prospects for implementation: high-performance distributed computing, intelligent decision support systems.

Consumers: specialized research groups, information and analytical centers, companies whose work is related to customer service, marketing, analytical information processing, etc.

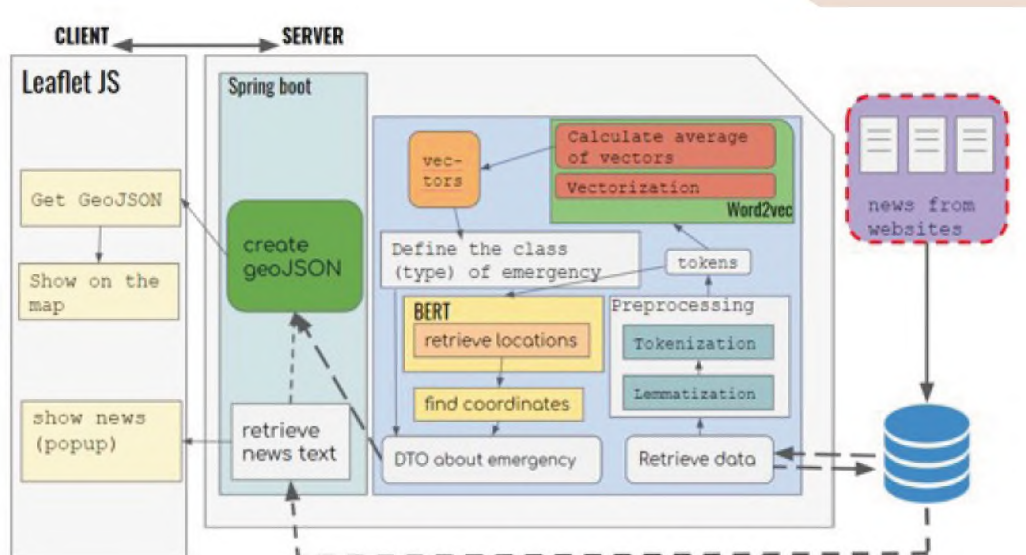
Competitiveness (Technology Advantages) and Commercialization of the Project: The results of the project are patentable and commercializable.

Investment amount: 45 million tenge. 

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High-level scheme for extracting knowledge from heterogeneous data sources to improve the quality of decision making



Architecture of a web application for visualizing city emergency situations



INTELLECTUAL INFORMATION-ANALYTICAL SYSTEM FOR ASSESSING THE HEALTH STATE OF STUDENTS OF KAZAKHSTAN

Priority area: Information, telecommunication and space technologies.

The aim of the project: development and implementation of an information and analytical system for assessing the health of students for the formation of a set of measures for the prevention of diseases and improving the quality of life of young people using artificial intelligence algorithms.

Know-how: contingent of Al-Farabi KazNU students by region of residence allows us to consider KazNU as a model for studying and managing the health of youth throughout the country.

Relevance and novelty: the relevance of the discussed issues determines the need for comprehensive research that allows assessing the current state of students at the preclinical level, and developing individualized approaches to the formation of a preventive environment and health promotion in educational institutions.

Practical significance: the fulfillment of the tasks of this project will allow the development of an up-to-date, but currently absent system that collects and analyzes information on the health status of young people on a regular and continuous basis, which is of great importance from the point of view of sustainable national development.

Object of implementation: information and analytical system for assessing the state of health of students.

Prospects for implementation: Methods and algorithms for data mining, developed in the course of the research, make it possible to determine indicators that have the greatest impact on the health and well-being of young people, as well as to identify risk factors for health disorders. The study of the health of students within the framework of the project is considered as the first stage of a large-scale study, the purpose of which is long-term monitoring of the health of student youth.

Consumers: educational institutions of Kazakhstan.

Expected results:

- development of the architecture of an intelligent information and analytical system for assessing the state of health of students;
- research and development of a module for the collection, storage and preprocessing of data on health indicators and indicators related to the health of students, obtained as a result of surveys and medical examinations;
- design and development of a student's digital health profile as a module of the educational process automation system using cloud technologies;
- development of machine learning algorithms for multifactorial analysis of a complex of health indicators and indicators related to the health of students and to identify the influence of biological, social, psychological, geochemical factors on health indicators and quality of life of students;
- design and development of a student's digital health passport based on processing and consolidated analysis and classification of data, taking into account the threshold values of health indicators and indicators related to health;

– development of recommendatory functionality for the prevention and health improvement of students.

As part of the research, it is planned to expand the student’s digital profile by developing a health profile as a new module of the educational process automation system using the example of the information and software complex “Univer 2.0”.

Competitiveness (Technology Advantages) and Commercialization of the Project: the proposed intelligent information and analytical system will be developed on the basis of a high-performance computing cluster and data processing center of Al-Farabi KazNU. Research on the digital profile of student health is especially relevant for Kazakhstani educational institutions, which, on the basis of data mining, will be able to develop a set of preventive measures to support the health and quality of life of student youth – the future human potential of the Republic of Kazakhstan.

The developed intelligent information and analytical system with visualization of the results of aggregation and analysis of data on health indicators and indicators related to health, including in the context of the regions of Kazakhstan, can be used by various groups of internal and external stakeholders as a regularly updated information resource for the development of various support programs of a social or medical nature.

Availability of documents of title:

– Copyright certificate No. 360 “Information and analytical system “Science” (computer program).

– Copyright certificate No. 1275 “Information system “InnoMap.kz” (map of innovative development of Kazakhstan) (computer program).

– Copyright certificate No. 1868 “Information system “Workeffect.kaznu.kz” (Electronic map of the efficiency of use of labor resources in Kazakhstan)” (computer program).

Availability of contracts, agreements with production and business: Cooperation with FE “Global Construction”.

Investment amount: 58 mln. tenge.

