WATER PURIFICATION AND WATER TREATMENT

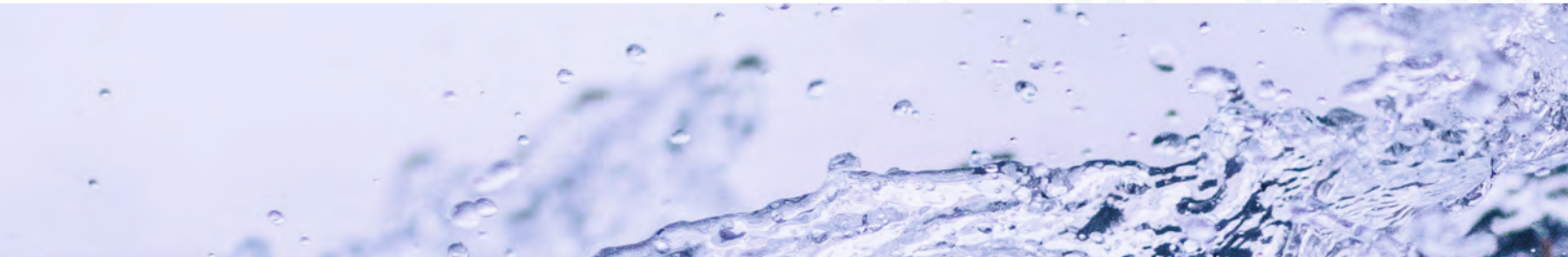
TECHNOLOGY
MATERIALS
EQUIPMENT

Contents

R&D PRODUCTS OF THE STATE SCIENTIFIC INSTITUTION "THE INSTITUTE OF GENERAL AND INORGANIC CHEMISTRY"

R&D PRODUCTS OF THE STATE SCIENTIFIC INSTITUTION "THE INSTITUTE OF PHYSICAL ORGANIC CHEMISTRY"

Contents



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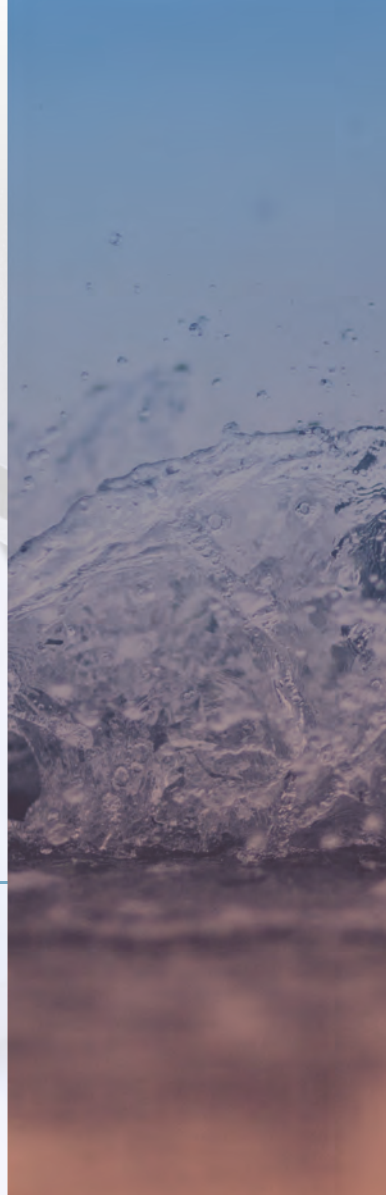
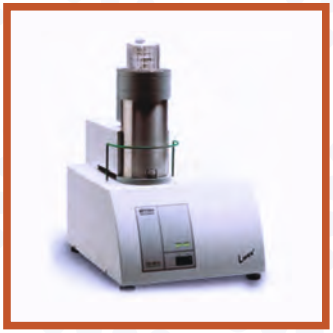


Pilot plant for manufacturing of water purification materials and equipment

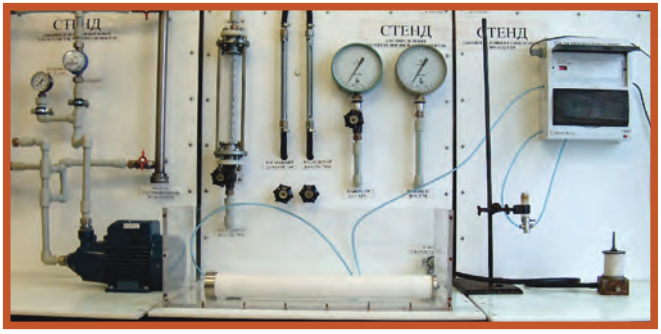


FUNDAMENTAL RESEARCH:

development of physical and chemical bases for the synthesis of new porous materials with specified properties, structural and phase organization, and chemical nature of the surface

APPLIED RESEARCH:

development and implementation of membrane, sorption and catalytically active materials, and automated units based on them for non-reagent water purification



Test stands for ceramic membrane materials

Modern scientific and technical equipment

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Water purification equipment:

- stations of catalytic removal of iron from artesian water;
- microfiltration units;
- modular process water purification units for removal of colloids and solids;
- modular units for purification of low- and high-mineralized water for household and drinking water supply.

Materials for reagent-free water purification:

- catalytically active filtering materials for iron and manganese removal from artesian water;
- ceramic microfiltration membranes;
- adsorbents for industrial wastewater purification from heavy metal ions and liquid radioactive waste from radionuclides.

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Stations of catalytic removal of iron from artesian water

ADVANTAGES:

- no need for catalyst regeneration with strong oxidants;
- high efficiency of the mineral water purification;
- full automatization.

CUSTOMERS:

RUE “Belorusneft”;

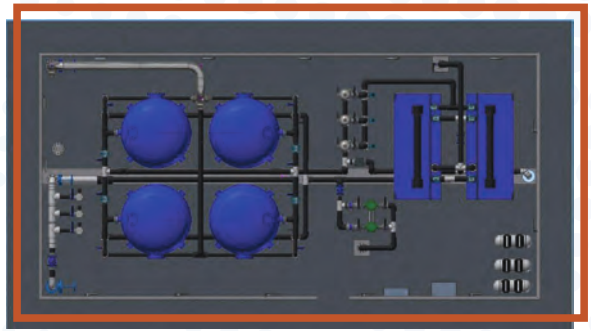
RUE “Starodorozhskoe Housing and Utilities”;

RUE “Novogrudskoe Housing and Utilities”;

“Zhemchuzhina” children's rehabilitation and health center;

OJSC “Gomel Poultry Farm” and others.

Iron removal station at RUE “Novogrudskoe Housing and Utilities”, working with sorption-catalytic filter material of the Institute of General and Inorganic Chemistry



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Microfiltration units

ADVANTAGES:

- high performance;
- low water consumption for own needs;
- high efficiency at decreasing the turbidity and colloid index of water;
- the ceramic membranes are regenerated automatically by backwash;
- high chemical and thermal stability.

CUSTOMERS:

OJSC “Minsk Mechanical Works named after V.I. Vavilov – Head Company of “BelOMO” holding”;

State Agency “Republican Center for Medical Rehabilitation and Balneotherapy”;

State Enterprise “Priozerny Resort”;

Health Care Institution “Mogilev Regional Clinical Hospital” and others.

Automated microfiltration water purification unit
(in cooperation with the Institute of Chemistry of New Materials)

Characteristics of microfiltration ceramic membranes

Indicator name		Value
Pore size, microns	Support	40-80
	Membrane layer	1-5
Water capacity, $m^3/(h \times m^2 \times atm)$		12,5
Size of tubular membrane elements (diameter×wall thickness×length), mm		16-65×2-4×550
Maximum working pressure, atm		
diameter (16-40) mm diameter (50-65) mm		4 15
Operating pH range of treated solutions		2-12

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Modular water purification units for process water production

ADVANTAGES:

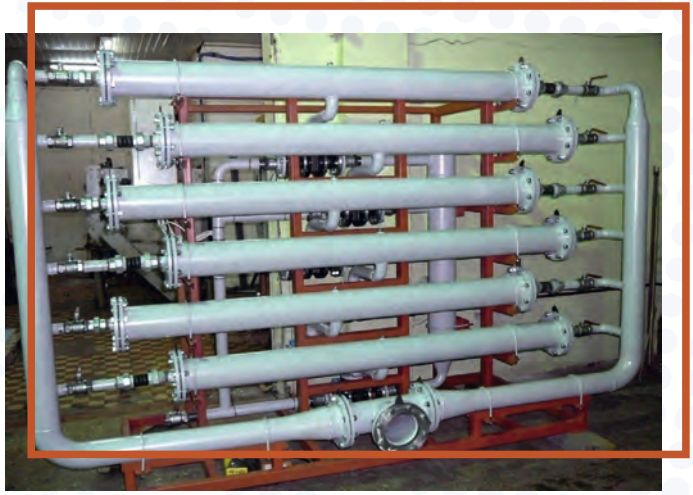
- ability to purify water from surface sources;
- low consumption of water for own needs;
- high efficiency in reducing turbidity and colloidal index of water;
- the filtration elements are regenerated automatically by backwash;
- no reagent pre-treatment is required.

