Description of the technological scheme of desalination

The original seawater pump is served directly from the waters of the sea at a depth of 1.5 m and is collected in the intermediate tank.

Immediately prior to dosing capacity occurs sodium hypochlorite in an amount of up to 10 mg / l to disinfect and prevent fouling of pipelines and tanks. The dosage of sodium hypochlorite is made from solution-supply tank, dosing pump is proportional to the chlorine sensor readings.

Of capacity pump delivers the raw water to the pre-filter. The pre-filter is required to remove the original water of suspended particles larger than 200 microns. Removal of particles larger than specified, it is necessary to prevent them from falling directly, facility-in hollow fiber that help prevent damage and possible blockage. Constructively is a disc filter with a rating of 200 micron filtration. Wheels put on a hollow cylinder. They are color coded their micron size and are collected in bags depending on the requirements to the quality of filtering. A filtering unit for compressing a spring disc and a hydraulic cylinder disposed within the piston which is used to switch the filter from the filtration mode to the rinsing mode and back. Switching modes is done in a fully automatic mode.

Given the nature of the water source, water intake directly from the open sea with a second depth of 1.5 m, must be used the stage of preliminary coagulation.

Coagulation is the main technological methods for the removal of the source water of colloidal particles. Basic mechanisms of coagulation:

Firstly, the destabilization of colloidal dispersions by neutralization of surface-charge-colloidal particles (decrease □ — potential), which contributes to their convergence and consolidation (the mutual repulsion due to the same charge colloid decrease) with the possibility of settling and effective filtration .

The second mechanism, the mechanism of adsorption of colloidal particles on the developed surface of coagulant (usually iron hydroxide (III) and aluminum) flakes followed by separation of coagulant.

The optimal dose of coagulant is determined in the process of coagulation test, assembly coagulation is as follows:

Two solution-expendable container is a cylindrical plastic reservoir with re-charging port, electromechanical agitator and gauges. These containers are dissolved daily amount of coagulant and its further dosing water feed stream dosing pumps. Dosage in proportion to the flow of water from a water meter with pulse output.

Then the water pump is supplied to the ultrafiltration module consisting of parallel, vertically mounted, ultra filtration hollow fiber elements.

Filtering takes place in a dead end mode with the source of water supply to the entire installation ultrafiltration. Backwashing conducted periodically flushing frequency washes every 25-30 minutes, 60 seconds duration.

One unit consists of ultrafiltration elements with a common supply pump of water. Backwashing unit includes a pump, tank washing water storage and dosing units: sodium hypochlorite (consists of a pump — dispenser and flow capacity), dosage gray-acid (consists of a pump — dispenser and expenditure capacity, which is proportional to the dosage of the pH sensor).

Ultrafiltration module operates in the following modes:

1. Operating mode – a dead-end filtration.

Duration regime between backwashing: 25-30 minutes.
During operation the raw water pump is supplied to the hollow fiber elements. The filtrate is directed into the intermediate container. The module is equipped with electromagnetic and manual valves for the organization of the process and switch between different modes.

2. Mode of backwashing.

Every 25-30 minutes continuous operation mode starts backwashing. Washing is carried out pump from the tank storage filtrate. During flushing water you can add concentration of sodium hypochlorite, 20 mg / l with the help of the metering pump. Flush consists of several sub-steps:

2.1. Mode rams washing.
2.2. Backwashing up.
2.3. Backwashing down.

Duration of each mode may be programmed by building awareness opti-wash operation.
After all modes backwashing plant goes into operation mode of PA.

3. Mode chemically enhanced cleaning.

In the ultrafiltration unit has a mode of chemically enhanced pro-rinsing: Dosage if acid in the discharge line of the pump washing, pH = 2.5, control by sensor of pH.
Washing performed with an interval of 12 – 168 hours, and the best modes are selected Xia in the process of commissioning and subsequent operation of the equipment.
Directly chemically enhanced flushing consists of several sub-steps:

3.1. Mode rams washing.
3.2. Backwashing up.

In this mode the appropriate dosage of a chemical`s.

3.3. Backwashing down.

In this mode the appropriate dosage of a chemical`s.

3.4. Soaking mode.

The duration of the regime – 30-600 seconds (programmable interval).

3.5. Mode rams washing.
3.6. Backwashing up.
3.7. Backwashing down.

The duration of each mode can be programmed by optimization-wash operation.
After all modes backwashing plant goes into operation mode of PA.

