

NPO PASSAT

Mineral Processing
Equipment

Made in Belarus



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04 REFERENCE LIST

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ABOUT THE COMPANY

Research and Production Association "Passat" (holding "PASSAT") specializes in the production of chemical processing equipment, including the implementation of turnkey projects with research, design, manufacture, automation, commissioning and bringing equipment to technological indicators.

- ▶ Location: Republic of Belarus
- ▶ Year of foundation: 2008
- ▶ Staff: 250 employees (2500 in the PASSAT Holding)
- ▶ Production capacity: more than 2500 tons of equipment per year

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THE COMPANY'S MAIN PRODUCT IS THE EQUIPMENT FOR HALURGICAL AND FLOTATION MINERALS PROCESSING.

The company's developments are carried out in its own design department. Design solutions in the field of mineral processing are developed by the chemical and technological department, the automation service designs, manufactures and creates software for process automation. Based on many years of experience in the potash industry, the company offers its technological competencies to provide engineering and consulting services in the design and commissioning of potash processing plants.



The company has a full mechanical-engineering cycle for the manufacture of processing equipment. NPO Passat performs machining and welding of carbon, low and high alloy steels, nickel and titanium alloys by all arc welding methods (MMA, MIG/MAG, TIG, SAW).

The quality management system is certified for compliance with STB ISO 9001-2015 and ISO 9001:2015 standards. The labor protection management system is certified for compliance with STB 45001-2020. Welding production is certified in accordance with international standards DIN EN ISO 3834-2 and EN 1090-2 and for compliance with STB 2349-2013 in the National Conformity Assessment System. Welding technologies are certified in accordance with the requirements of STB ISO 15614-1, STB ISO 15614-5, and DIN EN ISO 15614-1:2017+A1:2019. Coordination of welding works is performed by a specialist of the 4th level of competence in accordance with STB 1063, as well as a qualified International Welding Engineer. The environmental management system is certified for compliance with ISO 14001:2015.





EQUIPMENT FOR PROCESSING PLANTS



Products

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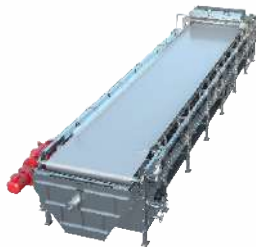
Flotation
Machines



Thickeners /
Hydroseparators



Belt Vacuum
Filters



Vacuum Crystallizers



Process Vessels
for KCl Dilution



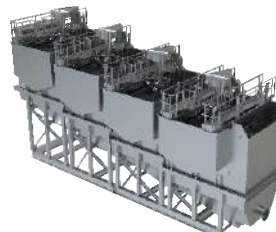
Machines
with Agitator



Reagent Preparation
Equipment



Foam Separation
Machines Deep
Impeller



Shell-and-tube
Heat-exchange
Apparatuses



Horizontal
Agitators



FLOTATION MACHINES

NPO Passat manufactures mechanical and ejector flotation machines used in the process of ore beneficiation at the stage of main, control, cleaning flotation.

Advantages of NPO Passat ejector flotation machines:

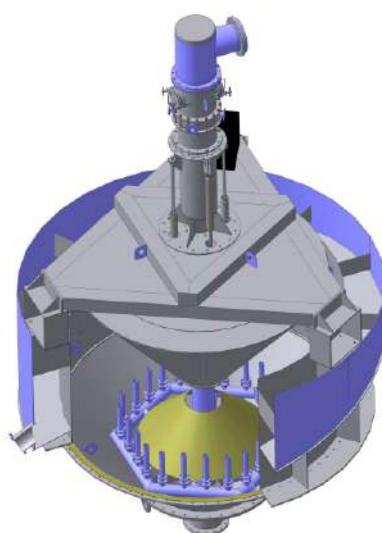
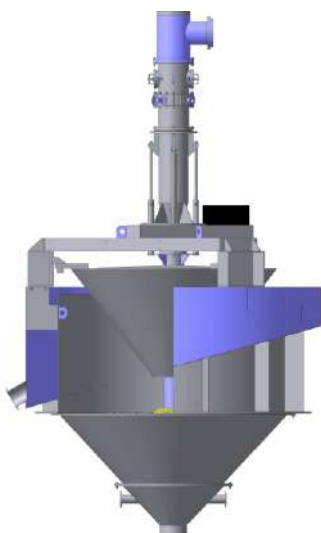
1. Possibility of application in flotation operations on products of a wide range of fineness;
2. High efficiency of technological operations due to:
 - ▼ high pulp aeration;
 - ▼ adjustable degree of pulp aeration;
 - ▼ adjustable air bubble size from 5 to 1000 microns;
 - ▼ high degree of dispersion of air bubbles in the pulp volume;
 - ▼ automatic maintenance of the level of the foam layer.
3. Low operating costs compared to conventional mechanical flotation cells:
 - ▼ absence of moving parts in the machine, and as a result, low power consumption;
 - ▼ the use of non-metallic structural elements allows to increase the service life of the equipment;
 - ▼ no need to use air injection units (compressors, blowers).

Ejector flotation machines are supplied as a set:

- ▼ deaeration vessel;
- ▼ pump unit;
- ▼ elevator;
- ▼ software;
- ▼ sensors and devices;
- ▼ control panel.

Optionally we supply:

- ▼ froth bed control system;
- ▼ process pipelines for piping the flotation section;
- ▼ technological metal structures for equipment installation;
- ▼ stations for the reagents preparation and dosing;
- ▼ execution in structural and stainless steel, with lining or coating with protective compositions.







RADIAL THICKENER / HYDRO SEPARATORS

Radial thickeners are designed for thickening, dehydration, hydroclassification, desliming and clarification in the mining and chemical industries. NPO Passat mass-produces radial thickeners with a diameter of up to 30 meters. We also manufacture custom-made thickeners of larger sizes.

68 radial thickeners produced by NPO Passat are currently operating at mining and processing plants. Thickeners are available in both carbon steel and stainless steel, including super duplex, non-ferrous, clad and titanium.

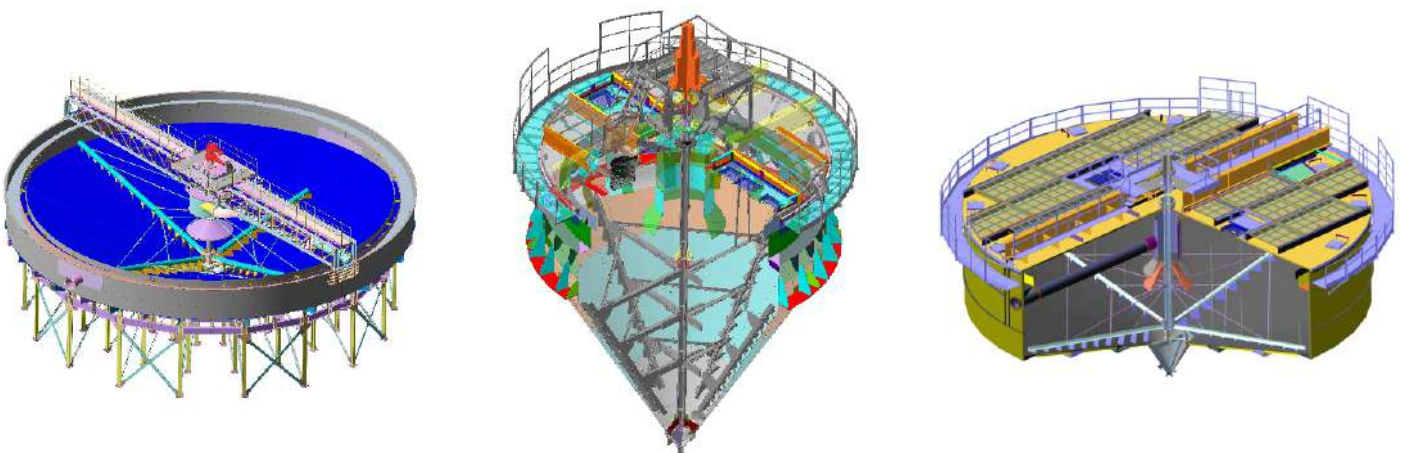
Optional thickeners are equipped with:

- ▼ foam removal system;
- ▼ deaerator;
- ▼ occulant preparation and dosing device;
- ▼ rake lifting system;
- ▼ a set of pumping equipment, instruments, sensors and shut-off and control valves;
- ▼ automation system of own production on a component base at the request of the Customer with integration into the process control system of the enterprise.