CUSTOMERS:

OJSC “Minsk Mechanical Works named after V.I. Vavilov – Head Company of “BelOMO” holding”;

OJSC “Belshina”;

Health Care Institution “Mogilev Regional Clinical Hospital” and others.



Modular water purification unit for process water production at OJSC “Belshina”, 100 m³/h

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Pilot technology for domestic water supply

ADVANTAGES:

- promising for implementation at municipal water supply facilities and industrial enterprises;
- reduces water supply costs;
- improves water purification quality and reduces wash water volume to 0,5-1% of treated water.

CUSTOMERS:

OJSC «Belshina».

Operating mode: automated, full dispatch control of the unit. Patent for the invention: No. 22803 “Method for producing a catalytically active filter material”. Utility model patent: No. 12025 “Water purification unit”.

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Catalytically active filtering materials for iron and manganese removal from artesian water

ADVANTAGES:

- no need for catalyst regeneration with strong oxidants;
- high rate of filtration (up to 20 m/h), including mineral water purification;
- low water consumption for backwashing (less than 1%);
- service life - at least 5 years.

CUSTOMERS:

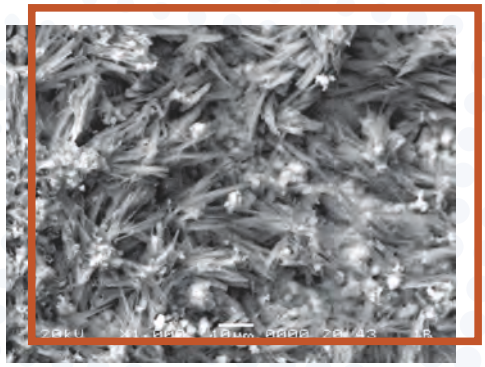
RUE “Belorusneft”;

RUE “Starodorozhskoe Housing and Utilities”;

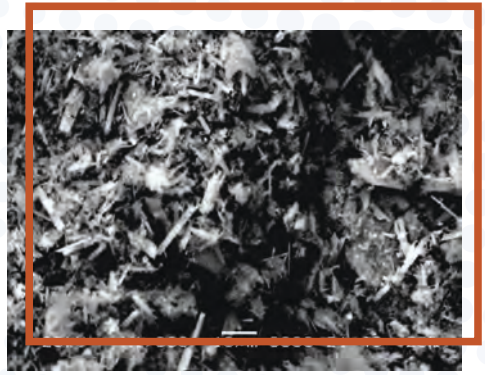
RUE “Novogrudskoe Housing and Utilities”;

“Zhemchuzhina” children's rehabilitation and health center;

OJSC “Gomel Poultry Farm” and others.



Electron microscope image of catalyst coated surface (×1000)



SEM image of Fe, Mn-oxide catalyst (×1000)

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Ceramic microfiltration membranes

ADVANTAGES:

- high performance and service life;
- low consumption of water for own needs;
- high efficiency at decreasing turbidity and colloidal index of water;
- high chemical and thermal stability.

CUSTOMERS:

OJSC “Minsk Mechanical Works named after V.I. Vavilov – Head Company of “BelOMO” holding”;

State Agency “Republican Center for Medical Rehabilitation and Balneotherapy”;

State Enterprise “Priozerny Resort”;

OJSC “Svetlogorskhimvolokno”;

Health Care Institution “Mogilev Regional Clinical Hospital” and others.

General view and electron microscopic image (×100) of the cleavage of ceramic microfiltration membranes

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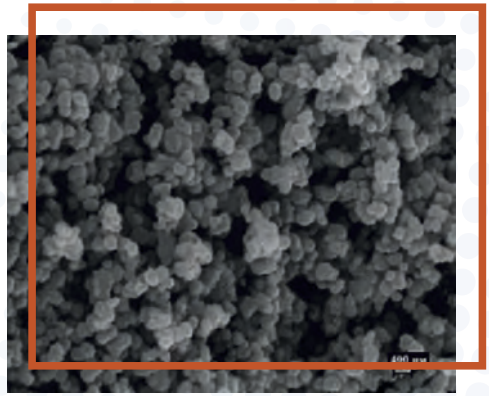
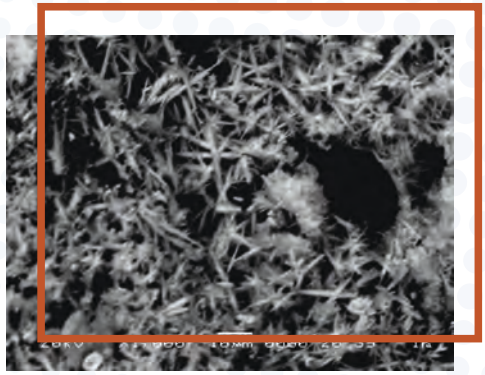
Adsorbents of toxic metal ions and radionuclides

ADVANTAGES:

- highly efficient extraction of ^{137}Cs, $^{85, 90}Sr$, ^{60}Co radionuclides, including during the saline water purification (sea, ocean and others);
- high sorption capacity of Pb^{2+}, Cd^{2+}, Cu^{2+}, Ni^{2+}, Co^{2+}, Mn^{2+} and others;
- wide operating pH range (2-12);
- possibility of sorbents utilization by cementing or vitrification.



Electron microscope image (×20000) of a sorbent based on octahedral molecular sieves of OMS-1 and OMS-2 types



SEM image of a metal phosphate adsorbent (×1000)