Filter operate in fully automatic mode, while the filter operates it control the following parameters:
1. Control of pressure on the pressure lines of pumps.
2. Control of turbidity in the raw water line and the UF control devices Mut-ness.
3. Control "dry run" pumps.
4. Control costs: raw water filtrate, and the flow line backwashing.
5. Pressure monitoring of source water at the entrance to the installation on the pressure sensor.
6. Check the pressure in the process of backwashing pressure sensor.
7. Containers water level control.
8. Check the water temperature.

Reverse osmosis desalination mode

Place in flow sheet: after the hollow fiber ultrafiltration.

Common to all diaphragm processes is that the separation is carried out using these diaphragms. The diaphragm can be considered as a selectively permeable barrier between two phases. The

transfer takes place through the diaphragm upon application of a driving force on the component. In most diaphragm processes driving force is pressure difference or the concentration (activity) as well as potentials on both sides of the diaphragm.
Today, diaphragms processes are widely used, and their scope is constantly expanding. At the present time — a transition process between the development of the first generation of diaphragms processes such as microfiltration, ultra filtration, reverse osmosis, electro dialysis and dialysis and membrane processes of second generation, such as gas separation, pervaporation, diaphragm distillation and separation by liquid membranes.

There are many diaphragm processes based on different principles of section-or mechanisms and applicable for the separation of objects of different sizes — from particles to the mall-molecules. Despite these differences, all diaphragm processes have something in common, namely the diaphragm.

The exact definition of the diaphragm is difficult to provide the most general definition can be after-follows: a diaphragm — a selective barrier between two phases, wherein the term "selective" may refer to both diaphragm and to the diaphragm processes. The most specific is the following definition: a diaphragm — a phase or group of phases that separate two different F-PS, which differ physically and / or chemically to the phase of the diaphragm; the diaphragm has a friend or properties that allow it under the applied force field to manage the processes of mass transfer between phases shared.

Diaphragm processes occurring under pressure, called baromembranes.

Between pore pressure gradient and there is a relationship: solution, decrease pore size of the membrane, leading to the ability to delay the smaller particles slavlivaet OBu-increasing need for high pressures. Therefore, the processes of bar-brane filtration classified as follows:

Pore Size, microns	Pressure MPa
microfiltration	0,02-10 0.01-0.2
ultrafiltration	0.001-0.02 0.2-1.0
nanofiltration	0.001-0.01 0.3-1.6
reverse osmosis	0.0001-0.001 1,0-25,0

Microfiltration — a diaphragm process which is very close to normal filtration. Microfiltration membranes pore sizes can vary from 0.05 to 10 microns, the process is used for separating the solution of large colloidal particles or suspended mikroparticles, it is used for concentrating the fine suspensions (e.g., latex), chalking (remove suspended solids) of various solutions, cleaning and natural waters. Application of micro-effectively for the preparation of fluids before the process is reversible-osmosis and ultra filtration (eg, before the desalination of sea and brackish water).

Ultrafiltration — the process of membrane separation of solutions of high and low molecular weight compounds as well as the concentration and fractionation of high-molecular compounds. Ultrafiltration is typically used for separation of systems in which the molecular weight of the dissolved components is much larger of molecular weight of the solvent. For example, aqueous solutions believe that ultrafiltration is applicable when at least one system component having a molecular weight of 500, and D more high.

Reverse Osmosis — a filtering process of fluids under pressure greater than the osmotic through a membrane permeable molecule delaying and solvent and solute ions. The basis of this method is based on the phenomenon of osmosis — the spontaneous transition solvent through a semipermeable membrane into a solution. The pressure at which an equilibrium is called osmotic. If the solution is to attach by pressure above the osmotic, solvent, then the transfer will be carried out in the opposite direction, is reflected in the title of this process "reverse osmosis".

The method is a method of reverse osmosis desalination, water and widely used, uses energy, medical, food, chemical industry, as well as to improve the quality of technical and drinking water. Exceptional interest is the use of reverse osmosis for the treatment of industrial and domestic waste.

In each case the choice of membrane depends on the nature of wastewater. In our country and in other countries developed and manufacturing high-performance and high-selective membrane-resistant in a wide pH range. The advantages of the method of reverse osmosis include:

Return up to 95% of the production of purified water;

- the degree of purification of water from mineral salts and salts of heavy metals reaches 97-99,5%;
- relatively small size installations, which does not require large production areas;
- simplicity of instrumentation;
- none additional reagents for the process.

Carried out in recent years in our country and abroad in recent years industrial testing methods membrane separation wastewater treatment showed that reaches a depth of purification, reverse osmosis is one of the first places and is the most promising for co-building water circulating.

An essential advantage of the method of reverse osmosis desalination compared with distillation is lower energy costs, less equipment corrosion and exclusion heat pollution. According to foreign scientists compared the cost of desalination by reverse osmosis and distillation, the cost of water in the latter case by 10-40 % lower power consumption is 4 times less.

