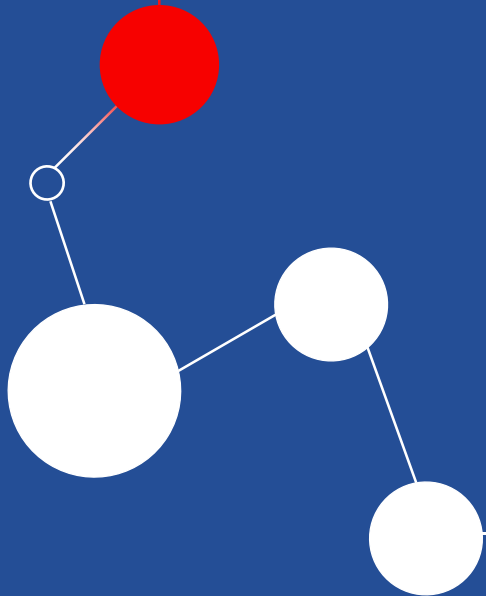


**VSUET**

# CATALOG

## INNOVATIVE DEVELOPMENTS

**Ecology and chemical  
industry faculty**





1. Composts for low-fertility soil with sewage sludge and natural waste
2. Oleochemicals based on the oil and fat industry related products
3. Hybrid composite materials based on thermoplastics and natural fillers
4. Packaging for non-traumatic plant transplantation
5. Eco-packaging
6. Loading for biofilter of wastewater treatment plants with improved immobilization properties
7. Utilization of oil and fat industry waste to obtain import-substituting multifunctional additives
8. Multifunctional additives for elastomeric compositions from industrial waste
9. Biological treatment of highly concentrated wastewater
10. Development of innovative technological solutions to slow down the increasing anthropogenic influence of the greenhouse effect
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23. Superpolymers for a new generation of fertilizers and plant growth stimulants
24. Sugar colorings
25. Sorbent based on rice production wastes
26. Development of mineral dyes for granular mineral fertilizers for their marking
27. Development of a hydrophobic shell of granular mineral fertilizers for their prolonged action
28. Electrodialysis of technological aqueous solutions – waste from large-scale industries

# Composts for low-fertility soil with sewage sludge and natural waste

1

authors Popova L. V., Korchagin V. I.



## Application area

- restoration of roadside areas of cities, agricultural complexes, private farms, etc.;
- restoration of soil fertility, waste recycling



## Competitive advantages

The resulting compost mixture can be sold as an organic fertilizer, the cost of which will be lower than that one of known analogues, since it will be made from industrial waste



## Brief description

Joint composting of plant sludge sewage with other industries waste, obtaining compost mixtures of optimal composition and their properties complex studying



# Oleochemicals based on the oil and fat industry related products

authors Korchagin V. I., Popova L. V., Protasov A. V.



## Application area

- polymer composites formulations:
- contribute to the dispersion of low-solubility ingredients in elastomeric systems;
  - improve the processability of rubber compounds in high-speed equipment;
  - allow to obtain rubber-technical products with increased performance indicators;
  - accelerate the oxidative degradation of traditional plastics



## Brief description

From fatty acids isolated from soapstock by ion exchange reaction, variable valence metal carboxylates are obtained, which are used to get concentrate additives for polymers with controlled service life and targeted additives for elastomers



## Competitive advantages

- price;
- the product component composition is domestic raw materials;
- it is not inferior to well-known analogues in terms of quality indicators



Organic metal salts of variable valence:  
1 – iron carboxylate; 2 – copper carboxylate;  
3 – cobalt carboxylate



Multifunctional concentrate additives based on:  
1 – iron carboxylate; 2 – copper carboxylate;  
3 – cobalt carboxylate



# Hybrid composite materials based on thermoplastics and natural fillers

authors Protasov A. V., Studenikina L. N., Korchagin V. I.