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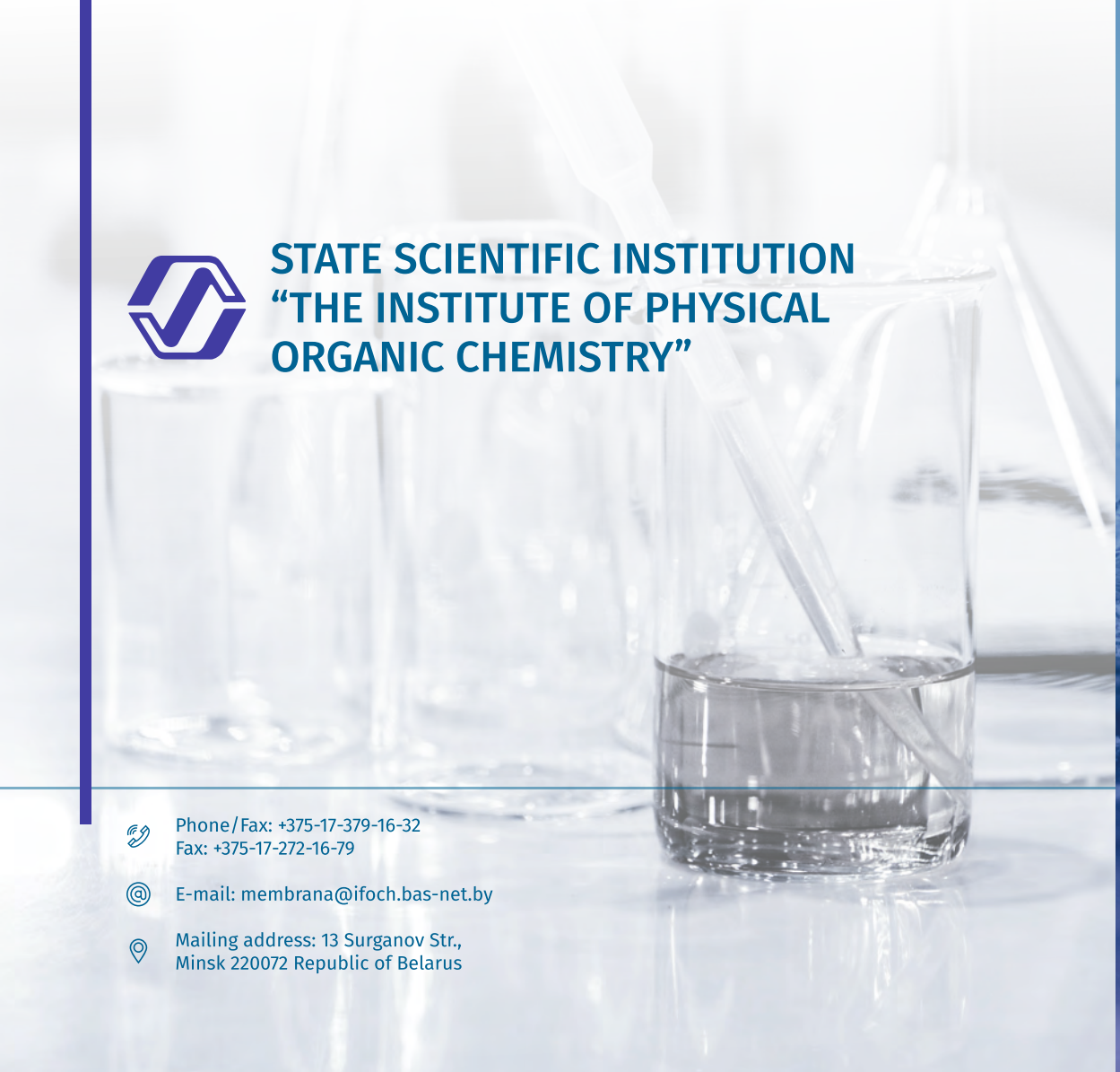

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Pilot plant for manufacturing of flat and hollow fiber membranes and membrane elements for water purification

A complex of research and development work was carried out. As a result, the commercial production of 18 types of second generation micro- and ultrafiltration membranes (trademark “MIFIL”) up to 20000 m²/year was organized.

Pilot plant for manufacturing of substrate-reinforced membranes

Equipment set for manufacturing of capillary membranes

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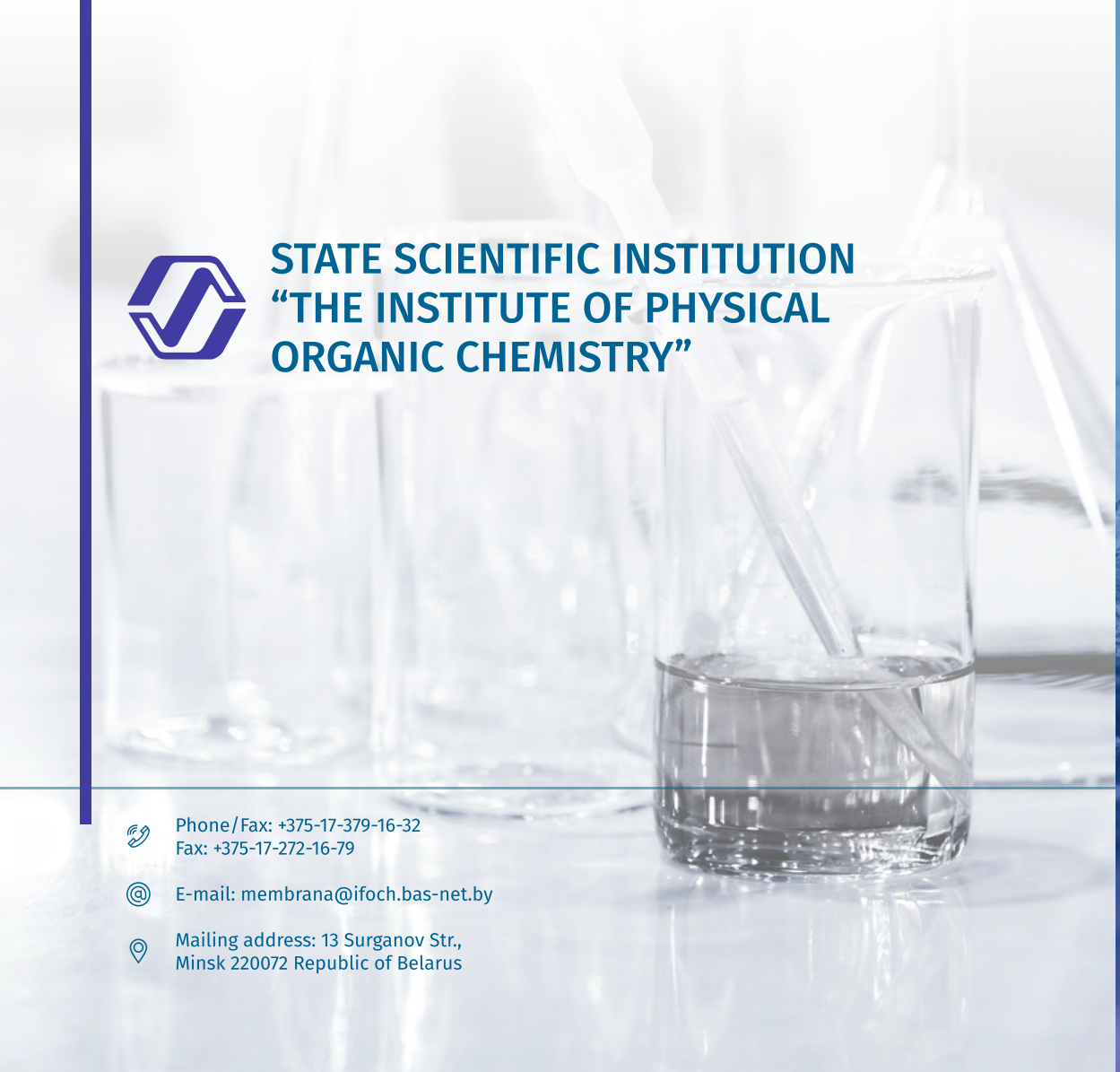

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Membrane elements for low-pressure dead-end ultrafiltration

Membrane type	hollow fiber
Filtration mode	inside-out
Polymer	polysulfone
MWCO	100000 D
Inner diameter	0,9 mm
Outer diameter	1,25 mm
pH range	1-13
Temperature	up to 60 °C
Membrane area	80 m²
Permeability	1,2-2,5 m³/h