The thickener control system is designed to control the process of cleaning saturated salt solutions returned to the process for further use, and consists of:

- ▼ electromagnetic systems for measuring the consumption of the initial feed, flocculant, unloading, located on the pipelines of these products;
- ▼ probes for the upper and lower levels of thickened sludge located in the thickener, with computing devices located locally;
- ▼ inductive sensor located on the stirrer motor;
- ▼ thermistors built into the electric motors of the stirrer and pump drives;
- ▼ servo pneumatic drives aggregated respectively with ball valves;
- ▼ sound emitters, lamps;
- ▼ control cabinet.

NPO Passat offers testing and laboratory tests by its own chemical and technological department to determine the optimal parameters of the thickener, the technological process, and also provides installation supervision, starting-up and bringing the equipment to technological parameters.





LAMELLA THICKENER

Lamella thickeners are designed for thickening, dehydration, hydroclassification, desliming and clarification in the mining and chemical industries. The thickener is a device with plate packs installed in the body, which significantly increase the deposition area and thickener performance.

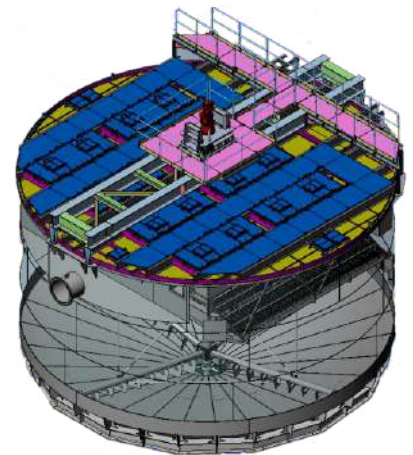
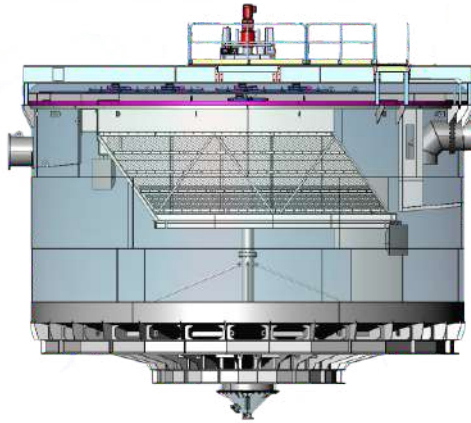
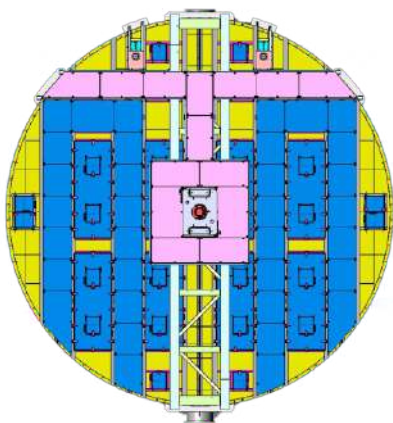
NPO Passat lamellar thickeners are used in technological processes:

- ▼ clarification of recycled liquor;
- ▼ thickening of tailings;
- ▼ thickening of crystals;
- ▼ sludge thickening (flotation);
- ▼ sludge thickening (halurgy, 100 °C);
- ▼ hydroseparation, etc.

Advantages of lamella thickeners:

- ▼ high productivity (2-3 times higher than the radial thickener);
- ▼ minimized investment costs due to smaller footprint, reduction of construction and installation works;
- ▼ reduction of operating costs, reduction of the park of pumps, pipelines, shut-off and control valves and the cost of their maintenance;
- ▼ possibility of thermal insulation of the entire thickener, including mirrors;
- ▼ reduction of energy consumption of the technological process;
- ▼ wide range of productivity for the initial pulp 20-6000 m/h;
- ▼ low flocculant consumption;
- ▼ high content of solids in the unloaded product up to 55% solid phase;
- ▼ drain purity up to 50 mg/l.

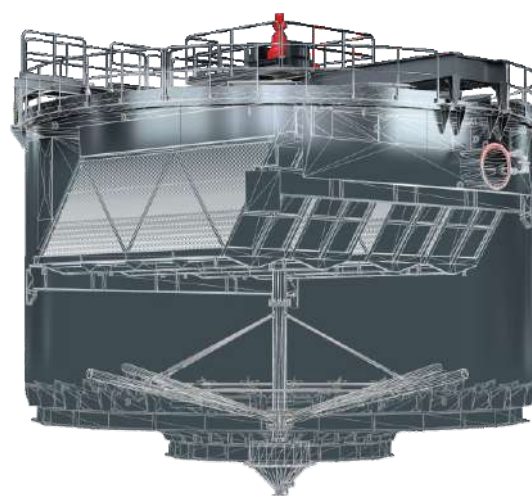
Thickeners are available in both carbon steel and stainless steel, including super duplex, non-ferrous, clad and titanium.



Optional thickeners are equipped with:

- ▼ foam removal system;
- ▼ deaerator;
- ▼ flocculant preparation and dosing device;
- ▼ rake lifting system;
- ▼ a set of pumping equipment, instruments, sensors and shut-off and control valves;
- ▼ system of automation of own production on a component base at the request of the Customer with integration into the enterprise process control system.

NPO Passat offers laboratory and pilot tests by its own chemical and technological department to determine the optimal parameters of the thickener, the process. It also provides installation supervision, start-up and bringing the equipment to the technological parameters. Own pilot plant of the lamella thickener is available for full-scale testing of the parameters of the lamella thickener in the chemical production of the Customer.







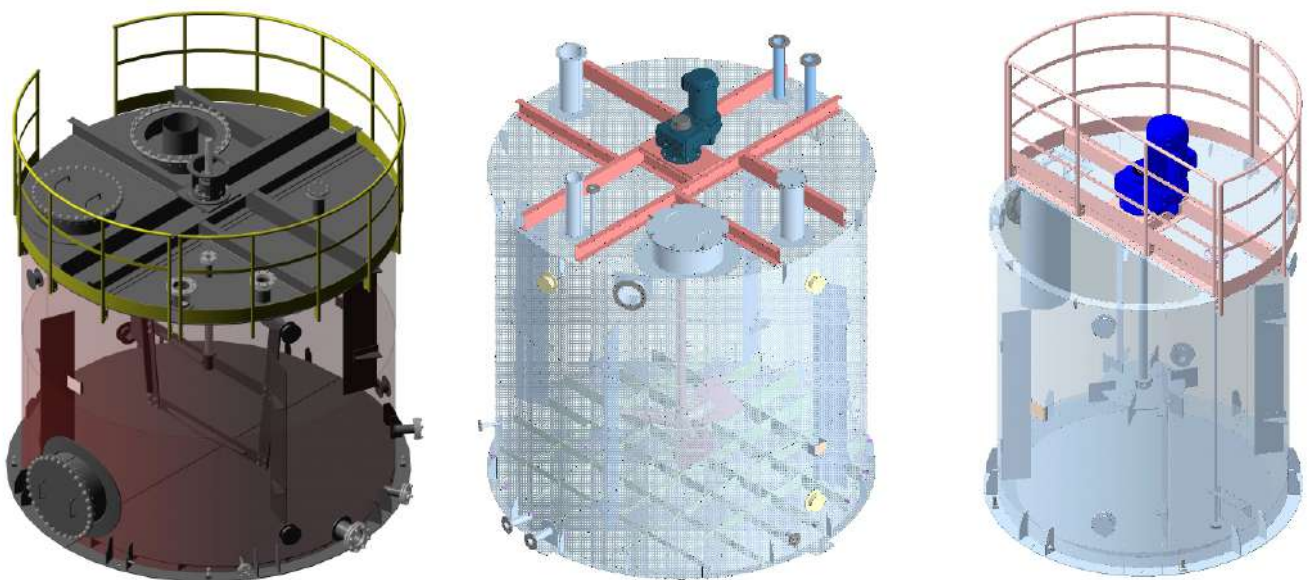
APPARATUS WITH AGITATOR

Apparatuses with agitators are used in the mining and processing chemical industries for:

- ▼ pulp conditioning with reagents;
- ▼ preparation of a reagents solution;
- ▼ carrying out of leaching and dissolution processes.