## Application area

- eco-packaging;
- loading for biofilters with improved immobilization properties;
- packaging for non-traumatic plant transplantation;
- fertilizers with extended service life (life durability)



## Competitive advantages

- the product is entirely domestic;
- the cost is 2.5-3 times lower than that one of foreign analogues;
- properties adjusting possibility;
- reduced environmental load after intended use



## Brief description

Production of highly filled compositions based on thermoplastics and natural fillers in high-speed extrusion equipment with modification of the filler in a high-energy field, including the stage of liquid-phase combination with latex, which increases the manufacturability of production and improves the properties of the resulting product



Photo of food tray



Floating loading photo

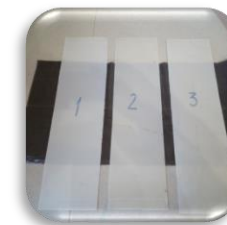


Photo of the material for making bowls



Photo of fertilizer granulate (base)



# Packaging for non-traumatic plant transplantation

4

authors Protasov A. V., Studenikina L. N.



## Application area

plant growing;  
hydroponics;  
gardening



## Competitive advantages

- low cost;
- variation in terms of destruction;
- environmental safety



## Brief description

Composites based on synthetic thermoplastics, mineral and organic natural fillers and functional modifying additives, for growing plants in them with the technology of non-traumatic transplantation, with different destruction periods in natural environmental conditions (from several months to several years)





authors Studenikina L. N., Protasov A. V., Korchagin V. I.



## Application area

water-soluble and biodegradable packaging for food and non-food products



## Competitive advantages

- components of domestic production;
- the cost of the material is lower than its imported analogues;
- compliance with compostable standards packaging;
- the ability to regulate the dissolution temperature and destruction time



## Brief description

Composites based on water-soluble thermoplastic - polyvinyl alcohol (or based on other water-soluble matrices) and natural polysaccharides (starch, dextrin, cellulose, etc.), capable of being molded into housing products and / or films that have the ability to be dissolved by water (at different temperatures) and biodestruction



# Loading for biofilter of wastewater treatment plants with improved immobilization properties

6

authors Studenikina L. N., Protasov A. V.



## Application area

treatment facilities for biological wastewater treatment (domestic, industrial)



## Competitive advantages

- domestic production components;
- cost is lower than imported analogues;
- variation of shape and density;
- self-cleaning ability;
- high biocapacity;
- durability



## Brief description

The highly effective bioloadings being developed differ from their analogues in that they are made from a thermoplastic-based composite material. It provides strength, durability and cellulose moldability as a filler, ensuring a developed surface, water absorption and biodisc optimal density. They are additionally modified with a pore-forming substance to create a developed internal surface, which will allow to fix the biomass in the volume of the biodisk





# Utilization of oil and fat industry waste to obtain import-substituting multifunctional additives

7

authors Karmanova O. V., Popova L. V., Tihomirov S. G.



## Application area

application as vulcanization activators, dispersants for rubber compounds, vulcanizing agent, structuring and activating additives



## Competitive advantages

- price;
- the component composition of the product is domestic raw materials of natural origin;
- it is not inferior to well-known analogues in terms of quality indicators



## Brief description

Multifunctional additives (in the form of plastic material) that increase the process efficiency of:

- the production and processing of rubber compounds based on synthetic rubbers;
- the production of elastomeric crumbs



# Multifunctional additives for elastomeric compositions from industrial waste

authors Pugacheva I. N., Nikulin S. S., Molokanova L. V.