MEMBRANE ELEMENT DIAMETER, mm	EFFECTIVE MEMBRANE AREA, m²
90	2-5
160	10-15
250	45-50

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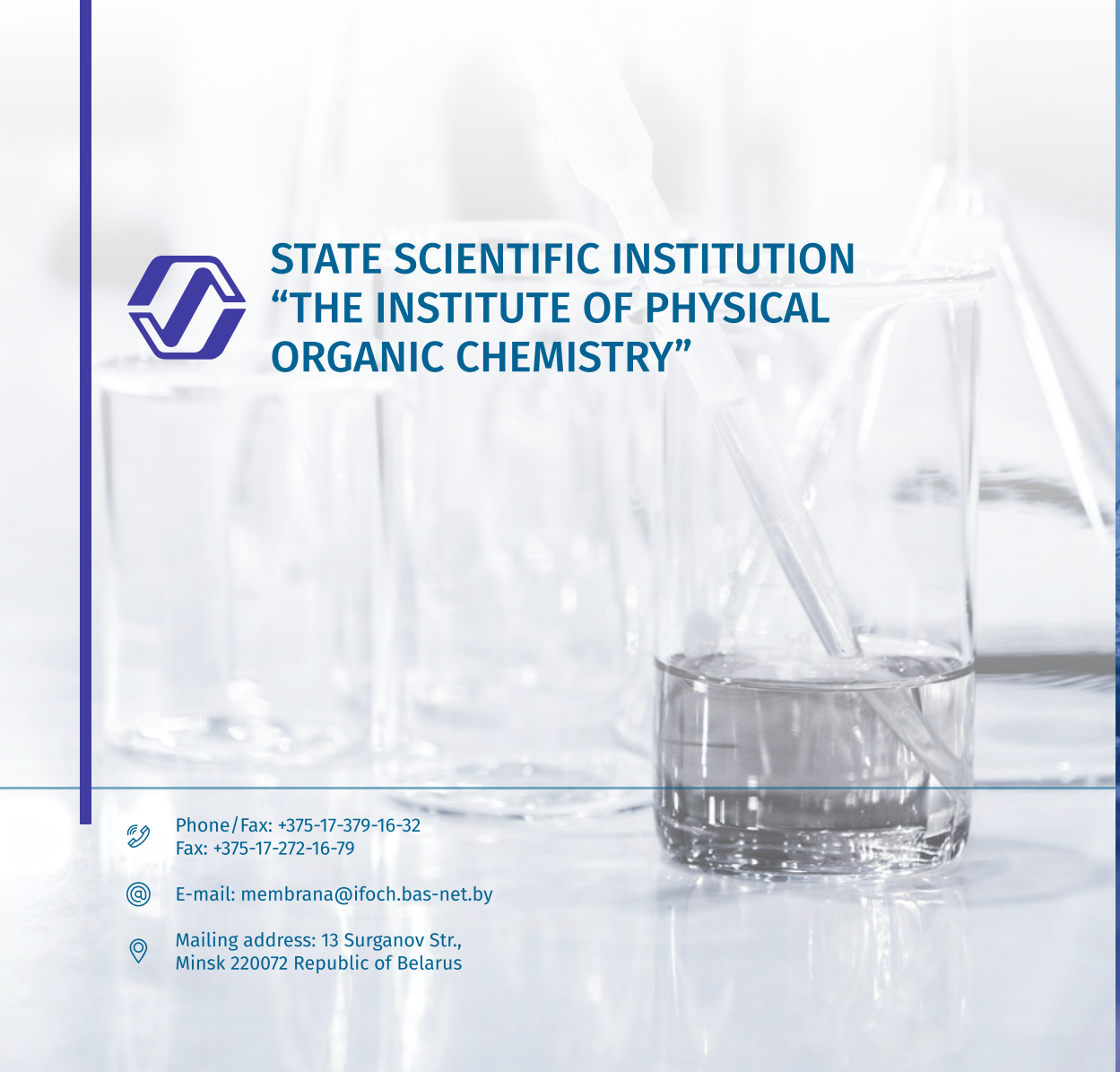

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MIFIL household water purification filter

Modifications:

- universal;
- water purification from radionuclides (^{238}U, ^{235}U, ^{90}Sr, ^{60}Co, ^{134}Cs, ^{137}Cs);
- water purification from heavy metals (Pb, Cu, Ni, Cd, Fe).

ADVANTAGES:

- high efficiency;
- simple operation, ease of use;
- extended service life of the replaceable filter cartridge;
- preservation of the sanitary necessary mineral composition of water;
- protection against salvo emissions;
- filter media disinfection system.

These advantages allow implementation of a fundamentally new approach to solving the problem of water purification from lead and other heavy metals.

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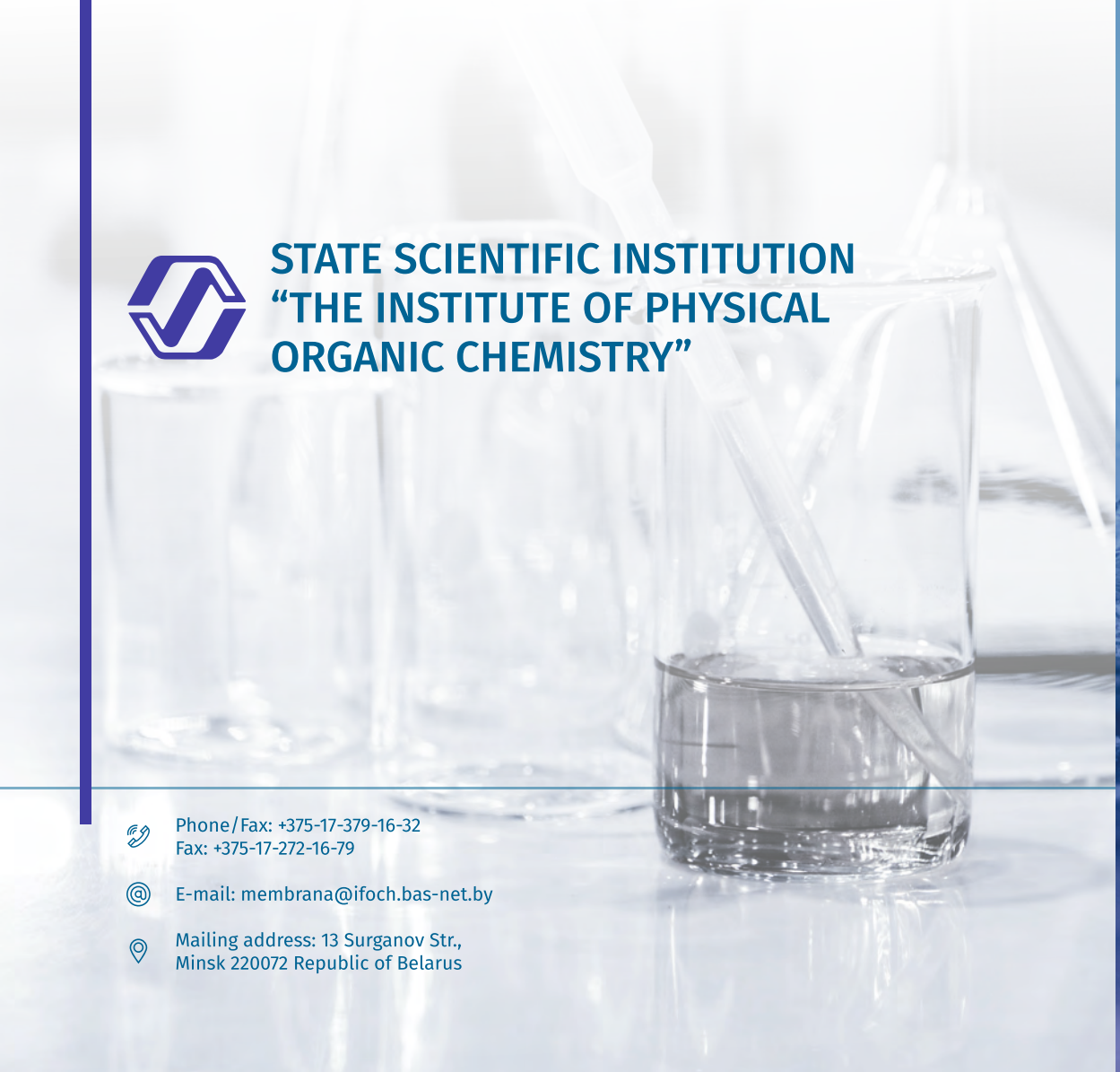

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Pilot membrane equipment for testing water purification technologies