Depending on the requirements for the device (appointment, operation time), its volume and overall dimensions are calculated. If necessary, the devices are equipped with heating devices of various types, an automation system, sensors and devices. Available in carbon steel, stainless steel, non-ferrous alloys and titanium.

The type of mixing device is selected depending on the properties of the mixed components (density, viscosity, surface tension, fineness, concentration, etc.). These can be low-speed (frame, anchor, paddle) or high-speed mixers (turbine, propeller) and others.



REAGENT PREPARATION EQUIPMENT

NPO Passat develops, manufactures and supplies equipment for reagent departments. These are complex deliveries of lines for the preparation of reagents for the Usolsky Potash Plant (EuroChem) and Petrikovsky Mining and Processing Plant (Belaruskali). For some types of reagents, new preparation technologies have been developed that make it possible to use the mother liquor as a solvent instead of technical water, as well as to prepare an emulsion with a certain dispersion of the collector and modifying additives, which can increase the flotation selectivity. For the preparation of solutions of high-molecular reagents, special equipment is used. It allows obtaining solutions with a uniform concentration in the volume of the apparatus. NPO Passat develops complex lines, including not only apparatuses with agitators, but also other special equipment (gelatinizing pumps, steam injectors, etc.), which makes it possible to obtain high-quality reagents and accurately maintain the concentration of working solutions. This approach reduces the introduction of excess water into the process.

Apparatus for preparation of reagent solutions provide:

- ▼ high-quality preparation of a solution or an emulsion of a reagent;
- ▼ minimum preparation time for a solution or emulsion of a reagent;
- ▼ minimum power consumption.

If necessary, heating of the contents of the container is provided. It can be electric heating, supply of live steam to the apparatus, steam jacket. The preparation of reagent solutions is carried out according to a given program from the operator panel without the presence of technological personnel on site.

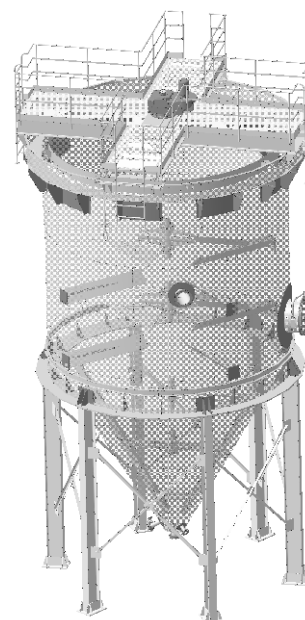
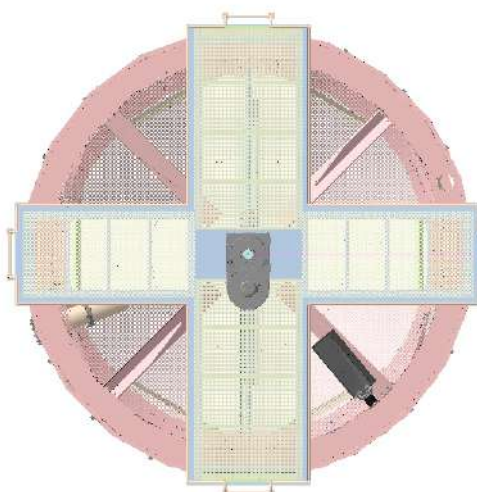
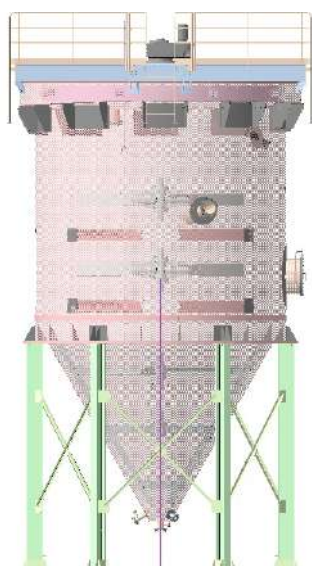


PROCESS VESSELS FOR KCL DILUTION

Apparatuses are designed for dissolution of KCl in sludge from unloading sludge thickeners with brine until it is saturated at operating temperature and clarifies the drain (mother liquor). KCl dilution is used to work with potash ores. The resulting component is used in the production of potash fertilizers. The dilution of KCl occurs in cylindrical apparatus with a cone-shaped bottom. The units are equipped with special agitators to improve the interaction between the leached raw material and the solvent lye.

The equipment package includes:

- ▼ pump;
- ▼ apparatus for mixing;
- ▼ reliable shut-off and control valves;
- ▼ equipment control system and process automation system.



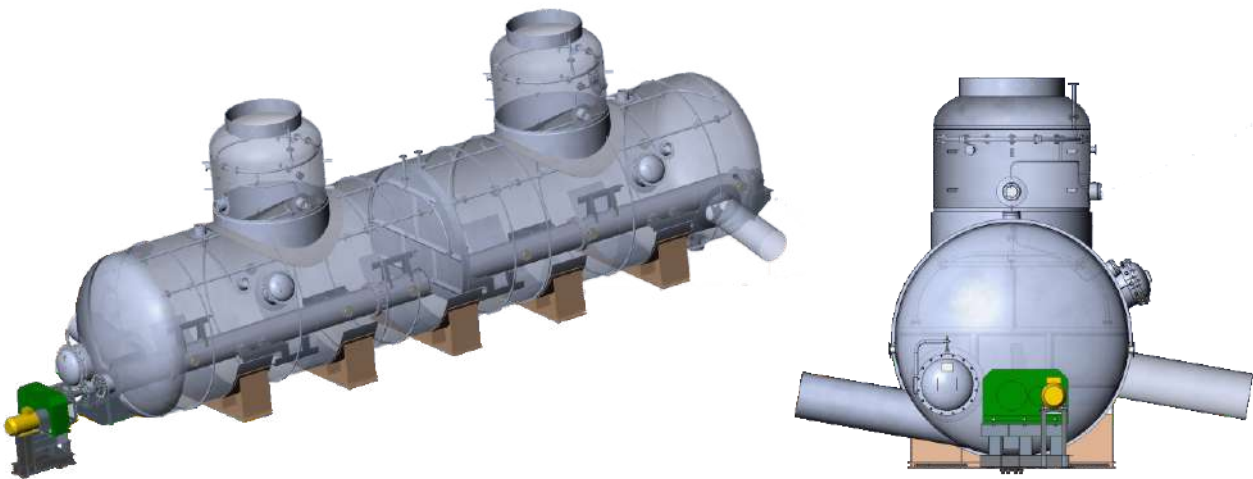
VACUUM CRYSTALLIZERS

Horizontal vacuum crystallizer is designed to produce potassium chloride by crystallization from hot saturated lye. When boiling under vacuum, water evaporates and the concentrated solution cools, which leads to the formation of salt crystals and a decrease of the the KCL content in the lye.