## Application area

chemical industry;  
rubber industry



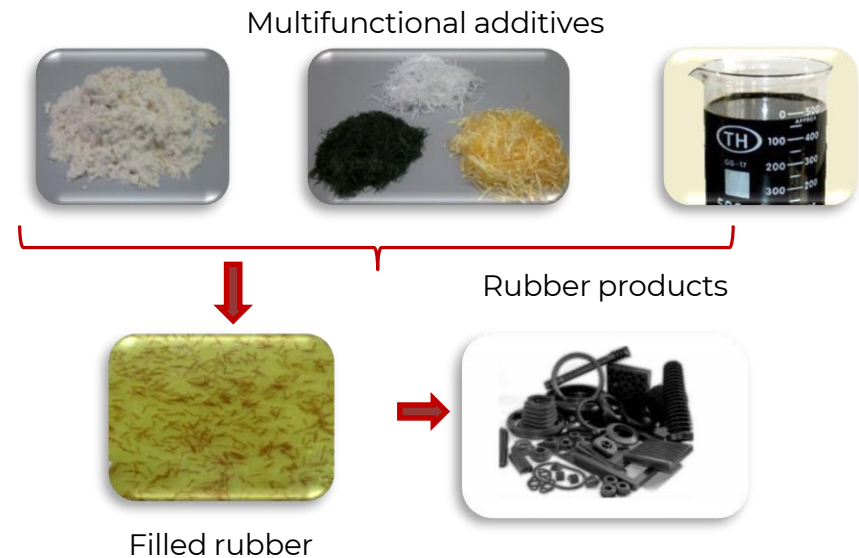
## Competitive advantages

- low cost;
- increases the environmental friendliness and resource saving of the process of filled elastomeric compositions obtaining;
- improves the properties of the resulting composites;
- reduces the negative impact on the environment by industrial waste recycling



## Brief description

A technology for multifunctional additives production from petrochemical and textile industry waste, and a method for modifying elastomeric compositions with them were developed. Additives are designed to improve the performance characteristics of the resulting composites



# Biological treatment of highly concentrated wastewater

authors Korchagin V. I., Dochkina Yu. N.



## Application area

highly efficient treatment of highly concentrated wastewater from poultry processing plants



## Competitive advantages

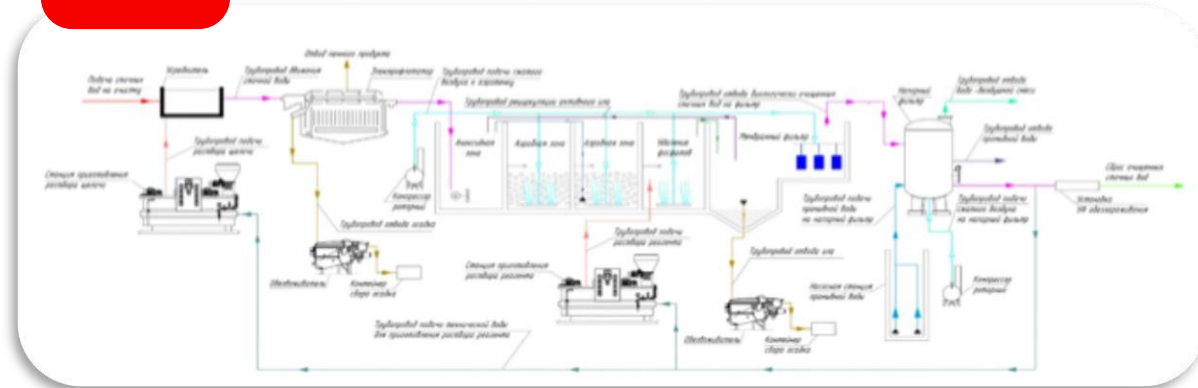
Purification efficiency: COD – up to 95.6%, suspended solids – up to 92.7%, dry residue – up to 94.8%.

Reduction of the amount of environmental damage caused by 97.3 million rubles/year, an increase in the amount of prevented environmental damage by 8.8 million rubles/year with an environmental and economic effect of 31.8 million rubles/year



## Brief description

An integrated approach to ensuring the sustainability of activated sludge biocenosis when treating wastewater with a high concentration of protein-lipid and associated contaminants, involving the application of electroflotation treatment and biooxidation in aeration tanks with a floating composite bioload



# Development of innovative technological solutions to slow down the increasing anthropogenic influence of the greenhouse effect

10

author Emelyanov A. B.



## Application area

the sphere of ecology is the global environmental problems of the Earth: emissions of greenhouse gases, water vapor, ozone layer restoration, reducing the influence of the anthropogenic factor on global warming, energy-resource-saving technologies