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MEDIEVAL CITY AKTOBE (BALASAGUN)

Priority area: Research in the field of social sciences and humanities.

The aim of the project: carrying out archaeological and interdisciplinary research works on a medieval settlement, determining the significance of the monument, organizing security measures, laying the preconditions for its transformation into a tourist site showing the urban culture of medieval Kazakhstan.

Know-how: The settlement Aktobe (Balasagun) is one of the largest settlements in Kazakhstan, located on the Great Silk Road, therefore, the study of this object is important for studying the medieval history of Kazakhstan.

Relevance and novelty: Having carried out this scientific project, we can obtain new information concerning the history and culture of the Aktobe (Balasagun) settlement and settlements in its vicinity. Also, with the help of modern technical capabilities, it is planned to create a digital relief of the earth and a 3D drawing. With the help of laboratory studies, the exact age of the bones of people and animals found during excavations will be determined, the composition of pottery and shards will be clarified. At this monument, such works have not been carried out until that time. Therefore, with the help of interdisciplinary research, there are great opportunities for obtaining new data.

Practical significance: the significance of the project lies in the uniqueness and scale of the investigated object, which makes it possible to apply the research results in various fields, including science, education, cultural, tourism organizations.

Expected results: As a result of the research, restoration work will be carried out at the archaeological base at the Aktobe settlement, which will facilitate the organization of summer archaeological schools and field seminars.

It is also planned to build a visit center at the medieval settlement, which will help to attract tourists and organize scientific conferences.

Object of implementation: Universities, archaeological, ethnographic, local history museums, travel companies.

Prospects for implementation: scientific results will be used in writing scientific articles, textbooks, term papers in universities, creating exhibitions and educational programs, preparing materials in the media, conducting excursions in local historical museums and cultural and tourist routes.

Consumers: scientific community, students, undergraduates, doctoral students in the fields of history, archeology.

Investment amount: 60 mln. tenge. 

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Figure 1. Finds from Aktobe (Balasagun) settlement



Figure 2. Plan of the visitor center at Aktobe (Balasagun) settlement



ARCHAEOLOGICAL MONUMENTS OF THE FOOTHILLS OF THE SHILIKTINSKAYA VALLEY AND TARBAGATAI

Priority area: Research in the field of social sciences and humanities.

The aim of the project: study and restoration of archaeological sites in the foothills of the Shiliktinskaya valley and Tarbagatai.

Know-how: in 2020, a sensational archaeological discovery was made on the “Gold jewelry of horse equipment”.

Relevance and novelty: the prospect of the study of the studied sub-region lies in its geographical location. This area was a kind of nomadic center in antiquity and the Middle Ages. It was here that active ethnocultural processes took place.

Practical significance: This study is determined by the possibility of applying its provisions and main conclusions in the development of a regional archaeological atlas, as well as special courses and special seminars for students of history faculties, in the preparation of generalizing works on archeology and local history. In the future, the cultural and historical significance of the Shilikta foothills, which is one of the key regions of Kazakhstan, requires further understanding and comprehensive study.

Expected results: The social effect is to increase the level of historical knowledge and culture of the population of Kazakhstan, foster respect for their history and culture, as well as in the formation of a positive image of the Republic of Kazakhstan.

The obtained results of research work on the study of the material and spiritual culture of the ancient population of the region under consideration can be used both for the development of educational programs in general and specialized educational institutions, and in writing generalizing works on archeology and other humanities.

Also materials can be applied:


- in the preparation of generalizing works on the funeral rite, cults and rituals, architectural structures and cultural and genetic aspects of Central Asia;
- for writing works on the problems of connections of the continuity of tradition;
- for the development of special courses on the culture and ethnography of the ancient Türks, Kazakhs and other Türkic-speaking ethnic groups;
- when creating educational and methodological complexes in archeology.

The materials obtained in the course of archaeological excavations will replenish the funds and expositions of the regional historical, local history and city museums of Kazakhstan.

Object of implementation: Universities, archaeological, ethnographic, local history museums.

Consumers: the target consumers of the obtained results are students, undergraduates, doctoral students in the specialties of history, archeology, anthropology and ethnography, as well as philosophy, religious studies and art history.

The results of the study are designed for scientists, archaeologists, ethnographers, culturologists, folklorists, etc., dealing with issues of worldview, cults, rituals of culture of the ancient tribes of Eurasia. Within the framework of the project, international archaeological summer schools are organized annually.

Investment amount: 40 mln. tenge. 

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Figure 1. Eleke Sazy cemetery. General view of the excavation of the burial mound



Figure 2. Eleke Sazy cemetery. View of individual gold jewelry



ANCIENT TÜRKIC CULTURAL COMPLEX OF EASTERN KAZAKHSTAN: ORIGINS AND TRANSFORMATION

Priority area: Research in the field of social sciences and humanities.

The aim of the project: carrying out scientific research related to the formation and development of the ancient Türkic cultural complex on the territory of East Kazakhstan, as well as the reconstruction of the way of life, religious beliefs, economics and social structure, ethnocultural processes, based on the materials of the monuments of late antiquity and the early Middle Ages.

Know-how: on the territory of East Kazakhstan region in the foothills of Tarbagatai, archaeological research is being carried out at the monument to Eleke Sazy – the only Kagan complex on the territory of Kazakhstan, which has not only scientific, but also historical and political significance for our country.

Relevance and novelty: the novelty and significance of the project is due to the lack of study of two interrelated periods of time, which are designated in the scientific literature as the pre-Türkic (III century BC – V century AD) and ancient Türkic (VI-X century AD) periods. The relationship between these two periods is characterized by the fact that the origins of the latter are in the previous one. However, the explicit mechanisms and successive stages of the transformation of the ancient Türkic culture as a whole and its individual elements have not yet been established. In the wide area of settlement and movement of ethnocultural formations of the pre-Türkic and ancient Türkic times, the territory of East Kazakhstan remains a blank spot. The region is located in the central part of Eurasia and includes the Altai and Saur-Tarbagatai mountains, the Kalbinsky mountain range, wide hollows, shallow plains. The position of East Kazakhstan at the crossroads of many routes for the movement of human masses determined its uniqueness.