For efficient and long-term operation, the crystallizers of NPO Passat are equipped with:

- ▼ dry steamers to prevent droplet entrainment;
- ▼ bubblers to prevent overgrowth of the hull with salt deposits;
- ▼ a high-performance agitator located inside the body for homogeneous mixing of the pulp.

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BELT VACUUM FILTERS

NPO Passat serially produces belt vacuum filters with a filtration area of up to 35 square meters. We also manufacture custom-made belt vacuum filters with a larger filtration area.

PRODUCED STRUCTURES OF BELT VACUUM FILTERS

Vacuum chamber:

- ▼ dry by using belts;
- ▼ dry, not using belts;
- ▼ with liquid phase supply for sliding.

Belt support structure:

- ▼ table with sliding plates;
- ▼ roller table.

Feeding device:

- ▼ with 2 loading points;
- ▼ with 1 loading point;
- ▼ fishtail type.

Belt tension device:

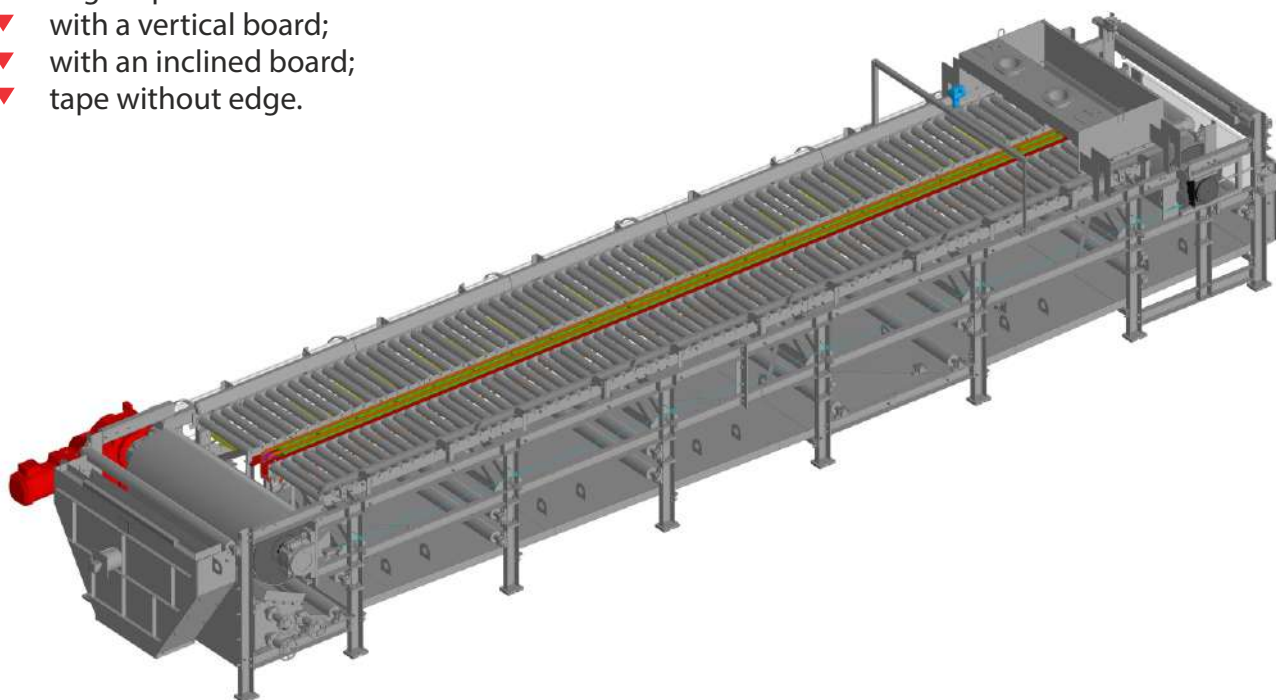
- ▼ special housing with tension screw;
- ▼ SKF body with skids.

Filter cloth tensioner:

- ▼ in the form of a weighted roller;
- ▼ device for tensioning the filter cloth with weights.

Drainage Tape:

- ▼ with a vertical board;
- ▼ with an inclined board;
- ▼ tape without edge.



By virtue of the full automation of the filtration process, belt vacuum filters ensure the uninterrupted operation of filtration departments with the maintenance of the required technological indicators in automatic mode, with no participation of maintenance personnel.

The applied automation tools provide:

- ▼ stability of the cake layer height on the filter by changing the speed of the belt;
- ▼ long service life of the fabric drift sensor and the Belt drift sensor, because non-contact type sensors are used and there is no mechanical contact of the sensor with the belt and fabric;
- ▼ protection of the pipeline, vacuum manifold and auxiliary equipment from high vacuum;
- ▼ control of "plugging" of the receiver, which ensures uninterrupted operation of the vacuum filter.

Optional filters are equipped with:

- ▼ vacuum pump;
- ▼ collectors and vacuum system;
- ▼ receiver and drop catcher;
- ▼ technological structures for installation;
- ▼ sludge washing device;
- ▼ cake steaming system;
- ▼ all necessary service platforms.

At the moment, more than 20 vacuum belt vacuum filters from NPO Passat are used in the mining industry of the Republic of Belarus and the Russian Federation.

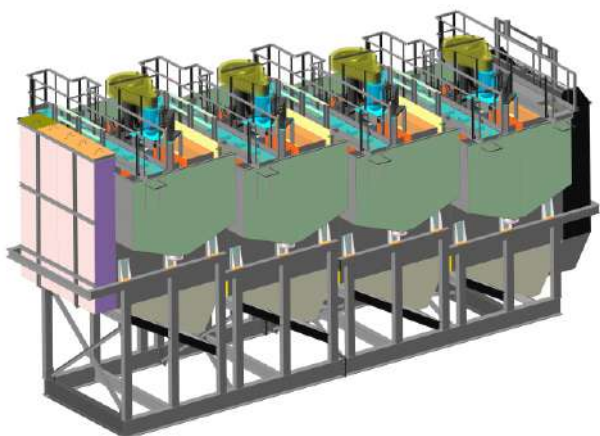


FOAM SEPARATION MACHINES

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Deep impeller foam separation machine is used in the process of sludge flotation to de-sludge the discharge of hydraulic separators in the production of potash fertilizers. Foam separation machine is a column machine divided into four chambers, each with a volume of 38 m³.

In each chamber there is a block-impeller equipped with an electric drive, into which compressed air is supplied. The slurry flotation process produces a froth product which is removed through a downcomer trough. The height of the froth bed in the chamber is measured by a pressure sensor and is automatically adjusted by the gate valve. The desludged product is a chamber product, which is discharged through the gate and enters further into the process. Foam separation machines are equipped with instrumentation and automated. This provides operation in automatic or manual modes. The instrumentation and control system is controlled by a programmable controller that provides start-up and control of the technological process, process visualization, archiving of information, and its inclusion to the process control system. Thanks to the almost complete automation of the sludge flotation process, high technological indicators are achieved, reducing the loss of a useful component with sludge.





SHELL-AND-TUBE HEAT-EXCHANGE APPARATUSES

24

Shell and tube heat exchangers are the most common among tubular heat exchangers. With a relative simplicity of design, they have a fairly large specific heat transfer surface. They are used as:

- ▼ evaporators;
- ▼ capacitors;
- ▼ heaters;
- ▼ refrigerators.

In shell-and-tube heat exchangers, one of the heat carriers moves through the tube space, the other moves through the annular space.

It is necessary to direct the coolant into the pipe space:

- ▼ more polluting the heat exchange surface;
- ▼ having a high corrosiveness;
- ▼ having a very high (low) temperature;
- ▼ having a lower heat transfer coefficient (with the equivalence of the indicators for the previous paragraphs).