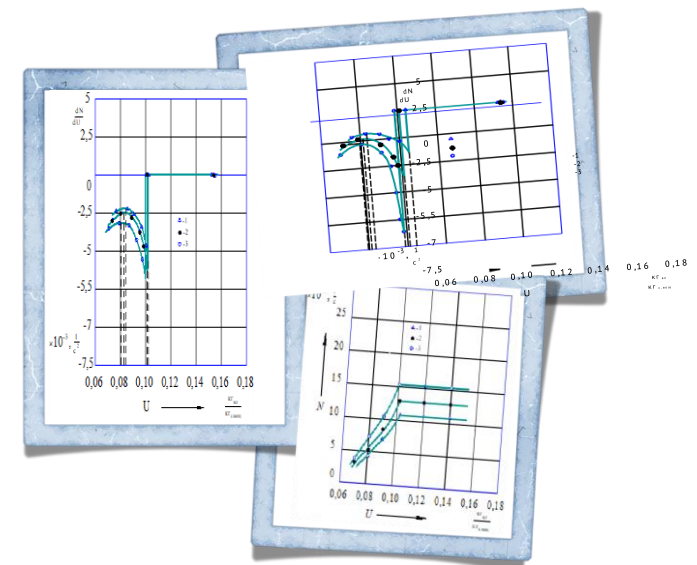
## Brief description

The methods developed for technological processes intensifying can significantly reduce energy costs and optimize temperature and time conditions of the production cycle. This will significantly reduce emissions of thermal energy, greenhouse gases and water vapor into the atmosphere and water resources



## Competitive advantages

- there are practically no financial investments;
- the versatility of the proposed solutions;
- minimum time frame for project implementation;
- an integrated approach to the problem of slowing down the increasing anthropogenic influence of the greenhouse effect



# New analysis devices for early detection and control of inflammation of cows uterus, assessment of the potential for inflammation of the respiratory system of calves

authors Kuchmenko T. A., Umarhanov R. U., Shuba A. A.



### Application area

ensuring highly productive reproduction in animal husbandry through timely, rapid detection and control of inflammation of the uterus in cows and the respiratory system in calves by the smell of biosamples



### Brief description

A portable device combined with a laptop/computer/tablet. It is equipped with eight selective and sensitive gas sensors. Sensor coatings capture volatile compounds released from biosamples of small volume and mass. The visual trace of molecules is constructed in the form of a geometric figure according to sensor signals. The decision about the presence and severity of inflammation processes is made according to these data



### Competitive advantages

- the data correlate with microbiological analysis, but are obtained much faster;
- expensive reagents and consumables are not required;
- the operator learns quickly, the technique is simple, the data are stored indefinitely, it is possible to compare samples and monitor treatment

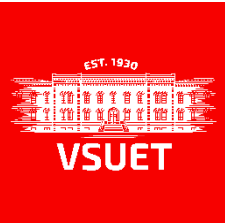


Cotton swab into the device, 3 minutes measurement

The software processes data instantly, visualization allows to make decisions on the spot

Simple mucus sampling (5 s), 30 minutes before measurement

Replaceable sensors, 1 year warranty, the device - 10 year warranty





# Point-of-care device for express diagnostics of water and soil

12

authors Kuchmenko T. A., Umarhanov R. U. (VSUET),  
Sensorika-New Technologies LLC



## Application area

- ecological monitoring services at any level, internal monitoring and control of treatment facilities;
- analysis of natural, waste water, soil, waste in a mobile laboratory



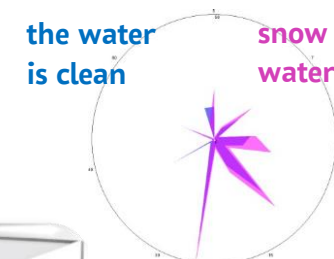
## Competitive advantages

- no sample preparation is required;
- no chemical reagents are used;
- results are saved digitally;
- high sensitivity and operating time



## Brief description

Static detector based on 4-8 gas sensors of different selectivity to volatile molecules. It allows to record changes in sensor signals for samples of any nature of small volume and mass (from 100 mg) in 20-60 s. Direct detection of volatile vapors of organic compounds (petroleum products), heavy metals in water, soil, and surfactants is possible



# Mobile complex for environmental monitoring "AQUA-STOCK"

13

authors Kuchmenko T. A., Umarhanov R. U. (VSUET),  
Sensorika-New Technologies LLC



## Application area

- ecological monitoring services at any level, air monitoring in office and residential premises, building materials and furniture control;
- analysis at any point