Practical significance: The proposed project will undoubtedly be of great importance for Kazakhstan and on an international scale, since the international scientific community believes that acquaintance with the culture of all mankind requires acquaintance with all the cultures organized by it, and, if necessary, are interested in the preservation of all archaeological monuments. Contemplation of the monuments of bygone eras and acquaintance with them will contribute to the strengthening of mutual understanding between nations, which will lead to the need to establish international relations in the world use of cultural heritage. Therefore, each member country of the UNESCO Organization should preserve its archaeological heritage based on the relevant provisions and recommendations.


Expected results: the social effect consists in increasing the level of historical knowledge and culture of the population of Kazakhstan, fostering respect and respect for their history and culture, as well as in forming a positive image of the Republic of Kazakhstan.

On the basis of a complex of archaeological finds, an exposition “ancient Turkic cultural complex of the Kazakh Altai” will be created in the East Kazakhstan Regional Museum of History and Local Lore.

Object of implementation: Universities, archaeological, ethnographic, local history museums.

Prospects for implementation: scientific research results and materials can be used both for the development of educational programs in general and special educational institutions, and for the popularization and propaganda of the national heritage and cultural heritage in the country’s museums, which in turn will have a great social effect associated with the popularization of a vast cultural heritage, which allows the people of Kazakhstan to form civic consciousness and patriotism.

Consumers: the direct target consumer of the results of the project is the scientific community, the indirect consumer is the educational sphere. Dissemination of the results of work among potential users, the community of scientists and the general public is possible through the media, including the World Wide Web (Internet), as well as in traditional ways, through the publication of articles and monographs.

Investment amount: 52.3 mln. tenge. 

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Figure 1. The cult-memorial complex of the ancient Turkic time at Eleke Sazy



Figure 2. A stone disc with a hole found in the collapse stones inside the temple



SACRED SPACE AND FUNERAL RITES OF POPULATION OF THE KAZAKH ALTAY FROM ANCIENT TO THE MIDDLE AGES

Priority area: Scientific foundations of “Mangilik El” (education of the XXI century, fundamental and applied research in the field of humanities).

The aim of the project: study of the features of the formation and development of economic and cultural traditions of ancient and medieval pastoralists of the Kazakh Altai on the example of funeral and memorial complexes, including the study of social, cultural, historical, ideological, religious, art history and other aspects of the ancient and medieval era, as well as the continuity of cultures.

Know-how: the finds found during archaeological research (horse equipment from the Tuyetas burial ground, gold jewelry from the Besoba burial ground) are exhibited in the National Museum of the Republic of Kazakhstan. Reconstruction of horse equipment from the Tuyetas burial ground, reconstruction of the decoration from the Ayan burial ground are exhibited in the composition “Seven Facets of the Great Steppe” in the library of Al-Farabi KazNU.

Relevance and novelty: against the background of the monuments of other regions, the mounds of the Kazakh Altai stand out because of the permafrost factor, due to which the mummified remains of people, corpses of horses and organic objects, including highly artistic items, are clearly manifested in the mounds of the elite of early nomads, as well as the features of ground and intra-grave structures of burial structures. Archaeological research, carried out by the staff of the Institute of Archeology in 1998-2017, opened up a huge potential and scientific perspective of the study of permafrost monuments on the territory of Kazakhstan Altai. The preservation of burial mounds with permafrost determines a huge amount of information that cannot be obtained from the study of ordinary monuments.

Practical significance: laboratory and analytical data processing makes it possible to theoretically simulate the most important processes that took place on the territory of the formation of early state formations of the era of early nomads.

Expected results: theoretical reconstruction of the main elements of material culture, religious, mythological and ideological ideas, funeral and memorial rituals and religious and cult practice of the nomads of the Kazakh Altai. For the first time were discovered: 2 medieval settlements, 9 settlements from the Bronze Age to the Middle Ages, 10 burial grounds and 3 complexes of rock carvings.

Object of implementation: Universities, archaeological, ethnographic, local history museums, tourist companies.

Prospects for implementation: the findings were introduced into textbooks for schools and universities. The finds are presented in the museums of the republic, including the regional museum of history and local lore in Ust-Kamenogorsk.

Consumers: scientific community, students, undergraduates, doctoral students, historians, archaeologists.


Investment amount: 18.7 mln. tenge. 
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Figure 1. Reconstruction of horse harness based on materials from the Tuyetas burial ground



Figure 2. Tuyetas burial ground. Bridle and chest strap after restoration work

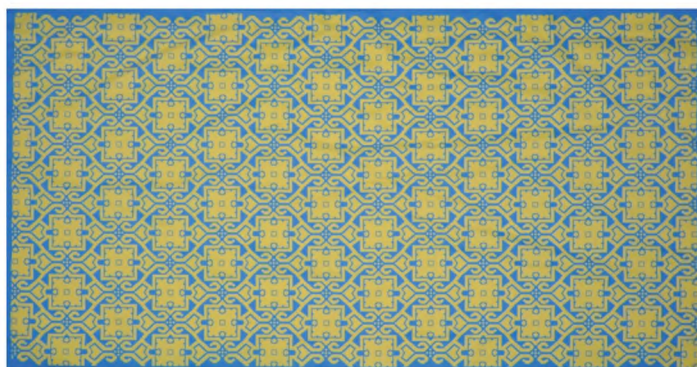


Figure 3. Tuyetas burial ground. Reconstruction of ornament and textiles



ARCHAEOLOGICAL MONUMENTS OF THE AYAGOZ DISTRICT OF THE EASTERN KAZAKHSTAN REGION

Priority area: Research in the field of social sciences and humanities.