Execution of shell-and-tube heat exchangers:

- ▼ with fixed fastening of tubes in tube sheets;
- ▼ with lens compensators on the casing;
- ▼ with U-shaped pipes;
- ▼ with floating head.

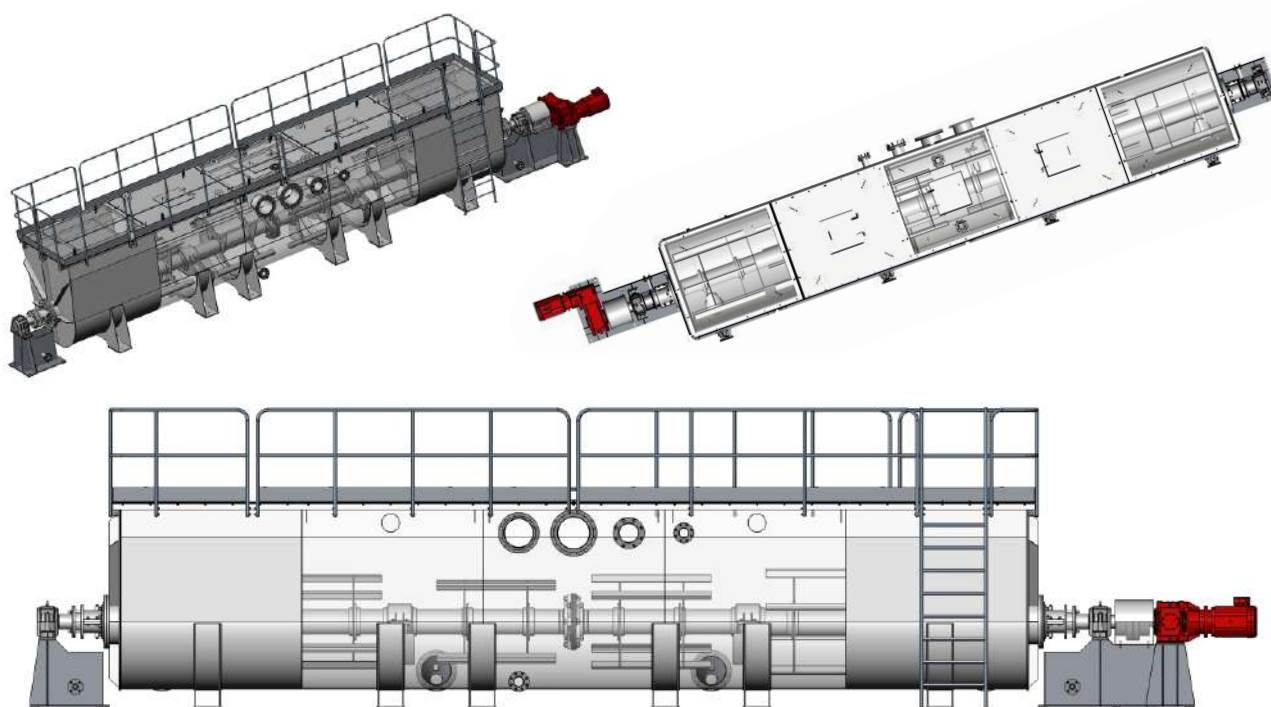


HORIZONTAL MIXERS

Horizontal mixers are designed for receiving, mixing and transporting thickened suspensions. NPO Passat develops and manufactures horizontal agitators for operation in various environments, including aggressive and highly aggressive ones. Horizontal agitators produced by NPO Passat ensure uniform distribution of the suspension supplied to the middle part, its further distribution, soft maintenance of the entire volume of solid particles in suspension.

They are equipped with various types of mixing devices. The type of devices is selected depending on the properties of the mixed components (density, viscosity, surface tension, particle size, solid concentration, etc.). The mixing device is driven by a geared motor. Horizontal agitators are equipped with a drive and a control system.

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PROJECTS FOR INTEGRATED SUPPLY OF EQUIPMENT FOR TECHNOLOGICAL COMPLEXES

Along with the production of individual equipment, NPO Passat implements complex turnkey projects for the supply of technological lines of processing plants. Together with the companies of the PASSAT Holding, we offer EPC solutions for processing enterprises, as well as engineering services in the field of technological audit and adjustment of the enrichment process.



CONSTRUCTION OF VACUUM CRYSTALLIZATION INSTALLATION FOR CRYSTALLIZATION OF POTASSIUM CHLORIDE FOR BELARUSKALI, JSC

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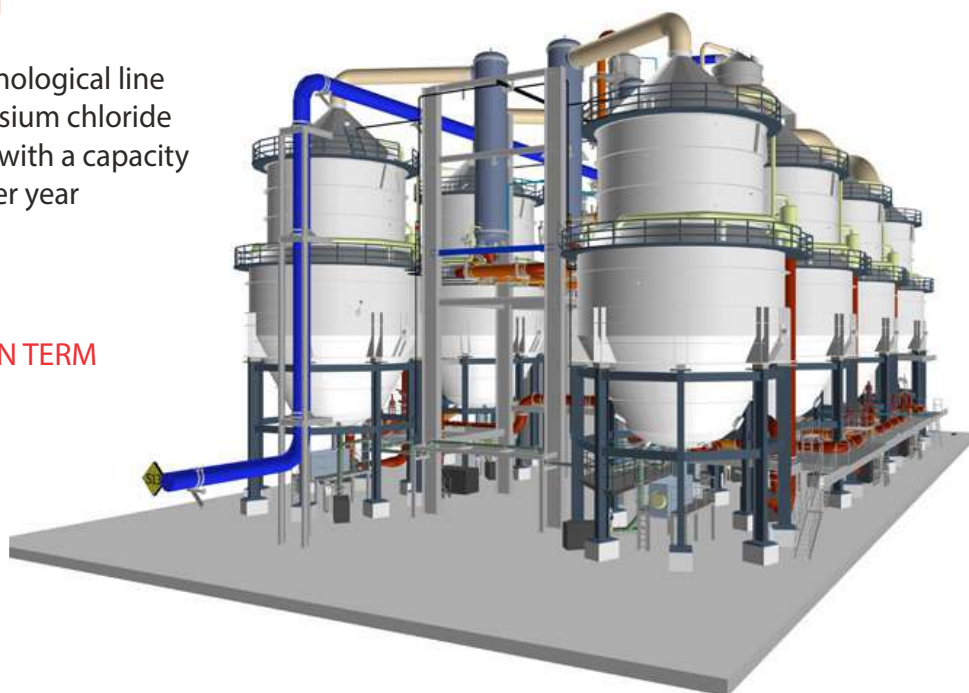


PURPOSE OF THE PROJECT

construction of a new technological line for the production of potassium chloride large-crystalline halurgical with a capacity of at least 1,500,000 tons per year

PROJECT IMPLEMENTATION TERM

is 20 months



PRODUCTION METHOD

vacuum crystallization of potassium chloride from hot saturated liquors. The chosen process for obtaining coarse-grained potassium chloride consists in stepwise evaporation of liquor under vacuum in a plant consisting of seven evaporators. For the maximum energy efficiency, the plant provides for the recovery of thermal energy during cooling of mother liquor by means of titanium surface heat exchangers and mixing condensers. To reduce foaming, the unit is equipped with an automatic system for the preparation and dosing of antifoam agent.

Finished product is a coarse-grained potassium chloride, chemical formula KCL, average size of intergrowths of rounded crystals $d_{cp} = 0.6-0.8$ mm. It is planned to produce large-crystalline potassium chloride with a useful component content in terms of K_2O of at least 60.0% with the possibility of producing large-crystalline potassium chloride with a useful component content in terms of K_2O of at least 62.0%.



THE DELIVERY INCLUDED:

▼ basic technical design with technological solutions and architectural design assignment for the design of the production building, three-dimensional modeling of the entire installation.