Tangential-flow ultrafiltration

Nanofiltration, reverse osmosis

Dead-end flow ultrafiltration

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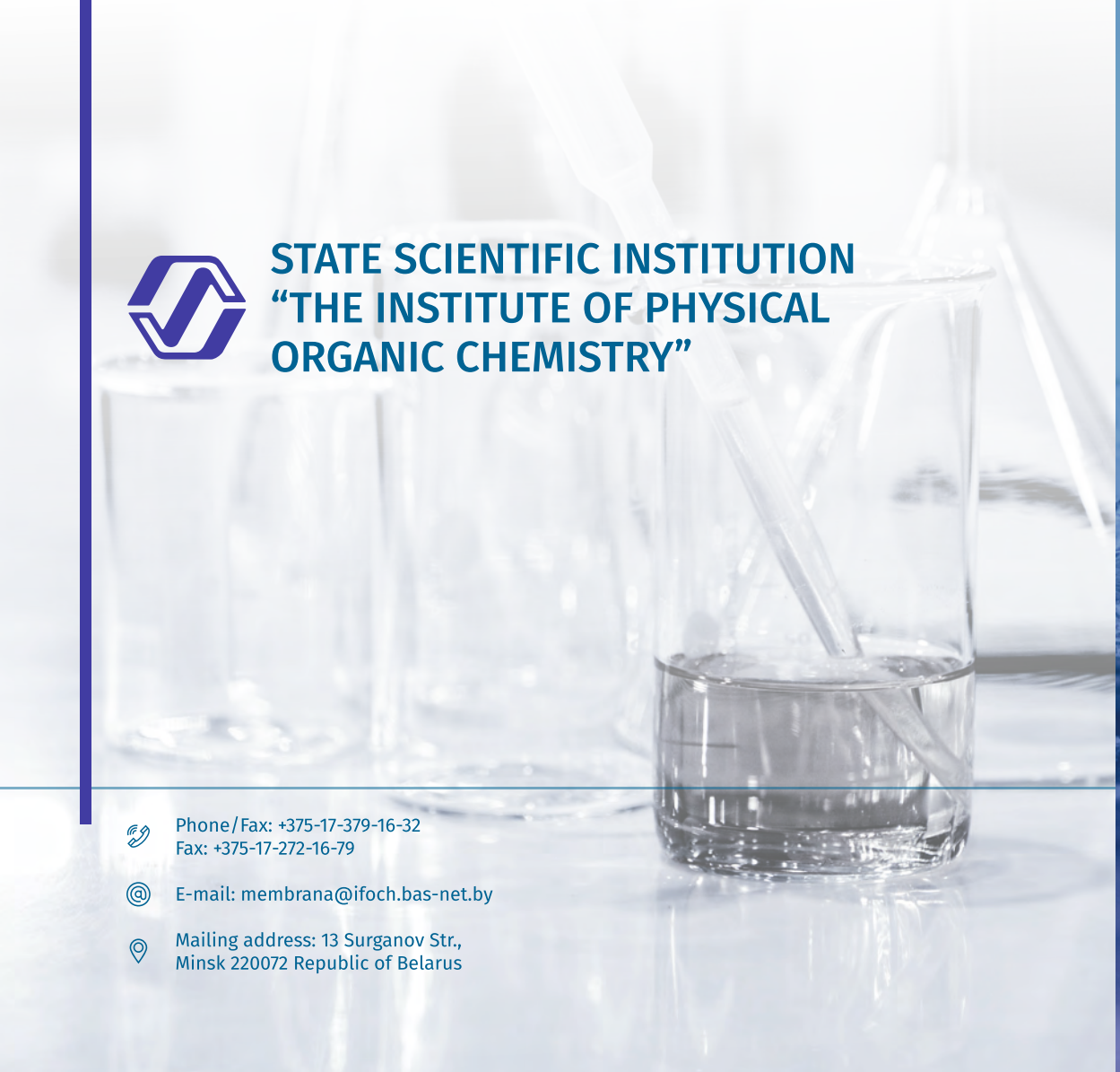

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Automated modular hollow fiber membrane unit

FIELDS OF APPLICATION:

- surface and artesian water purification;
- pretreatment of water prior to ion exchange and reverse osmosis;
- minimization of clarifier effluents;
- treatment of make-up water for cooling towers;
- condensate purification.

CUSTOMERS:

Osipovichi mini-CHP;

“Eastern” Mini-CHP, Vitebsk;

“Western” Boiler plant;

“Gomel Heating Networks” branch of RUE “Gomelenergo”;

Centre for Science and Technology (Saudi Arabia);

Xenan Constant MR Technology (China).

ADVANTAGES:

- high-quality purification;
- qualitiative indicators of the purification process are independent of seasonal fluctuation of water composition and temperature;
- reduce the need for coagulants by 10-20 times;
- reduced occupied area;
- reduced capital and operating costs.

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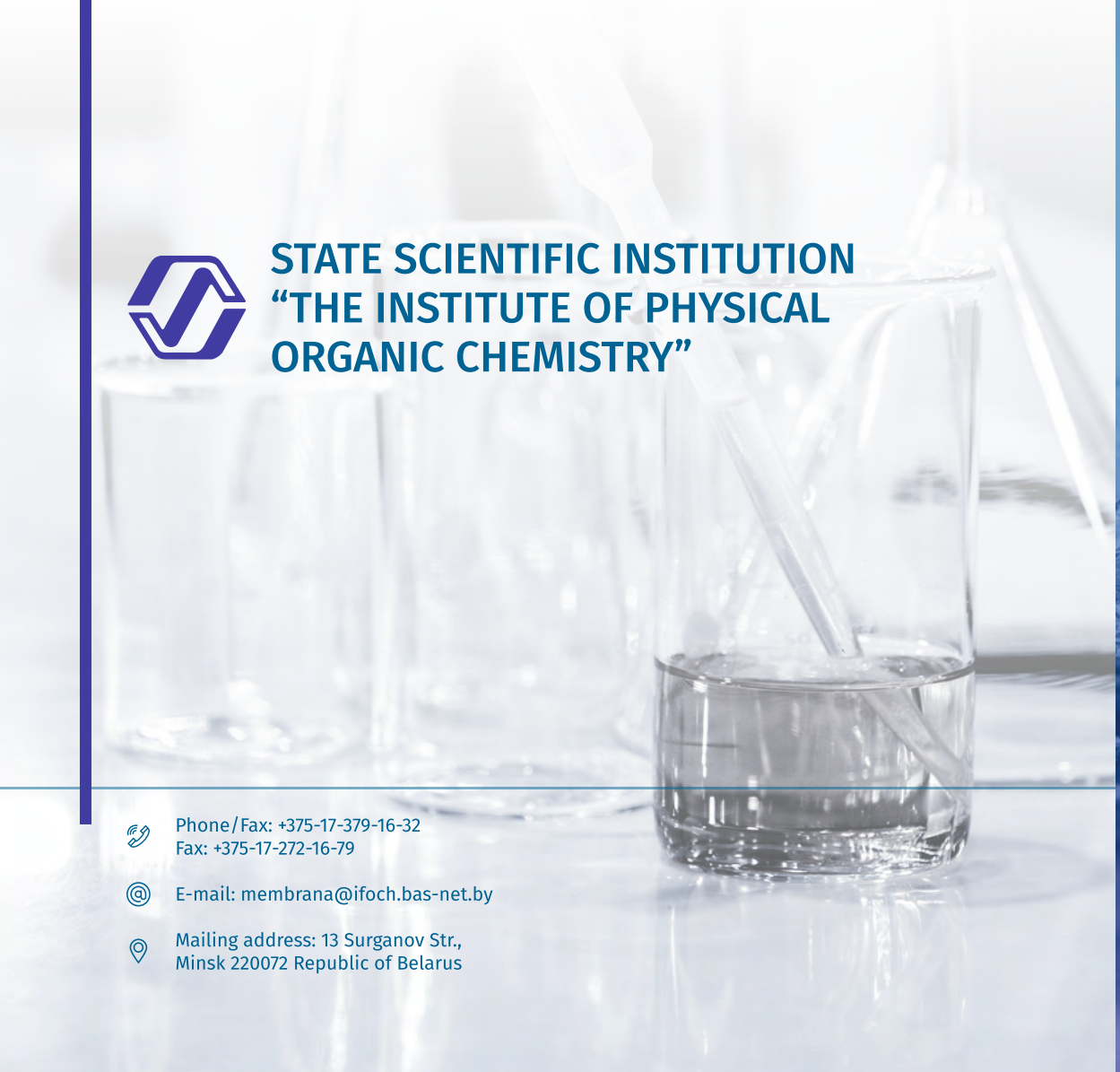

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Industrial plant for heavy metals removal from water

A unique water purification system for removal of lead and other heavy metals. It is based on chelating cation-exchange fiber (FIBAN X-1) in the form of standard cartridges.

It has been experimentally discovered that FIBAN X-1 fibers most efficiently absorb Pb^{2+} ions from multicomponent systems at concentration levels 2-10 MAC (20-100 μg/l).

ADVANTAGES:

- continous operation mode;
- high speed of adsorption and ion exchange;
- the possibility of using thin (2-6 cm) filter layers;
- high chemical resistance and regenerative capacity.

The estimated period between section regenerations is 60-65 hours at nominal capacity.

These advantages allow implementation of a fundamentally new approach to solving the problem of water purification from lead and other heavy metals.