The aim of the project: interdisciplinary research and historical reconstruction of the processes of formation and development of cultures of ancient tribes that inhabited the eastern part of the Kazakh Upland from the Bronze Age to the Middle Ages.

Know-how: for the first time comprehensive studies of historical and cultural monuments will be carried out on the territory of the Ayagoz region of the East Kazakhstan region, which will provide material about the spiritual and material culture of this region. Today the territory of Ayagoz region is a blank spot on the archaeological map of Kazakhstan.

Relevance and novelty: the novelty of the planned works lies in the analytical processing and comprehension of new extensive collections – ceramic, metal, metallurgical, stone, bone, zoological, etc. from various objects of historical and cultural heritage with the involvement of a wide range of research. Considering the favorable geographic and climatic conditions of the designated area and the presence of “royal” elite burial mounds, it should be noted that research in this region is highly promising.

Practical significance: the significance of this project is obvious not only nationally, but also internationally. The topic of the project is currently the most relevant in the world scientific community and therefore is being intensively researched. The verified and tested results obtained in the course of the study will form a fundamental scientific basis for the active popularization of cultural heritage and the formation of the scientific historical memory of Kazakhstani society, and will also greatly contribute to the effective actualization of the idea of “Man-gilik El” as a natural development and modernization of public consciousness in Kazakhstan.

Expected results: the obtained data on the ancient and medieval history of the eastern part of the Kazakh Uplands will have a great social effect for fostering patriotic feelings of the population and knowledge of their past.


The economic significance of the program assumes the predicted effect of improving the quality of higher education, an increase in the percentage of students who choose Kazakh universities, which, in turn, has a positive effect on the economic climate in the country.

Object of implementation: Universities, archaeological, ethnographic, local history museums.

Prospects for implementation: in the course of research, new practical and theoretical material will be introduced into scientific circulation, which will have a

positive effect on the development of problems in the archeology of East Kazakhstan and, possibly, Eurasia.

Consumers: scientific community, students, undergraduates, doctoral students, historians, archaeologists.

Investment amount: 62.9 mln. tenge. 

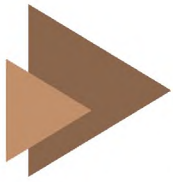
Contact information: sagyndykova.symbat@gmail.com.



Figure 1. Map of the Ayagoz region of the East Kazakhstan region



Figure 2. Mausoleum of Kozy Korpesh - Bayan Sulu



MEDIEVAL KISHKALA (BARSHYNKENT): IN THE CONTEXT OF URBAN CULTURE OF THE ERA OF THE GOLDEN HORDE

Priority area: Research in the field of social sciences and humanities.

The aim of the project: carrying out archaeological and interdisciplinary research work in medieval Kyshkala, determining the historical name and significance of the monument, organizing security measures, laying the prerequisites for its transformation into a tourist site showing the urban culture of the Golden Horde era.

Know-how: For the first time, comprehensive archaeological research is being carried out at the medieval settlement of Kyshkala, and a madrasah is being reconstructed on the territory of the settlement. It is planned to determine the historical name of the settlement.

Relevance and novelty: the emergence, history of formation and development of medieval cities and settlements in Kazakhstan is a very complex phenomenon. It is especially difficult to determine the peculiar features in the history of the development of individual cities and to identify common features with other cities. The studied cities of Kazakhstan during the Golden Horde era include Otrar, Turkestan, Sauran, Sygnak. And in cities such as Zhent, Barshynkent, Ashnas, Zhuvara and many others located on the lower reaches of the Syr Darya, large-scale studies have not been carried out. Considering all this, the relevance of such holding in the city of Barshynkent is increasing as never before. Comprehensive archaeological research carried out in medieval cities can be noted as a global and Kazakh alternative to the scientific project. For example, the first written sources about clay buildings and madrasahs in Central Asia are found in the work “History of Bukhara” by the 10th century author Narshakhi Muhammad. Such structures began to be erected in Eastern Iran and Bukhara at the end of the 9th century - the beginning of the 10th century. Archaeological research concerning the urban culture of the Golden Horde era on the territory of Kazakhstan was carried out in the cities of Turkestan, Otrar, Sygnak, Zhankent, etc.


Practical significance: in the course of the implementation of this scientific project, another monument related to the urban culture of the era of the Golden Horde will enter the scientific circulation. Therefore, the city of Kyshkala and the settlements in its vicinity will be investigated in connection with the history of medieval cities. The discovery and partial reconstruction of fortified settlements helps to attract a flow of tourists.

Expected results: for the scientific reconstruction of urbanization, communication and external economic relations of the era of the Golden Horde, it is required to carry out comprehensive studies of settlements and settlements located in the vicinity of this city.

Object of implementation: Universities, National Museum of the Republic of Kazakhstan, State Central Museum of the Republic of Kazakhstan, institutions for domestic historical tourism, departments of internal policy of local akimats, Departments of culture, Committees for the protection of historical and cultural monuments.

Prospects for implementation: scientific results will be used in writing scientific articles, textbooks, term papers in universities, creating exhibitions and educational programs, preparing materials in the media, conducting excursions in local historical museums and cultural and tourist routes.

Consumers: scientific community, students, undergraduates, doctoral students, historians, archaeologists, committees for the protection of historical and cultural heritage.

Investment amount: 57.4 mln. tenge. 