MAIN CHARACTERISTICS OF THE PROJECT:

- the volume of the production building (LxWxH) is 80x40x45 meters (the height of the upper capital mark of the building is +24.00 m);
 - the total weight of the equipment is about 2,000 tons;
 - material of crystals - steel clad with nickel-copper alloy 400 (2.4360), material of surface condensers - titanium, mixing condensers are made of stainless steels;
 - components for the project: pumps Sulzer (Switzerland), Egger (Switzerland), SPX Lightnin (Great Britain), valves Sistag WEY (Switzerland), instrumentation Endress+Hauser (Switzerland);
 - technological pipelines made of stainless steel with a protective vinyl ester-acrylic coating.
- ▼ automation of the process up to the operator's console;
 - ▼ supervised installation, training and commissioning of the entire complex of equipment, acceptance tests and commissioning.



INTEGRATED SUPPLY OF REAGENTS PREPARATION LINES FOR EUROCHEM - USOLSKY POTASH PLANT, LLC

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NPO Passat supplied nine production lines for the reagent department of the sylvinite processing plant of the Usolsky potash mine:

- ▼ preparation of a binder solution;
- ▼ preparation of sludge dispersant;
- ▼ preparation of a sludge collector solution;
- ▼ preparation of amino-oil mixture;
- ▼ preparation of water and water-salt solution of flocculant;
- ▼ preparation of an anti-caking agent-dust suppressor solution;
- ▼ preparation of a sludge depressant solution;
- ▼ preparation of an emulsion of the sylvite collector;
- ▼ preparation of hot and warm water.

This project contains, first of all, new developments (technologies) for the preparation of basic reagents for the potash industry.

These are following technologies:

- ▼ preparation of sylvite collector emulsion with optimal dispersion of modifying additives;
- ▼ preparation of a sludge depressant of mother liquor;
- ▼ preparation of concentrated solutions of non-ionic flocculants without the stage of "ripening" and working solutions by diluting with mother liquor.

All stages of the processes are carried out on the equipment of NPO Passat. The main type of equipment is contact tanks with agitators. The type of agitators was chosen depending on the properties of the agitating components (density, viscosity, surface tension, particle size, solid concentration, etc.). If necessary, in addition to tanks with agitators, special non-standard equipment was used in the schemes (pump-gelatinizer, dilution device, loading device, static mixer, etc.) The process of preparing any reagent is a complete cycle. It is equipped with the necessary equipment, mixing devices with tanks, pumping equipment, shut-off and control valves, an automation system complete with automated workstations, and a control system. The scope of delivery included: supervised installation, commissioning, acceptance tests and training of the customer's specialists.



CLEANER FLOTATION OF THE PLANT OF PETRIKOVSKY MINING AND PROCESSING COMPLEX BELARUSKALI, JSC

NPO Passat supplied five cleaning flotation units based on an EFM-41 ejector flotation machine to the grinding and flotation department of the Petrikovsky Mining and Processing Plant.

The set of delivery of NPO Passat equipment includes:

- ▼ deaeration tank;
- ▼ foam pump;
- ▼ ejector flotation machine;
- ▼ elevator unit;
- ▼ control panel.

The delivery set of NPO Passat included:

- ▼ installation supervision;
- ▼ commissioning;
- ▼ acceptance tests;
- ▼ training of the customer's specialists.

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FILTRATION DEPARTMENT OF THE PLANT OF PETRIKOVSKY MINING AND PROCESSING COMPLEX OF BELARUSKALI, JSC

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For dehydration of the potassium chloride flotation concentrate, NPO Passat supplied five belt vacuum filters to the filtration department of the Petrikovsky Mining and Processing Plant, and five belt vacuum filters for dehydration of flotation tailings.

The filtration process at the LVF is carried out according to a given algorithm developed for a specific process. For belt vacuum filters designed for dehydration of flotation tailings at the Petrikovsky Mining and Processing Complex, this means maintaining a given level of sludge at the speed of the belt with constant power supply. For belt vacuum filters, designed for dehydration of potassiumchloride flotation concentrate, this means maintaining a constant speed of the belt with a given constant layer by regulating the power supply to the belt vacuum filter.

Thanks to the full automation of the filtration process, belt vacuum filters ensure the uninterrupted operation of filtration departments with the maintenance of the required technological indicators in automatic mode, with little or no participation of maintenance personnel.

NPO Passat delivered to the Petrikovsky Mining and Processing Complex, installations, including not only belt vacuum filter, but also vacuum pumps of the required capacity, receivers, traps, water seals, sludge washing devices, shut-off and control valves, an automation system complete with automated workstations, a control system.

The delivery set of NPO Passat included:

- ▼ installation supervision;
- ▼ commissioning;
- ▼ acceptance tests;
- ▼ training of the customer's specialists.





REAGENT DEPARTMENT OF THE PETRIKOVSKY MINING AND PROCESSING COMPLEX OF BELARUSKALI, JSC

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For the reagent department of the Petrikovsky Mining and Processing Plant, NPO Passat supplied six production lines:

- ▼ depressant solution preparation line;
- ▼ line for preparation of the collector's solution;
- ▼ flocculant solution preparation line (PAA);
- ▼ soda solution preparation line;
- ▼ line for preparation of amino gas oil emulsion (AGE);
- ▼ line for preparation of amino-gas oil mixture (AGS).

This project includes new developments (technologies) for the preparation of basic reagents for the potash industry. These are technologies:

- ▼ preparation of sylvite collector emulsion with optimal dispersion of modifying additives;
- ▼ preparation of a sludge depressant on mother liquor;
- ▼ preparation of concentrated solutions of non-ionic flocculants without the stage of "ripening" and working solutions by diluting with mother liquor.

All stages of the processes of preparation of the Customer's reagents are carried out on the equipment manufactured by NPO Passat. The main type of equipment is devices with mixing devices. The type of agitators was chosen depending on the properties of the agitating components (density, viscosity, surface tension, particle size, solid concentration, etc.). Low-speed or high-speed agitators (blade, turbine or frame) were used. If necessary, in addition to tanks with agitators, special non-standard equipment was used in the schemes (pump-gelatinizer, dilution device, loading system, static mixer, etc.).

The process of preparation of all reagents is a complete cycle. It is equipped with the necessary equipment: devices with mixing devices, pumping equipment, shut-off and control valves, an automation system complete with automated workstations, and a control system. The scope of delivery included: supervised installation, commissioning, acceptance tests and training of the customer's specialists.



OPTIMIZATION OF THE PERFORMANCE OF PROCESSES OF PREPARATION OF REAGENTS OF THE GREMYACHINSKY MINING AND PROCESSING COMPANY, LLC EUROCHEM-VOLGAKALIY

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NPO Passat performed work on optimizing the performance of reagent preparation processes with subsequent automation of reagent preparation processes at the processing plant of Gremyachinsky Mining and Processing Complex. As part of the agreement signed for EuroChem-VolgaKaliy LLC, our process engineers analyzed the existing preparation scheme and developed proposals taking into account the equipment purchased by the customer for subsequent adjustments to the design and working documentation, issuing instructions for the preparation of reagents. The technical solutions developed and adopted by the customer included the maximum use of existing equipment, data were also provided for the design of additional equipment.

CUSTOMER RECEIVED:

- ▼ developed working hardware-technological schemes for the preparation of reagents;
- ▼ recommendations for the use of additional equipment;
- ▼ instructions for the preparation of reagents;
- ▼ overall and connecting dimensions of additional equipment and fixtures.

Works on the design of automation of reagent preparation processes at the enrichment plant of the Gremyachinsky Mining and Processing Complex are carried out jointly with the partners of NPO Passat in the PASSAT Holding. Changes were developed to the automation system, solutions for integrating the software for reagent preparation lines into the process control system of the mining and processing plant of EuroChem-VolgaKaliy, LLC.