## Competitive advantages

- no sample preparation;
- sensor array – removable, 11 independently operating sensors;
- software – universal and special for close samples comparison;
- convenient and cost-effective for routine monitoring;
- high accuracy, low level noise, highly stable sensors



## Brief description

The most energy-intensive device for on-site analysis of water bodies, air, point control of the level of volatile compounds emission into the air from any surfaces. NON-DESTRUCTIVE testing tool. It allows to identify specific groups of anthropogenic pollutants, to assess the state of the sample and the distribution trend of highly volatile pollutants, the environmental load at specific points, and draw up a map of water pollution



# Composite vulcanization activator

14

authors Karmanova O. V., Golyakevich A. A.



## Application area

chemical industry



## Competitive advantages

- low cost (compared to analogues);
- improved vulcanization characteristics of rubber compounds based on it;
- elastic strength properties of vulcanizates comply with GOST requirements;
- possibility of application in formulations based on various brands of rubbers



## Brief description

The composite vulcanization activator is developed to be used in rubber compound formulations. The application of the product makes it possible to reduce the release of zinc ions into the environment as a result of operation and wear of rubber products. It is developed on the basis of domestic raw materials



Complex vulcanization activator  
(light gray non-dusting powder)



Zinc white (white or slightly  
yellowish amorphous powder)



authors Karmanova O. V., Tihomirov S. G., Kazakova A. S., Kuligina M. A.



## Application area

chemical industry



## Brief description

A technology was developed for the regeneration of used rubber based on butyl rubber through the combined effects of ionizing radiation and shear deformations. A mathematical apparatus for predicting the technical properties of a material was developed. A series of butyl regenerates with technological properties in a wide range was obtained. This allows it to be used in various industries - as part of rubber compounds with high gas impermeability, sealants, mastics



## Competitive advantages

- obtaining regenerate without additional chemical reagents or softeners introduction;
- replacing butyl rubber in rubber formulations can reduce the cost of products;
- improving the technological properties of rubber compounds;
- resource saving – return of hydrocarbon raw materials to a new production cycle;
- application in technology of elastomers (rubber mixtures for the liner of tires, etc.), materials for construction (roofing, mastic, sealing)



# Technologically active additives for elastomers

16

authors Karmanova O. V., Tihomirov S. G., Popova L. V., Golyakevich A. A.



## Application area

chemical industry



## Competitive advantages

- price;
- component composition of the product is domestic raw materials of natural origin;
- not inferior to well-known analogues in terms of quality indicators



## Brief description

A technology was developed for producing a series of functional additives to elastomers in the form of organomineral complexes based on metal oxides and higher carboxylic acids deposited on a mineral carrier. Depending on the composition and purpose, they are used to improve the processability, vulcanization characteristics and elastic-strength properties of elastomers





# Waterproofing elastomeric materials

17

authors Karmanova O. V., Moskalev A. S.



## Application area

- waterproofing of building structure elements;
- sealing elements



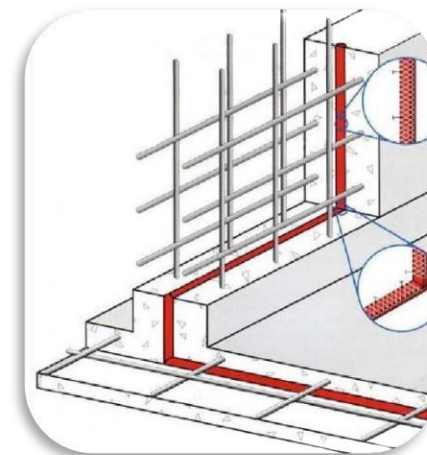
## Competitive advantages

- high sorption capacity (degree of swelling: 200-600%);
- adjustable properties for specific operational tasks;
- low cost due to the use of inexpensive domestic raw materials



## Brief description

- elastomeric waterproofing materials based on synthetic rubbers and water-absorbing components (bentonite, polyacrylamide, etc.) and modifiers;
- various graduation forms (molded/non-molded products);
- adjustable swelling degree



# Water-swollable elastomer material

18

authors Karmanova O. V., Moskalev A. S.