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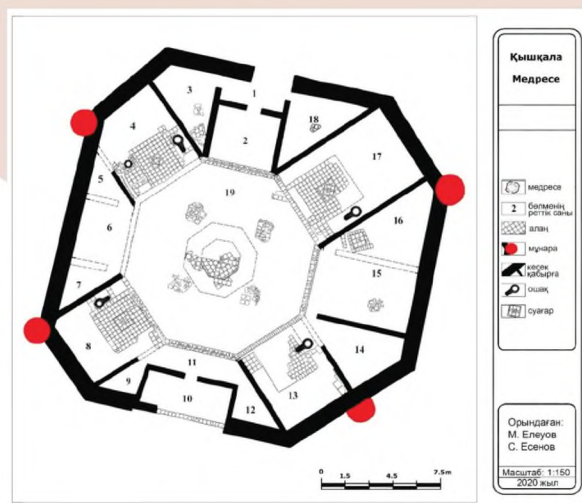


Figure 1. Plan of madrasah



Figure 2. General view of madrasah on the territory of Kyshkala



ETHNOGRAPHIC AND GEOARCHEOLOGICAL STUDY OF AGRICULTURAL LANDSCAPES IN THE DESERT DELTS OF KAZAKHSTAN

Priority area: Scientific foundations of “Mangilik El” (education of the XXI century, fundamental and applied research in the field of humanities).

The aim of the project: study of cultural landscapes and sustainability of land use of some large agricultural and pastoral areas located in the middle desert of Kazakhstan, which were periodically occupied over the past 2000 years and today are almost completely abandoned, special attention is paid to their resistance to anthropogenic and natural influences.

Know-how: is to study the evolution over the past 2000 years of the cultural landscapes of two large deltas and (their) surrounding deserts located along the longitudinal strip of the middle desert zone of South Kazakhstan, where agricultural and cattle-raising activities inevitably complement each other, and ethno-archaeological data indicate the alternation of phases occupation and abandonment.

Relevance and novelty: studies devoted to the structural cooperative interaction of agricultural, urban and livestock activities in large areas are quite rare. In particular, to date, none of the two deltas considered in the proposed study has ever been considered an interactive agricultural and pastoral economy complex, which shows the uniqueness of this project.


Practical significance: the national and international significance of the project and its applicability in a number of areas of socio-economic, scientific and public life is ensured by the attention paid to reconstruction on a centennial and millennial scale of environmental variability, historical land and water use and sustainability, as well as the alternation of phases of occupation and large areas of desert deltas.

In fact, a reference to long-term trends will shed light on the current potential threats associated with a worsening climate (global warming) and an increase in the frequency of sudden events, as well as the risks posed by population growth, consumption and unsustainable use of water and land resources.

Expected results: the scientific results of the project can serve as material for writing scientific articles, textbooks and special courses in universities, for preparing expositions and educational programs, materials in the media, for developing excursions in local historical museums and for tourist and cultural routes.

Object of implementation: Universities, archaeological, ethnographic, geological, historical and local history museums, travel companies, organizations on land issues.

Consumers: target consumers are regional Departments of Culture and Committees for the Protection of Historical and Cultural Monuments.

Investment amount: 48,3 mln. tenge. 

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Figure 1. Cattle corral. Kyzylorda region, Aralskiy district



Figure 2. Cattle corral. Kyzylorda region, Aralskiy district



Figure 3. A sandy landscape. Kyzylorda region, Aralskiy district



TRADITIONAL WATER SUPPLY METHODS IN ARID ZONES OF KAZAKHSTAN: ETHNOLOGICAL AND GEOARCHEOLOGICAL APPROACHES

Priority area: Scientific foundations of “Mangilik el” (education of the XXI century, fundamental and applied research in the field of humanities).

The aim of the project: study of traditional ways of collecting and using water in arid zones of Kazakhstan in order to compile a comprehensive database, revealing their diversity, originality and chronology. Creation of a new theoretical and methodological approach to the study of the peculiarities of the use of natural resources by the Kazakhs.

Know-how: the wells of the 19th century “Khan Edygy” and “Khan Meshiti men Khan bagy”, located on the territory of the Khan Ordasy Museum-Reserve of the West Kazakhstan region, were reconstructed and put into operation. In the course of geoarchaeological research, the depth, width, safety of the wells located along the caravan routes were determined. Geoarchaeological complex studies of the carize system discovered in the east of the city of Sozak have been carried out.

Relevance and novelty: On the territory of Kazakhstan, 60% of which consists of arid zones (45% of deserts and 15% of semi-deserts), historically, very original methods of collecting water for drinking and economic purposes have developed. There are studies on surface waters for irrigation of fields and on hydraulic devices practiced in mixed and sedentary agricultural communities in the oases of South Kazakhstan, but very little attention was paid to the traditional methods of collecting and storing groundwater in vast arid areas. This is in spite of the fact that arid zones for most of Kazakhstan’s traditional pastoralism community until the early 20th century were important pastures and prestigious wintering grounds, where water supplies from springs and wells were critical. “Water is the essence of the nomadic economy, therefore its water supply and water use system should be the basis for any typological characteristic of nomadic animal husbandry as its general and universal character and condition. In this regard, it is worth noting that only a few researchers have pointed out the importance of the water supply system in the typology of the nomadic economy”.

Practical significance: the significance of the project extends beyond it in an attempt to fill a critical gap regarding the ancient knowledge of traditional Kazakhstan livestock breeders about water use.

Expected results: due to the importance of water use in arid zones, the project will clarify the main issues of economic history, such as the formation and development of Eurasian mobile livestock. Moreover, in the context of current global warming and water scarcity in arid zones of Central Asia, the project may reveal forgotten or poorly understood methods of water extraction and storage that deserve to be reintroduced into practice in the arid places of Kazakhstan and beyond.


Consumers: The consumers of the project results are regional departments.

Prospects for implementation: The results of the project can be used for writing scientific articles, textbooks and special courses in universities, for preparing expo-

sitions and educational programs, materials in the media, for developing excursions in local historical museums and for tourist and cultural routes in Sacred Kazakhstan.

The research results will be disseminated among specialized research institutes to promote debate, teaching staff and university students for didactic purposes, local history and ethnographic museums to strengthen the general public interest in history, as well as to emphasize the centrality of the issue of water resources management in arid lands.