THE CUSTOMER RECEIVED THE FOLLOWING DOCUMENTATION:

- ▼ automation schemes;
- ▼ diagrams of information networks;
- ▼ circuit diagrams.



Technical documentation was also developed for a system for automating technological processes for preparing reagents in accordance with ESKD based on an optimized flowsheet provided by NPO Passat: Technical documentation was also developed for a system for automating technological processes for preparing reagents in accordance with ESKD based on an optimized flowsheet provided by NPO Passat:

- ▼ working documentation of "Mathematical support";
- ▼ working documentation of the "Software";
- ▼ application software for microprocessor controllers in terms of managing reagent preparation lines;
- ▼ application software for operator panels, PC in terms of managing reagent preparation lines;
- ▼ working documentation of the "Organizational support": manuals for the operation of the reagent line management system.

As a result of the work performed, the customer received solutions to improve the technologies for the preparation of reagents, which provided:

- ▼ reduction of cooking time;
- ▼ simplification of operation of schemes;
- ▼ use of mother liquor instead of water.



CLEANER FLOTATION UNIT AT PROCESSING PLANT OF 3 PRODUCTION UNIT BELARUSKALI, JSC

DELIVERY PACKAGE INCLUDED:

- ▼ pneumoejector flotation machine type EFM-41;
- ▼ conditioned apparatus for contacting the pulp with reagents before the main flotation;
- ▼ capacity deaeration;
- ▼ pump equipment;
- ▼ shut-off and control valves;
- ▼ control and automation system;
- ▼ supervised installation, training and commissioning of the entire set of equipment, acceptance tests and commissioning.

ADVANTAGES OBTAINED BY THE CUSTOMER AS A RESULT OF THE INTRODUCTION OF PNEUMATIC EJECTOR FLOT MACHINES:

- ▼ the quality of cleaner flotation was increased by 1% (the quality of concentrate from cleaner flotation was at least 91%, with three cleanings the quality was no more than 89%);
- ▼ reduced power consumption up to 130 kW/h for each section;
- ▼ reduced operating costs for maintenance;
- ▼ reduced production area for cleaning flotation;
- ▼ reduced costs for construction and installation work.



INTEGRATED SOLUTION HEATING UNIT FOR NEGINSKY MINING AND PROCESSING PLANT

The set of equipment supplied by NPO Passat will collect, heat and supply mother liquor for selective dissolution of KCl from sylvin ore.

Delivery contents:

- ▼ receiving tanks for mother liquor (400 m^3), acid and clean condensate made of carbon steel with anti-corrosion protection - 6 units;
- ▼ titanium heat exchange equipment - 24 heat exchangers with a heat exchange area of 309 m^2 ;
- ▼ pump equipment;
- ▼ pipelines;
- ▼ shut-off and control valves.

In addition to the equipment for heating the mother liquor, the scope of delivery included an automation system, electrical solutions, supervision of installation, commissioning and training of personnel.

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AUDIT AND ADJUSTMENT OF FLOTATION MACHINES FOR USOLSKY POTASH PLANT

Audit and adjustment of flotation machines of the Usolsky potash plant.

1ST STAGE

- ▼ Audit of the actual performance of pneumatic ejector flotation machines in the operations of sludge flotation from hydrocyclone discharges and cleaning sludge flotation.
- ▼ Evaluation of the operation of auxiliary equipment for slurry flotation.
- ▼ Training of the staff of the Federal Fund of the Usolsky Potash Plant in advanced methods of working on pneumatic ejector flotation machines.

2ND STAGE

Preparation and issuance of technical proposals to the customer to improve the efficiency of pneumatic ejector flotation machines, which will allow to achieve the highest possible technological performance of the machines.

3RD STAGE

- ▼ Analysis of the results of the implementation of the proposed activities.
- ▼ Setting up the operating mode of the equipment with the participation of the customer's representatives.



COMPLEX OF WORKS ON DEFINITION OF THE TECHNOLOGY OF PREPARATION OF REAGENTS FOR EUROCHEM-VOLGAKALIY, LLC

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NPO "Passat" specialists performed adjustment of automated control systems for technological processes, as well as testing of all seven lines according to approved algorithms:

- ▼ amino gas oil emulsion preparation;
- ▼ flocculant solution preparation;
- ▼ sludge collector solution preparation;
- ▼ amino-gas oil mixture preparation;
- ▼ preparation of polyethylene glycol solution;
- ▼ preparation of sludge depressant solution;
- ▼ preparation of sylvite collector solution.

Technological Audit and Optimization of Enrichment Technology at Processing Plant of Eurochem-Volgakaliy, LLC

As part of the project NPO Passat performed:

- ▼ detailed study of the existing stages of the processing plant technological process;
- ▼ development and issuance of recommendations for changing the parameters of the technological process;
- ▼ audit of implemented measures to optimize enrichment technology.



REFERENCE LIST

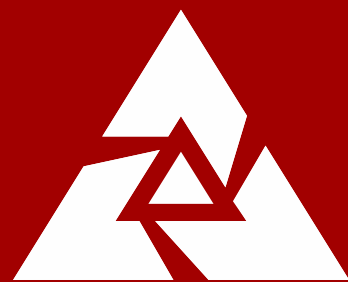
BELT VACUUM FILTERS	TOTAL 31	PERIOD	CUSTOMER
Belt vacuum filter 15 m ²	2	2011	Belaruskali, JSC
Belt vacuum filter 15 m ²	1	2013	Belaruskali, JSC
Belt vacuum filter 35 m ²	1	2015	3 PU Belaruskali, JSC
Belt vacuum filter 17 m ²	2	2015	1 PU Belaruskali, JSC
Belt vacuum filter 23 m ²	10	2018	Petrikovsky MPP of Belaruskali, JSC
Belt vacuum filter 15 m ²	2	2018	4 PU Belaruskali, JSC
Belt vacuum filter 19 m ²	1	2019	3 PU Belaruskali, JSC
Belt vacuum filter	3	2021	Belaruskali, JSC
Vacuum belt filter for halite waste (F=18.5 m ²)	4	2021	Verkhnekamsk Potash Company, JSC
Vacuum filter belt for concentrate (F=18.5 m ²)	5	2021	Verkhnekamsk Potash Company, JSC
THICKENERS AND HYDROSEPARATORS	TOTAL 68	PERIOD	CUSTOMER
High-performance thickener with a diameter of 10 m	19	2010	Belaruskali, JSC
Compact thickener with a diameter of 10 m	1	2010	PJSC Uralkali
Thickener for the fine fraction of flotation tailings	2	2012	Belaruskali, JSC
Hydroseparator with a diameter of 18 m	2	2012	Belaruskali, JSC
Salt sludge thickener	1	2012	Belaruskali, JSC
Clay-salt sludge thickener	1	2012	Belaruskali, JSC
Vessel for Metso IPS lamella thickener model LTC 2200-15	1	2012	Belaruskali, JSC
Thickener 18000 (Dorr type)	1	2014	Mozyrsol, JSC
High-performance thickener with a diameter of 10 m	4	2014	Belaruskali, JSC
Settler-thickener	1	2015	3 PU Belaruskali, JSC
Bottom of cone thickener	1	2017	4 PU Belaruskali, JSC