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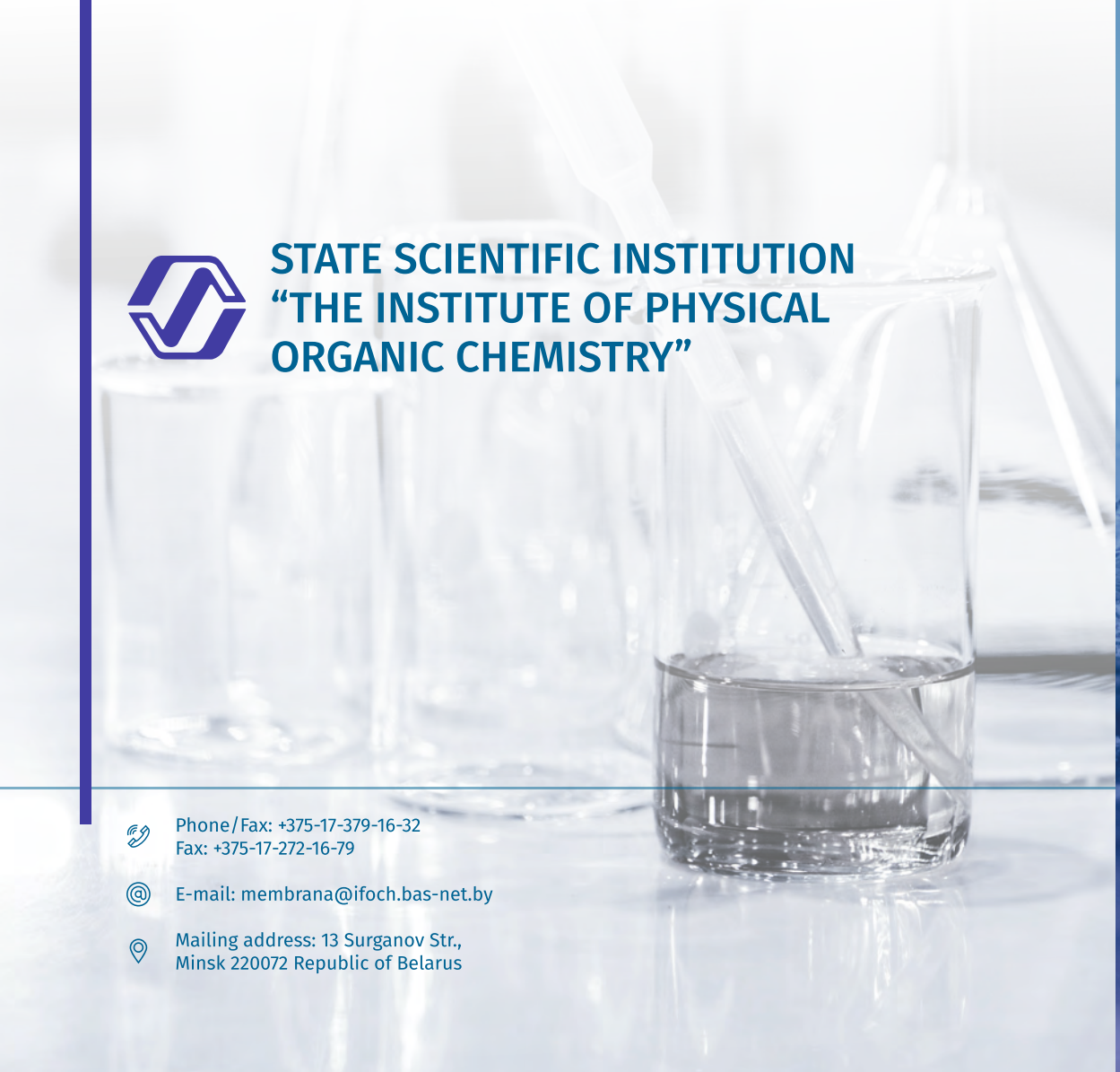

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Catalytic deaerator

Designed to remove the dissolved oxygen from water to protect pipelines and equipment from corrosion at energy, chemical, electronic, pharmaceutical, and food industry enterprises.

ADVANTAGES:

- high efficiency and performance due to the use of reactors based on fibrous Pd-loaded material;
- efficiency (reduced capital and energy costs);
- environmental friendliness (the only reaction product is water);
- water deaeration to the lowest possible residual oxygen values (1-20 μg/l).

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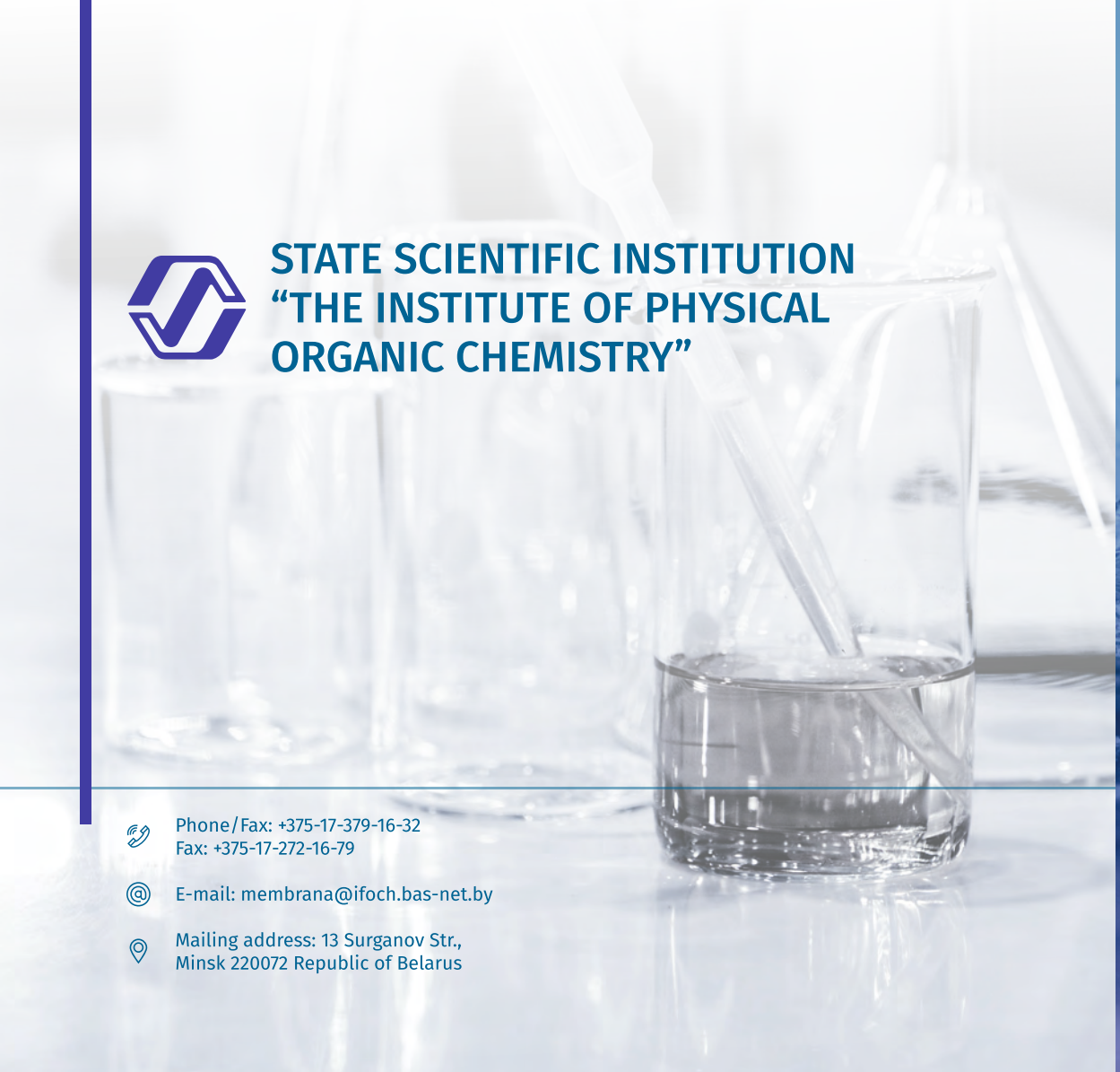

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Water purification unit for reverse osmosis equipment CIP cleaning

The equipment produces up to 5 m^3/hour
of high-quality water without chemical dosing.