Object of implementation: Universities, archaeological, ethnographic, geological, historical and local history museums, travel companies, organizations on land issues.

Investment amount: 22,95 mln. tenge. 

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Figure 1. Chigir. Shevchenko Fort



Figure 2. Well. Territory of the Ustyurt nature reserve



Figure 3. Reconstruction of wooden buckets for well



THEORETICAL CONCEPTS AND MODERN ANALYSIS TECHNOLOGIES OF LITERARY TEXTS: WORLD AND KAZAKHSTAN CONTEXT

Priority area: Scientific foundations of “Mangilik el” (education of the XXI century, fundamental and applied research in the field of humanities).

The aim of the project: is to identify and describe the distinctive constituent features of scientific and theoretical concepts of world literary studies related to the analysis of literary text; consideration of the essence and specifics, specific forms and strategies of literary text analysis, axiological foundations and philosophical and aesthetic dominants of innovative methods and technologies of literary analysis.

Know-how: the theoretical substantiation of modern technologies of philological analysis and ways to intensify their implementation in Kazakh philology and teaching practice.

Relevance and novelty:

– the genesis and scientific and theoretical concepts of innovative methods were defined and described literary analysis, not reducible to traditional technologies.

– the philosophical and aesthetic features of theoretical directions are analyzed and the terms and concepts of the most relevant technologies are systematized literary analysis in the world philological science.

– the characteristic of the creativity of individual scientists, the founders of scientific schools of Western European, American, Russian and domestic literary studies.

– the analysis of ways and means of intensification of the introduction of innovations of the world literary studies in Kazakh philology; introduction into practice of Kazakh literary studies of the latest English-language sources and concepts on the topic of the project.

– the specificity and variability of the latest methods of world literary studies are revealed (countries of the Western Europe and the USA) in their systemic integrity.

– scientific articles have been written as an illustrative basis for the application of literary innovations on in practice (samples of analysis of domestic and world literary texts in the aspect of advanced research technologies).

Practical significance: it consists in using the results and conclusions of the study in compulsory and elective disciplines of university education, generalizing monographs and initiative works, in entering the sphere of other fields of knowledge - cultural studies, philosophy, sociology, psychoanalysis.

To achieve the set goals and obtain the results of the project, the following interdisciplinary methods were used: structural and gender analysis, methods of

cognitive and psychoanalytic literary studies, artistic anthropology and narratology, mythological criticism and intertextual analysis.


Prospects for implementation: the implementation of research results in teaching creates conditions for improving the professional knowledge of RK teachers, as well as for the development of competitiveness of graduates of universities of Kazakhstan, improvement of their professional competencies and skills.

The completed work replenishes and expands the theoretical space of domestic research, diversifies their methodological status, contains an analysis of modern theoretical concepts and a description of modern research and their practical application in scientific works.

Scope of application: for use in the practice of university teaching of compulsory and elective disciplines for undergraduates and PhD doctoral students. The obtained results of the study it can also be used in the compilation of dictionaries, encyclopedias, reference books on the current state of modern world and Kazakh literary studies.

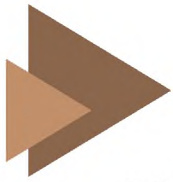
Consumers: PhD doctoral students, undergraduates, university teaching staff.

Competitiveness (Technology Advantages) and Commercialization of the Project: some results of the conducted research have been successfully tested (implemented) at the Faculty of Philology and the Faculty of Oriental Studies of Al-Farabi Kazakh National University. Each theoretical part of the project and methodological tools are illustrated by a specific analysis of literary texts.

Investment amount: 21,65 mln. tenge. 

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CONTACTOLOGY: THE INFLUENCE OF TURKIC CULTURE ON WORLD CIVILIZATION

Priority area: Fundamental research in the field of socio-economic and humanitarian sciences.

The aim of the project: To investigate and determine the historical and cultural factors of Turkic words based on the theory of language contacts to determine the historical and cultural factors of Turkisms in other unrelated languages, to analyze the semantics of words of Turkic origin in Hindi, Mongolian, Persian, Chinese and Slavic languages.

Know-how: This work examines the history of the use of Turkisms in Eastern and European languages, and also examines the problems of the spread of Turkic lexemes in the analyzed languages.

Relevance and novelty: The results of the research on linguistic contactology can shed light on many issues of modern Turkology (language contacts, ethnogenesis of Turkic peoples, Turkic-Mongolian contacts, Turkic ethnolinguistics). The effectiveness of the research results will help to establish the place and role of the Turkic culture in the world civilizational space and show the degree of mutual influence of heterogeneous cultures of the world. The results of the study will help to identify the main ways of development of Kazakh Turkology, in particular, Turkic linguistics (and especially the Kazakh language), to place accents in the study of the history and culture of the Turkic peoples. The scientific project is a breakthrough, since the compilation of an etymological dictionary requires more than a dozen years. If Turkisms in Russian, Arabic and Persian, Mongolian languages make up 50-70% of the transparency of the origin of lexical units and morphemes, then in other languages the work requires in-depth analysis and work together with foreign colleagues.

Practical significance: The practical significance of the work is that the main conclusions of the study can be used when writing Turkological works in the specialty “Turkology”, “Oriental Studies”, “Philology”, “Kazakh language”, “Uighur language”, “Uzbek language”, “Turkish language”, “Azerbaijani language” and can also become a necessary methodological basis for further study and historiographical analysis of Turkisms in unrelated languages. The results of research on this topic will help to popularize Turkic languages and cultures in the world, to awaken the world community to the study of Turkic languages and cultures.