## Application area

chemical industry;  
construction



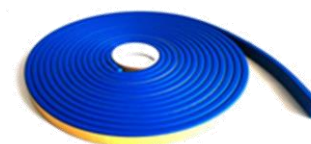
## Competitive advantages

- adjustable properties for specific operational tasks;
- low cost due to the use of inexpensive domestic raw materials



## Brief description

Water-swelling elastomer material is intended for the manufacture of sealing elements of building structures used for waterproofing purposes in the construction of buildings and structures. The composition of the material is developed on the basis of domestic raw materials. It is aimed at import substitution



a)



б)

Water-swelling elastomer materials:  
a) rectangular sealing cord,  
b) swelling plugs



# Anthocyanin dyes with a high content coloring substances

19

authors Bolotov V. M., Savvin P. N., Komarova E. V.



## Application area

food industry



## Brief description

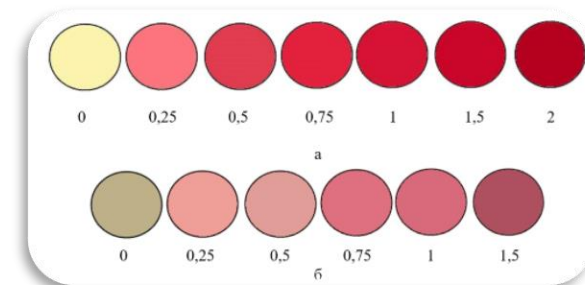
Anthocyanin dyes with a high content of coloring substances are obtained by acid-free processing of raw materials (chokeberry pomace, black currants, blackberries, blueberries, dark grape varieties, and flower petals) with ethyl alcohol.

The presence of antioxidant activity in anthocyanin dyes produced with the proposed production method was determined



## Competitive advantages

- absence of chemical modification of natural compounds during dye production;
- minimization of technological operations for dye obtaining;
- soft extraction mode, excluding the application of high temperatures;
- additives that degrade the quality of the product (in particular, organic or mineral acids) are not applied;
- prevention of microbiological contamination of the dye, which increases its stability during storage;
- the possibility of using juice production waste as a raw material source, as well as non-traditional local plant raw materials



Coloring of confectionery products samples (a – caramel, b – cream) with the introduction of black currant alcohol extract concentrate in an amount, g/kg

# Complex action dietary supplement

20

authors Bolotov V. M., Savvin P. N., Vorontsov I. N.



## Application area

food industry;  
cosmetics industry



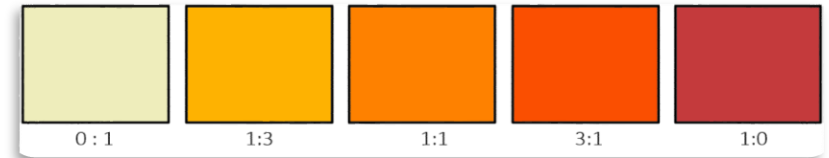
## Brief description

The dietary supplement is produced on the basis of joint extraction of carotenoid and anthocyanin pigments from local plant materials. Natural and nature-identical biologically active compounds often have a wide range of physiological activities. This has a beneficial effect on various systems of the human body. The developed additive has a complex effect (antioxidant and vitamin activity, coloring ability)



## Competitive advantages

- application of local plant materials as a source of biologically active substances. This simplifies logistics and increases digestibility;
- low cost due to the possibility of using waste from juice and fruit and vegetable production



Coloring of extracts of mixed alcoholic extracts (dilution 1:25) obtained by isolation from plant raw materials with the specified ratio of anthocyanin-containing: carotenoid-containing raw materials

# Hydrophobic flavonoid antioxidants from natural plant compounds

authors Bolotov V. M., Savvin P. N., Komarova E. V.