TREATED WATER INDICATORS:

<0,05	Iron level, mg/l
<0,02	Manganese level, mg/l
<15,0	Silica (soluble), mg/l
0	Silica (colloidal), mg/l
<0,05	Aluminum, mg/l
<0,05	Organic substances (Kjeldahl method), mg/l
<1,0	Turbidity, mg/l
<1,5	Silt Density Index (SDI)

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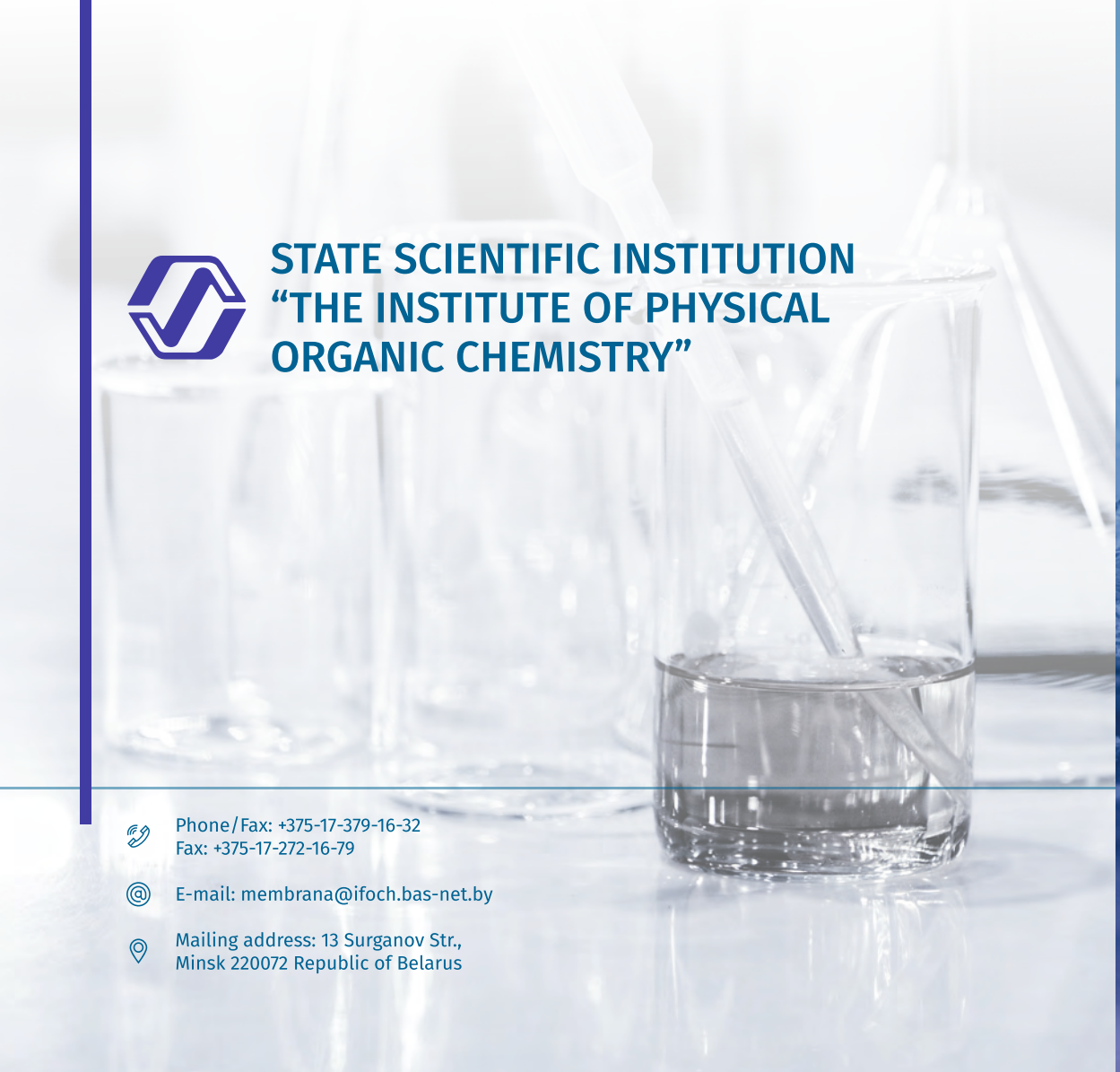

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Technology and equipment for the surface water nanofiltration

ADVANTAGES:

- no chemicals;
- lack of highly mineralized wastewater;
- qualitative indicators of the purification are independent of the seasonal fluctuation of surface water composition and temperature;
- reduced capital and operating costs.

Designed to purify the surface water from suspended solids and colloids, microorganisms, organic content, and partial removal of hardness salts using water treatment system in heat engineering.

The equipment can be used for the surface water purification to feed the district heating network. When combined with a sodium exchange as pretreatment the purified water complies with the quality requirements for steam boiler feedwater.

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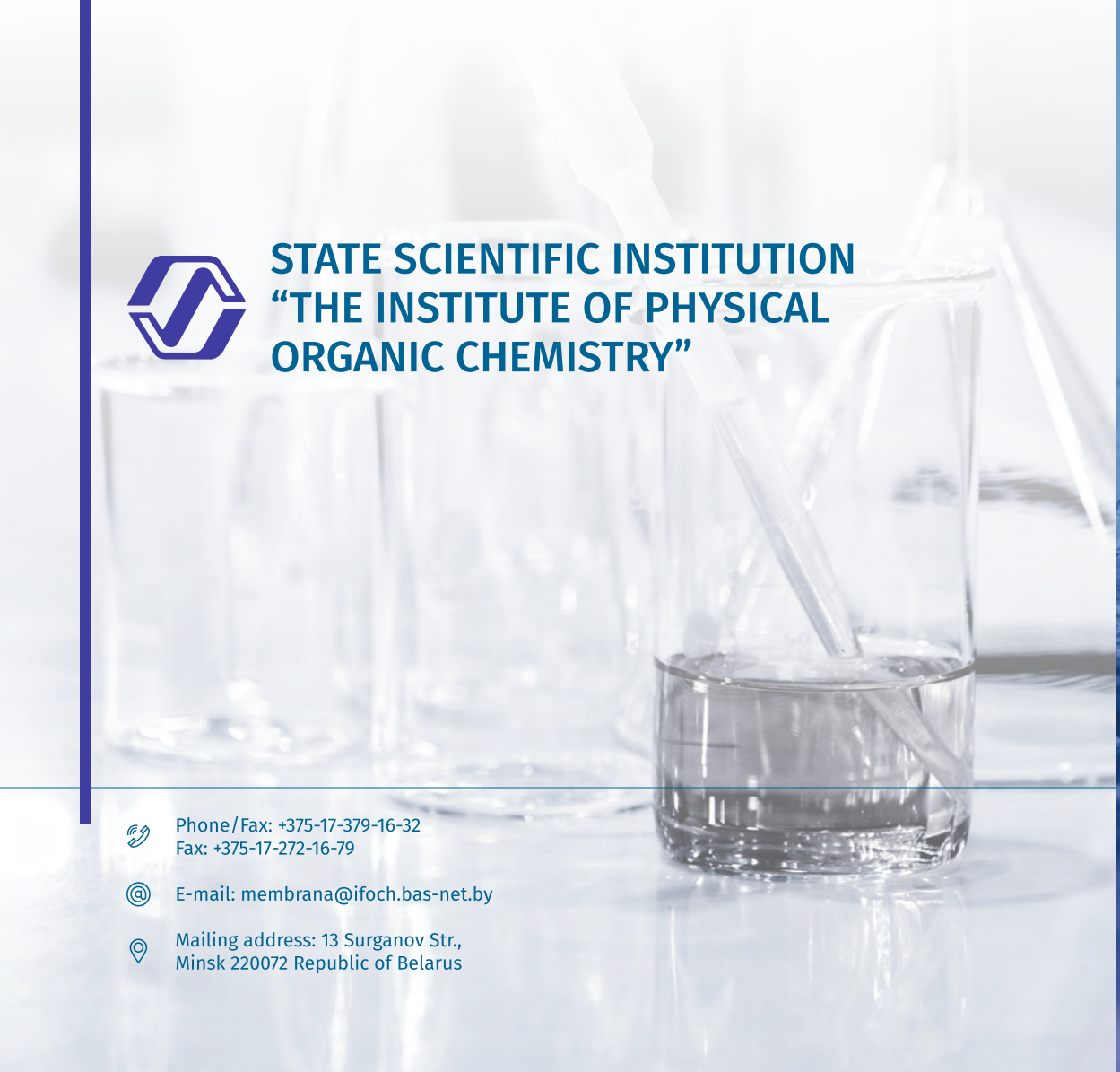