Expected results: Monographs “Contactology: the influence of Turkic culture on world civilization” (Avakova R.A., Bayat E. – Almaty: Kazakh University, 2020. – 235 pages); “Lingua-folkloric paradigms of the Turkic world” (Avakova R.A., Bayat E. – Almaty: Kazakh University, 2020. – 410 pages); Contactology: the influence of Turkic culture on world civilization”(On the bases of typology of the Turkic-mongol epos)” (Bayat E. – Almaty: Kazakh University, 2020. – 210 p.), textbook “Introduction to the Turkic philology” (Avakova R.A., Bektemirova S.B. – Almaty: Kazakh University, 2019. – 238 p.), and also defended 3 master’s theses and 1 doctoral dissertation on the topic of the project. We received an author’s certificate for the 2nd textbook.

Object of implementation: historical and cultural factors of Turkisms in other unrelated languages, the use of Turkisms in Eastern and European languages, problems of the spread of Turkic lexemes in the analyzed languages.


Prospects for implementation: In Kazakh linguistics, Turkisms in world languages are analyzed from the point of view of the historical factor of Turkic culture, their influence on world civilizational processes is determined. The scientific project is a breakthrough, since the compilation of an etymological dictionary requires more than a dozen years. If Turkisms in Russian, Arabic and Persian, Mongolian languages make up 50-70% of the transparency of the origin of lexical units and morphemes, then in other languages the work requires in-depth analysis and work together with foreign colleagues.

Consumers: Specialists of the Kazakh language and other Turkic peoples, students, undergraduates and doctoral students of humanities faculties, as well as those who are interested in the history of the language of Turkic backgammon.

Competitiveness (Technology Advantages) and Commercialization of the Project: The benefits of the scientific project for science and technology are undeniable – today, it is a great contribution to Turkology as a developing science. The results of the project will radically change the existing understanding of the Turkic world and its impact on world civilization. There is no doubt that the results of the project will be the first comprehensive study, and the form of the study is an innovation. The results of this project are of great interest to domestic/foreign science in the field of philosophy, cultural studies, ethnography and history, as well as to everyone who wants to study the Kazakh language both abroad and in Kazakhstan.

Availability of documents of title: Copyright certificate No. 8841 “Introduction to the Turkic philology “.- textbook . - Almaty: Kazakh University, 2018; 2) No. 16708 “Contactology: linguistic picture of the world” -. Monograph.- - Almaty: Kazakh University, 2019.

Availability of contracts, agreements with production and business: none.

Investment amount: 14.9 mln. tenge. 

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COGNITIVE WORLDVIEW: NATIONAL CODES IN KAZAKH LANGUAGE

Priority area: Scientific foundations of “Mangilik el” (education of the XXI century, fundamental and applied research in the field of humanities).

The aim of the project: To establish the historically formed national cultural codes considered as a national cognitive image in nature and knowledge of the Kazakh people; to study their influence on the modern human, his knowledge and modern renewed appearance, to carry out an in-depth and comprehensive analysis of the function of language as a custodian of culture and worldview, and explore the modernization of the system of national concepts and values based on cognitive, linguistic and psychological analysis, on the basis of studying the works of Turkic and Kazakh thinkers and scientists to conduct a comprehensive cognitive-axiological analysis of the national code and its reflection in the language as the basis and source of national values, to assess in cognitive focus reflection in the language of historical, cultural and spiritual existence and concepts.

Know-how: The identification and analysis of historically established national and cultural codes that determine the national life and worldview of the Kazakh people and their consideration as a national cognitive picture of the world, an assessment of their influence on the cognitive development of a modern and renewed personality.

Relevance and novelty: a prerequisite for the preparation of the project was an article by the First President – the Leader of the Nation N.A.Nazarbayev’s “Looking into the future: modernization of public consciousness” and the main principles calling not only to improve the national spirit and national consciousness, to preserve and value traditions, language and culture, but at the same time to modernize their development. Determination of the content of the spiritual nature of the nation, the foundations and basic values, the characteristics of the heritage for preservation and transmission to the future generation, the ideals of modern youth, the reassessment of Western values, all these problems are relevant for the modern Kazakh society are reflected in this program.

The language of any people can be called a folk encyclopedia, which captures the doctrine of the world, the experience and knowledge of past generations. The language denotes historical knowledge, and in order to assess the achievement of culture and the spirit of humanity, it is important to study the signs expressed in the national form scientifically. Currently, social and humanitarian knowledge comprehensively studies the process of globalization in the methodological, cognitive and axiological aspects. Systems research in this area, especially in the 21st century, is widespread.

Practical significance: the need for the project is primarily determined by the link with the new curriculum being introduced in higher education institutions and schools. The use of the scientific results of cognitive research in the study of the Kazakh language and literature, history of the new teaching system is important. Teaching students according to the traditional system, in a structural direction, in the era of globalization does not always bring the desired results. Therefore, the meaning and meaning in works of art requires interpretations in a cognitive, cognitive and modernization manner. In this aspect, the proposed project is undoubtedly of great scientific and practical importance. Consideration of the national and cultural codes formed in Kazakh history as a cognitive national picture of the world, analysis of its influence on self-awareness and understanding of the world of a modern person, comprehension of the modern updated picture of the world -

will help to understand the main cultural codes of modern Kazakh society, to determine the characteristics and stages of the modernization process.

Expected results: the scientific project will contribute to the development of cognitive linguistics in the Kazakh language. The study of language in the communicative, functional, cognitive directions and the use of its results in textbooks, textbooks and dictionaries determine the applied value of the project results. The use of facts of speech and cultural codes in accordance with the knowledge of the individual, the ease of assimilation of the content of the text, the explanation of the variants of the figurative meaning of words and phrases, the introduction of new innovative learning technologies show the applied nature of scientific results.


Consumers: the results obtained will serve as valuable material for all persons interested in Kazakh spiritual culture, and will also be of interest to scientists studying Kazakh culture and spiritual values of the Kazakh people. The scientific results obtained during the implementation of the project will be of great importance for teachers and methodologists of universities working in the field of language teaching, Kazakh philosophy, cultural studies and for school teachers.