Salt sludge thickener (type Brandes)	2	2017	4 PU Belaruskali, JSC
Clay-salt sludge thickener (Dorr type)	1	2017	4 PU Belaruskali, JSC
Salt sludge thickener Brandes	2	2018	4 PU Belaruskali, JSC
Emergency thickener with a diameter of 30 m	1	2018	Petrikovsky MPP of Belaruskali, JSC
Potassium nitrate crystal thickener	1	2019	Belkali-Migao, JSC
Potassium nitrate thickener	1	2019	Belkali-Migao, JSC
Ammonium chloride thickener	2	2019	Belkali-Migao, JSC
Flotation tailings thickener 18 m	3	2019	3 PU Belaruskali, JSC
Metso LTO500-F8 Plate Thickener Metal Structures	1	2019	4 PU Belaruskali, JSC
Metso LTO500-F8 Plate Thickener Metal Structures	3	2019	Petrikovsky MPP of Belaruskali, JSC
Metso LTC3450-18F Thickener Casing Complete with Support Columns	3	2019	Petrikovsky MPP of Belaruskali, JSC
Metso LTC3450-18F Thickener Casing Complete with Support Columns	1	2019	2 PU Belaruskali, JSC
Metso LTC3450-18F Thickener Casing Complete with Support Columns	1	2019	3 PU Belaruskali, JSC
Metso LTC3450-18F Thickener Casing Complete with Support Columns	1	2019	3 PU Belaruskali, JSC
Hydroseparator housing Metso LTC 2700-16.5 F	2	2019	2 PU Belaruskali, JSC
Housing and automation system for Metso LTC2200-15 plate thickener	1	2019	4 PU Belaruskali, JSC
Housing and automation system for Metso LTC1140-12 plate thickener	1	2020	4 PU Belaruskali, JSC
Thickener with a diameter of 18 m	1	2021	Belaruskali, JSC
Salt sludge thickener	1	2021	Belaruskali, JSC
Thickener with a diameter of 30 m	1	2021	Belaruskali, JSC

Thickener for clarification of saline water from discharges of wet stages of gas cleaning systems Ø18 m	1	2021	Belaruskali, JSC
Lamella thickener	1	2021	Belaruskali, JSC
Thickener SPV-24	1	2022	Sever Minerals, JSC
FLOTATION MACHINES	TOTAL 26	PERIOD	CUSTOMER
Separate fines flotation machine	1	2012	Belaruskali, JSC
Ejector flotation machine EFM-4100	1	2013	Belaruskali, JSC
Ejector flotation machine EFM-3500	2	2015	2 PU Belaruskali, JSC
Pneumatic ejector flotation	8	2018	2 PU Belaruskali, JSC
Pneumatic ejector flotation	2	2018	2 PU Belaruskali, JSC
Installation of cleaning and separate flotation based on ejector flotation machine type EFM-41	5	2018	Petrikovsky MPP of Belaruskali, JSC
Separate fines flotation machine	1	2018	Petrikovsky MPP of Belaruskali, JSC
Modernization of flotation machines with the supply of a set of equipment	1	2022	EuroHcem, LLC
Flotation machine	5	2022	Uralkali, PJSC
FOAM SEPARATION MACHINES	TOTAL 6	PERIOD	CUSTOMER
Deep impeller foam separation machine MPSGI-4	2	2018	1 PU Belaruskali, JSC
Deep impeller foam separation machine MPSGI-4	4	2018	3 PU Belaruskali, JSC
APPARATUS FOR REAGENTS PREPARATION	TOTAL 118	PERIOD	CUSTOMER
Apparatus for pulp conditioning with reagents $V=5\text{ m}^3$	7	2011	Belaruskali, JSC
Apparatus for pulp conditioning with reagents $V=10\text{ m}^3$	7	2011	Belaruskali, JSC
Depressor contact vessel $V=10\text{ m}^3$	1	2013	Belaruskali, JSC
Mechanical mixer for collector $V=5\text{ m}^3$	1	2013	Belaruskali, JSC
Leaching apparatus	1	2013	Belaruskali, JSC

Leaching apparatus	7	2013	Belaruskali, JSC
Leaching apparatus V=6.3 m ³	1	2015	1 PU Belaruskali, JSC
Apparatus for dissolving KCl in sludge	1	2015	1 PU Belaruskali, JSC
Supply of leaching vessels for the processing complex	28	2016	EuroChem–Usolsky Potash Plant, LLC
Apparatus with agitator V=5 m ³ , V=6.3 m ³ , V=10 m ³	5	2017	2 PU Belaruskali, JSC
Apparatus for leaching KCl in sludge	1	2018	3 PU Belaruskali, JSC
Apparatus with agitator V=6.3 m ³	5	2018	Petrikovsky MPP of Belaruskali, JSC
Apparatus with agitator V=12.5 m ³	5	2018	Petrikovsky MPP of Belaruskali, JSC
Apparatus with agitator V=12.5 m ³ with electric pumping unit HG 150EHC-D	5	2018	Petrikovsky MPP of Belaruskali, JSC
Conditioning tank, V pulp 300 m/h (12.5 m)	8	2018	3 PU Belaruskali, JSC
Conditioning tank V=6.3 m ³	8	2019	3 PU Belaruskali, JSC
Apparatus with agitator V=12.5 m ³	6	2019	Belaruskali, JSC
Apparatus with agitator V=10 m ³	1	2019	Belaruskali, JSC
Apparatus with agitator V=30 m ³	2	2019	Belaruskali, JSC
Apparatus with agitator V=55 m ³	2	2019	Belaruskali, JSC
Leaching apparatus V=12.5 m ³	1	2019	Belaruskali, JSC
Leaching apparatus V=10 m ³	2	2019	Belaruskali, JSC
Conditioning tank with agitator V=8.5 m ³	2	2020	EuroChem-VolgaKaliy, LLC
Conditioning tank PM-20 type with stirring mechanism	1	2021	Belaruskali, JSC
Saturated liquor tank V=40 m ³	1	2022	Belaruskali, JSC
Leaching apparatus V=6.3 m ³	1	2022	Belaruskali, JSC
Conditioning tanks V=8.5 m ³	8	2022	EuroChem-VolgaKaliy, LLC
VACUUM CRYSTALLIZERS	TOTAL 19	PERIOD	CUSTOMER
Horizontal vacuum crystallizer	2	2011	4 PU Belaruskali, JSC
Horizontal vacuum crystallizer	2	2015	4 PU Belaruskali, JSC

Vacuum vertical crystallizer for a plant with controlled crystal growth	7	2018	4 PU Belaruskali, JSC
Horizontal vacuum crystallizer	1	2020	3 PU Belaruskali, JSC
Horizontal vacuum crystallizer	5	2020	Belaruskali, JSC
Vacuum crystallizer vertical V=40 m ³	2	2021	Belaruskali, JSC
COMPLEX PROJECTS	TOTAL 4	PERIOD	CUSTOMER
Vacuum crystallization plant with controlled growth of crystals for the crystallization of potassium chloride with a capacity of 1.5 million tons	Проект "под ключ"	2015-2018	4 PU Belaruskali, JSC
Equipment for reagent preparation lines	24	2015	Petrikovsky MPP of Belaruskali, JSC
Equipment for reagent preparation lines	6	2018	Petrikovsky MPP of Belaruskali, JSC
Comprehensive commissioning work on debugging the technology for preparing reagents of object 540 "Departments for storage and preparation of reagents"		2020	EuroChem-VolgaKaliy, LLC
NON-STANDARDIZED EQUIPMENT	TOTAL 27	PERIOD	CUSTOMER
Sump	5	2015	1 PU Belaruskali, JSC
Sump V=23 m ³	1	2015	4 PU Belaruskali, JSC
Pulp divider	7	2018	Petrikovsky MPP of Belaruskali, JSC
Collector's conditioning tank, with depressant	5	2020	Belaruskali, JSC
Pulp divider V=3.0 m ³	1	2021	Belaruskali, JSC
Vacuum chamber for the belt vacuum filter	1	2021	Gomel Chemical Plant, JSC
Distributing tank	1	2022	Belaruskali, JSC
Distributing tank	1	2022	Belaruskali, JSC
Sands sump of the 1st stage of desliming	1	2022	Belaruskali, JSC
Coagulation dust collector KMP type with right-hand drip collector	2	2022	Belaruskali, JSC
Impact scrubber	1	2022	Belaruskali, JSC
Bucket elevator	1	2022	Belaruskali, JSC



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