## Application area

chemical industry;  
cosmetics industry;  
medicine



## Brief description

Hydrophobic flavonoid compounds with antioxidant properties are extracted from flavonoid-containing plant raw materials (black currant berry pomace, chokeberry, red rose flower petals, cloves, onion peels and other raw materials) followed by hydrolysis. The resulting flavonoids have increased hydrophobic properties and are used as food colorings with antioxidant properties of alcohol-containing food products, as well as antioxidants in polymeric materials for medical purposes



## Competitive advantages

- hydrophobic anthocyanin compounds are a dark brown-red powder. Flavonols are dark brown in color. They can be used to color alcoholic beverages in shades that are not found in natural flavonoid compounds;
- hydrophobic flavonoids introduction into polymeric materials for medical purposes instead of synthetic phenolic compounds (that are toxic to humans) makes it possible to impart not only antioxidant properties to polymers, but also bactericidal activity





# New coagulants for emulsion rubbers

22

authors Nikulin S. S., Pugacheva I. N., Vlasova L. A., Sannikova N. U.



## Application area

chemical industry



## Brief description

A series of studies on the use of various types of organic nitrogen-containing compounds in the production technology of emulsion styrene-butadiene rubbers to reduce the aggregative stability of latex dispersions was carried out for the first time. The application of these compounds in the technology of rubber isolating from latex makes it possible to obtain rubbers at low costs of a coagulating agent



## Competitive advantages

Low costs of coagulating agents provide good preconditions for implementing a closed technological cycle on an industrial scale, as well as reducing water consumption in workshops for extracting rubber from latex. This ultimately increases the environmental friendliness of the entire technological process of their production



# Superpolymers for a new generation of fertilizers and plant growth stimulants

authors Karmanova O. V., Churilina E. V.



## Application area

- consumers: plant growing enterprises, gardening partnerships, individuals;
- technology area: agrotechnology and agriculture



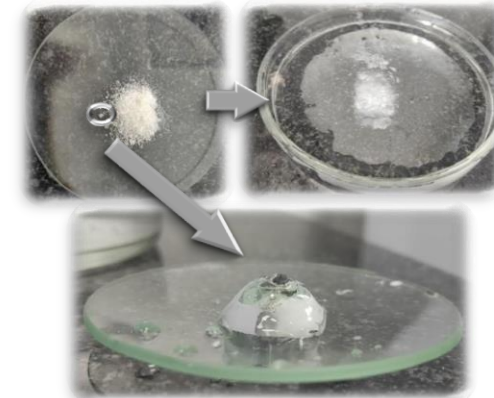
## Competitive advantages

- low toxic and biocompatible;
- contains released biologically active substances that can be controlled;
- increases the bioavailability of fertilizers and plant growth stimulants up to 85%



## Brief description

The polymer containing biologically active substances (BAS) is highly swelling in water, biodegradable. Water and biologically active substances are released into the environment in a controlled manner under the influence of external stimuli



# Sugar colorings

24

authors Bolotov V. M., Savvin P. N., Komarova E. V.



## Application area

food industry



## Competitive advantages

The proposed method for producing sugar color E150d allows to obtain food coloring with a higher content of coloring substances compared to standard production technology and with minimal content of harmful to human health inorganic ammonium and sulfite compounds



## Краткое описание

Sugar coloring is one of the most common and high-demand substance; it is used in the production of almost all types of sweets and confectionery, bread, baked goods, chips, creams, alcoholic drinks, where it acts not only as a colouring, but also as an emulsifier



# Sorbent based on rice production wastes

25

authors Sannikova N. U., Kushnir A. A.



## Application area

the product is intended for wastewater purification or water treatment for food and pharmaceutical plants.

Ecology: water purification, waste recycling



## Competitive advantages

- high bulk density;
- more effective against some organic compounds and metals compared to analogues;
- ease of disposal



## Brief description

The silica carbon sorbent is a polydisperse black or dark grey powder obtained by heat treatment of rice husks (multiple rice production waste).

- chemical composition - silicon dioxide (47 - 54%) and carbon (52 - 45%);
- bulk mass - 140 kg/m<sup>3</sup>;
- ignition temperature - 285±15 °C



# Development of mineral dyes for granular mineral fertilizers for their marking

authors Niftaliev S. I., Gorbunova E. M., Gubanova V. R.



## Application area

the product is aimed at marking of granular mineral fertilizers with natural dyes based on glauconite, a mineral that includes more than 20 useful microelements



## Competitive advantages

The content of micro- and mesoelements in glauconite makes it possible to obtain complex granular colored fertilizers



## Brief description

Fine glauconite is thermally processed at various temperatures and added to fertilizer before granulation.