Competitiveness (Technology Advantages) and Commercialization of the Project: consideration of the national cultural codes that have developed in Kazakh history as a national cognitive picture of the world and analysis of its modern modernized state, as well as its impact on the consciousness and cognition of a modern personality, allows us to clarify the process of modernization and updating of the main cultural codes in modern Kazakh society.

Consideration and cognitive analysis of the national code as the basis of national values, its manifestation in the language and works of Turkic and Kazakh thinkers makes it possible to understand cultural concepts in these works, reflect new ideological concepts when writing new textbooks and textbooks in line with national codes.

Availability of titles of protection:

- linguopoetics of the word Abay. Copyright certificate. No. 0358. February 1, 2018.
- Historical word formation (semantic aspect). Copyright certificate. No. 0359. February 1, 2018.
- The peak of Shakharam. Author’s certificate. - No. 12343. -2020. October 5. In the Kazakh language.
- Modern Kazakh language. Author’s certificate. - No. 12619. -2020. October 15. In the Kazakh language.

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SCIENTIFIC FOUNDATIONS AND THEORETICAL MECHANISMS OF KNOWLEDGE, UNDERSTANDING AND APPLICATION OF ABAI'S TEACHINGS

Priority area: Scientific foundations of “Mangilik el” (education of the XXI century, fundamental and applied research in the field of humanities).

The aim of the project: determination of the scientific foundations and theoretical mechanisms of knowledge, understanding and application of Abai's teachings.

Know-how: On the basis of the results of research on Abay studies, an independent scientific and information base was created, based on the experience of many generations of scientists, knowledge developed by historically established scientific schools, the serial publication “Abay Studies. Selected Works” in 50 volumes.

Relevance and novelty: Despite the fact that the scientific world knows about life, creative biography, general problems of Abai's work, the scientific foundations and theoretical mechanisms of knowledge, understanding and application of Abai's teachings in Abai studies or in the field of interdisciplinary research have not yet been fully considered.

There are no analogues of this study in the Republic of Kazakhstan and in the world. Determination of the constituent parts, foundations, categories of Abai's teachings as a phenomenon, the creation of scientific foundations and theoretical mechanisms of knowledge, understanding and application of Abai's teachings is the most important and urgent fundamental interdisciplinary scientific problem.

Practical significance:

- achievement of the expected results of the project will lead to the production of innovative knowledge in the field of Abai studies;
- innovative knowledge acquired in the field of Abai studies serves as the basis for creating the necessary conditions for knowledge, understanding and application of Abai's teachings;
- creation of the necessary conditions for knowledge, understanding and application of Abai's teachings will lead to the development and increase of the spiritual and intellectual potential of the Republic of Kazakhstan;
- the creation of scientific foundations and theoretical mechanisms of knowledge, understanding and application of Abai's teachings contributes to the production of the latest, innovative knowledge in the field of science and education in Kazakhstan.

Expected results:

- the principle of researching the scientific foundations and theoretical mechanisms of knowledge, understanding and application of Abai's teachings will be determined;
- the structure of the constituent parts and the foundations of Abai's teachings will be found, the main categories, their content and interrelationships will be systematized;
- the scientific basis of knowledge, understanding and application of Abai's teachings for all spheres and levels of social and social communication will be revealed;
- a theoretical description of the semantic-structural models of Abai's teachings will be drawn up.

Object of implementation: all levels of upbringing and education; system of social sciences and humanities; interdisciplinary research; literary criticism; Abai studies; linguistics; theory and methodology of teaching; institutions of public administration and the institution of the family.

Prospects for implementation: scientific foundations and theoretical mechanisms of knowledge, understanding and application of Abai's teachings are an object of fundamental and interdisciplinary research. The results of the project will be documented in the form of articles, books, concepts, models and scientific information base. Dissemination of the results among potential users, the community of scientists and the general public is carried out openly through the means of written and oral communication, as well as an open electronic library and the website of the Abai Institute <http://abai.kaznu.kz/>.

Consumers: researchers working at the disciplinary, interdisciplinary and intercultural level; consumers whose professional activities are related to the transmission of the results of scientific research in the field of personnel training; students, undergraduates, doctoral students, scientists, as well as parents. The use of the research results will be useful and necessary at all levels of upbringing, education and in all spheres of public life.

Competitiveness (Technology Advantages) and Commercialization of the Project: the project has no analogues either in Kazakhstan or in the world. The results of the research are prepared in the form of didactic principles, a hierarchical system of levels of cognitive thinking in the process of achieving learning goals, Abai's taxonomy, didactic measuring instruments, educational books. They are not among the forms of commercialization and are recommended for use at all levels of educational and educational activities. Research results have qualitative advantages.

Availability of documents of title: Copyright certificate No. 16745 "The concept of knowledge, understanding and application of Abai's teachings".

Investment amount: 27 mln. tenge. 

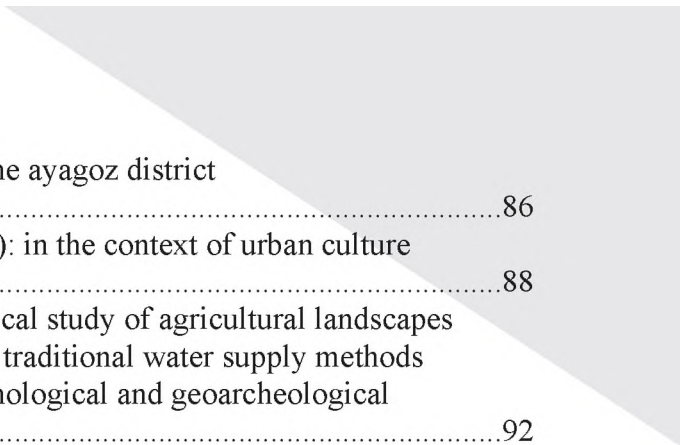
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FOR NOTES





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