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Integrated membrane processes

Via the example of wastewater purification at pharmaceutical enterprises

FILTRATION

OZONE TREATMENT

ULTRAFILTRATION

NANOFILTRATION

SCIENTIFIC AND INNOVATIVE REPUBLICAN UNITARY ENTERPRISE “ELKERM”

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Minsk 220141 Republic of Belarus

GEOPROFIL standard modular station for complex drinking water purification

ADVANTAGES:

- higher purification quality;
- qualitative indicators of the purification are independent of seasonal fluctuations of water composition and temperature;
- reduced need for coagulants 10-20 times;
- reduced occupied space;
- reduced capital and operating costs.

APPLICATIONS:

- preparation of water from surface water and artesian sources;
- water pretreatment prior to ion exchange and reverse osmosis;
- minimization of clarifier effluents;
- treatment of make-up water for cooling towers;
- condensate treatment.

Automated modular membrane plant based on hollow fiber membranes

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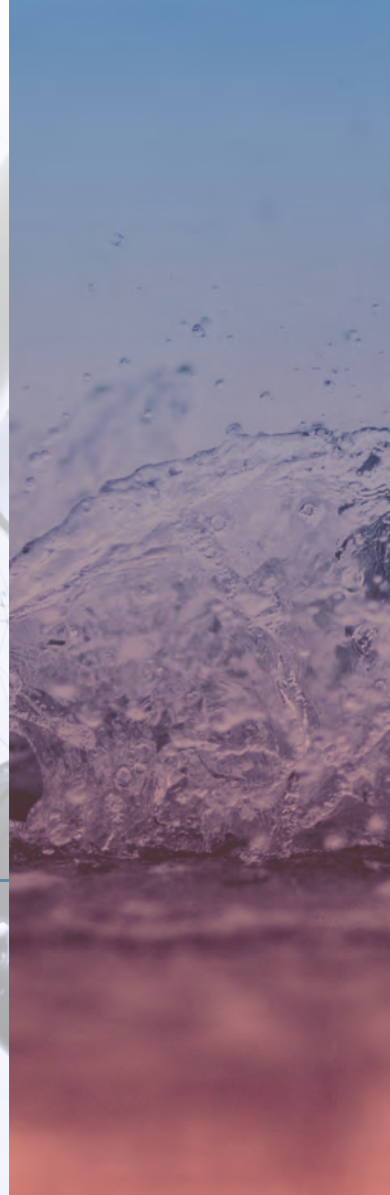

Porous titanium aerators

APPLICATIONS:

Fine dispersion of air, ozone, oxygen, carbon dioxide, and other process gases in liquids (bubbling of liquids) in contact chambers for ozonation of drinking water, in aeration tanks for biochemical wastewater treatment, flotation and oxytanks, etc.

ADVANTAGES:

- do not deteriorate under the influence of sunlight;
- pores and outer surface are not susceptible to microbial fouling due to the weak bactericidal effect of titanium ions similar to silver ions;
- can be regenerated by chemical solutions and heat treatment;

Automated modular membrane plant based on hollow fiber membranes

- the mechanical strength is much higher than polymer or ceramic aerators;
- reduced operating costs due to prolonged turnaround time;
- treatment of make-up water for cooling towers;
- condensate treatment.

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ANTOIL® microbial preparation

It is used to intensify the purification of municipal, agricultural, and industrial wastewater from fatty substances.

The preparation action is based on biodegradation of fatty substances by highly active strains of destructive microorganisms causing the formation of water and carbon dioxide.

ADVANTAGES:

- cleaning efficiency is 85-100%, depending on the concentration of fatty substances;
- the efficiency is not inferior to the foreign analog Microzyme™ Griz Treat (Russia), but is 16 times cheaper (based on the consumption of the preparation for treatment equal to 1 m^3/month).

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ANTOIL®+ Bioactivator

It is used for municipal wastewater treatment in biological treatment plants of any type.

ADVANTAGES:

- effective to activate the biocenosis in autonomous sewage systems;
- accelerates the restarting processes after the conservation of treatment facilities;
- quickly restores the biocenosis of activated sludge after the inflow of highly toxic effluents containing high concentrations of surface-active substances;
- removes and neutralizes odors at wastewater treatment plants;
- effluent treatment efficiency is 75-98%;
- the efficiency is not inferior to foreign analogues Microzyme™ Septi Treat and Unibacuniversal (Russia), but is 5 times cheaper.

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BIOVIR complex biopreparation

It is used for the disinfection and treatment of water in ponds and reservoirs from organic and mineral contaminants.

ADVANTAGES:

- reduces the content of mineral phosphorus, nitrate and ammonium nitrogen in ponds and water reservoirs by 2,3 times, the number of blue-green algae - 2 times, organic matter - 2,0-2,4 times in comparison with the permissible COD and BOD values for ponds pollution;
- prevents bacterial fish diseases;
- the efficiency corresponds to the world's best similar products, but is 5 times cheaper.

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FenoForm microbial preparation

It is used for the treatment of wastewater and absorption solutions from phenol and formaldehyde.

The preparation action is based on trapping of harmful pollutants by process water and subsequent regeneration of the resulting solution by microorganisms-destructors.

ADVANTAGES:

- helps to reduce the anthropogenic load on the environment;
- the efficiency of treatment from phenol is 80-99%, from formaldehyde - 75-99%.

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DEAMMON microbial preparation

It is used to intensify the treatment of municipal and agricultural wastewater from ammonia nitrogen.

ADVANTAGES:

- provides the intensification of municipal wastewater treatment from ammonium nitrogen by 80-87% for at least 6 months;
- increases the efficiency of wastewater treatment plants;
- increases the oxidative potential of the activated sludge;
- reduces the energy consumption for aeration;
- contributes to the reduction of anthropogenic load on natural water reservoirs;
- the preparation efficiency is not inferior to the foreign analogue MicrozymeTM Deiri Treat (Russia), but is 40 times cheaper (based on the consumption of 1 m^3/month for purification).

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RODOBEL-TN biosorbent

It is used for the wastewater treatment from oil and oil products. The biosorbent action is based on the decomposition of oil hydrocarbons by a consortium of microorganisms-destructors immobilized on peat.

ADVANTAGES:

- the efficiency of wastewater treatment is 97-99% when the pollution is up to 0,5%;
- the efficiency is not inferior to the foreign analogues Econadin (Ukraine) and Naftoks (Russia), but is 5 times cheaper.

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Teamin® microbial preparation

It is used for the treatment of wastewater and absorption solutions from trimethylamine, triethylamine, and dimethylethylamine.

ADVANTAGES:

- the purification efficiency is 95-100%;
- provides the complete regeneration of absorption solutions and excludes the release of toxicants from them causing improvement of operating conditions in the working area of enterprises and decrease of emissions into the atmosphere;
- reduces service costs of biological treatment facilities, reduces the cost of aeration by at least 4 times.

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CBO-intens microbial preparation

It is used for the wastewater treatment at woodworking and pulp and paper enterprises, helps to reduce the anthropogenic load on natural water reservoirs.

ADVANTAGES:

- the efficiency of wastewater treatment in terms of COD is 97-99% and 71-92% when the preparation is used as a biofuel or as an activator of the sludge mixture, respectively;
- allows to achieve stability in the operation of biological purification systems, including at shock loads and high concentrations of toxicants entering the treatment facilities;
- the efficiency is not inferior to the foreign analogue Biozim B570 (Great Britain), but is 4 times cheaper.

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FROM DEVELOPMENT TO TURNKEY IMPLEMENTATION

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