The ratio of thermally treated glauconite to fertilizer affects the color intensity of the granules



Fractional glauconite pigment can be thermally activated at various temperatures



Nitroammophos granules are colored with glauconite-based mineral dyes



# Development of a hydrophobic shell of granular mineral fertilizers for their prolonged action

27

authors Niftaliev S. I., Gorbunova E. M., Gubanova V. R.



## Application area

the product is aimed at long-acting fertilizers manufacturing. Granular fertilizers include useful micro- and mesoelements that are supplied to plants at long term basis



## Competitive advantages

- long-term stimulating effect on plant growth and development;
- better positional availability of nutrients to the root system;
- due to the prolonged action of glauconite, a significantly smaller amount of mineral fertilizers will be required to obtain a good harvest



## Brief description

The prolonged effect of fertilizers is manifested by adding glauconite to the fertilizer composition. The use of a fine fraction of the mineral promotes better mixing with fertilizer and absorption by the plant



Glauconite divided into fractions



# Electrodialysis of technological aqueous solutions – waste from large-scale industries

28

authors Niftaliev S. I., Kozaderova O. A., Kim K. B.



## Application area

chemical industry;  
mineral fertilizers manufacturing



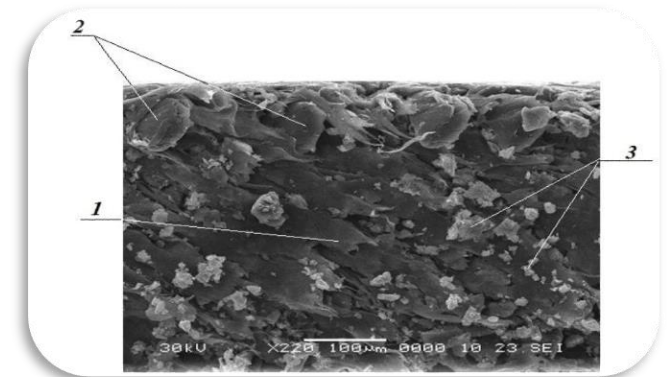
## Competitive advantages

The advantages of electrodialysis over reverse osmosis include less waste, less sensitivity to suspended solids, longer membrane life, no need for full pre-treatment, ease of operation and low energy consumption



## Brief description

The main idea of electrodialysis desalting and saline solutions concentrating is that a salt solution is passed through an apparatus separated by alternating cation-exchange and anion-exchange membranes. Desalting (diluate) and concentration sections are formed under the influence of direct electric current



Micrograph of a heterogeneous ion exchange membrane:  
1- polyethylene; 2 – reinforcing fiber;  
3– ion exchange resin



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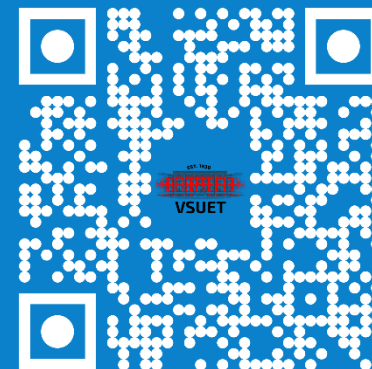
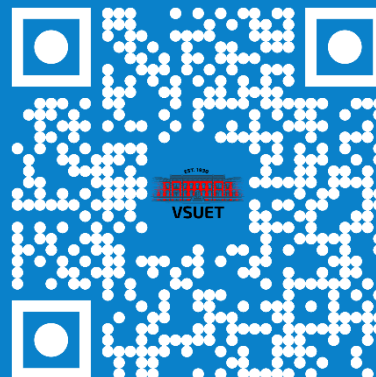
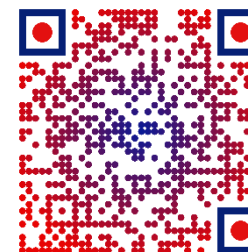
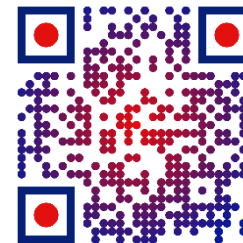
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