Wasps mainly disadvantages of reverse osmosis and nanofiltration:

- require pretreatment for mechanical purification, turbidity, colloidal particles, compounds capable of forming on the surface of the membrane stubborn deposits;
- produced a certain amount of concentrate (60 to 95% depending on the problems posed in the cleaning properties and environment (eg, salinity which depends on the osmotic pressure)), which requires a suitable disposal methods (from the banal draining into the sewer system to the sophisticated technology -cheskih techniques such as evaporation).

Nanofiltration is intermediate between ultrafiltration and reverse osmosis, and characterized by a low retention capacity (selectivity) for the salts with single valence anions and organic compounds having a molecular weight less than 150 and D-Coy high — on two — and salts with polyvalent anions, and organic compounds with a molecular weight of more than 30 D. The widespread use of nanofiltration is potable water for softening and partial demineralization hard and brackish waters.

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Initial water after hollow fiber ultrafiltration takes place for reverse osmosis desalination.

Immediately before installing a reverse osmosis unit installed dosage of sodium bisulfite and sedimentation inhibitor Avista Vitec 4000.

The dosage of sodium bisulfite is necessary to prevent contact with the reverse osmosis membrane elements of active chlorine. Active chlorine concentration greater than 0.1 mg / L lead to oxidation of the selective membrane layer and output elements of the system. Node dosage of sodium bisulfite is a metering pump, and supplies the reagent container.

Inhibitor Avista Vitec 4000 processes effectively minimizes sedimentation of salts such as calcium sulfate, calcium carbonate, silicates deposition and some others, the dosage was 3 mg / l. Node inhibitor dosage is a metering pump, as well as consumables capacity inhibitor.

Next, water pump high pressure supplied to the reverse osmosis unit, completed by roll membrane elements. In the process of separation of the feed stream is divided into two: the filtrate — purified

water and concentrate. Purified water is matched to the performance indicators of drinking water. The concentrate is discharged in the waters of the Black Sea.

Periodically performed chemical cleaning of the membrane module cleaning solution.

Determine the start time of chemical cleaning possible with the following changes reverse osmosis separation process:

- an increase in pressure drop across the membrane device indicates the accumulation of impurities in the membrane-channels and the need for chemical cleaning;
- selectivity decline (deterioration of the filtrate under constant as original water);
- drop in performance at constant pressure process diaphragm Section, as a constant source of water (total salt content), the constant-temperature.

Typically, the deterioration of the performance of 15-20% relative to the initial value, indicating the need for chemical cleaning. For chemical cleaning exist a special container with an electric mixer, pump and chemical cleaning strainer cleaning bag type filter with a rating of 50 microns.

A module for reverse osmosis desalination wastewater is constructive in the frame is rigidly fixed to a horizontal surface mounted membrane apparatus, bandaged by pipelines and allow the pressure to 6.9 MPa (69 bar). The module is equipped rotameter to control costs, the conductivity sensor readings are displayed on the LED control cabinet, pressure gauges and pressure sensors for measuring pressure.

A membrane desalting includes the following main parts:
– Frame;
– Membrane devices;
– Centrifugal pumps – are designed to create the working pressure in the apparatus membranes and for chemical cleaning;
– Installation of membrane elements used the world's leading manufacturers
The material of main components and parts is stainless steel, piping material (up to 6 bar) – PV.

Installation of reverse osmosis desalination

Node dosage of sodium bisulfite.
The dosage of sodium bisulfite in an amount sufficient to completely remove the chlorine before the stage reverse osmosis system, control over the sensor active chlorine.
Metering pump, proportional to the dosage of active chlorine sensor in the complex.
Flow capacity.
Node dosage inhibitor.
Dosage inhibitor Avista Vitec 4000 or equivalent in an amount of about 3 mg / l.
Metering pump, proportional to the dosage of the pulse meter.
Flow capacity.
On the reverse osmosis filtrate to ensure microbiological safety of water installed ultraviolet sterilizer.

Control system:

1) sensors, actuators;
2) Management of technical processes of industrial controllers;
3) Automated operator's seat.

This system implements:
– The Centralized process control in real time;
– Processing Information by industrial controllers;
– Storing and archiving of all production information to enable it after blowing-processing.

Conclusion archival information in a convenient form for the customer (trends, diagrams, we, tables);
- The Centralized output of operational information on the workstation operator and process visualization (display parameters on the mimics processes and output tables and graphs);
- Checking availability of equipment;
- Warning by Visual and sound signals in different situations (faults transducers achieve values of the parameters of near misses, etc.) and lock the equipment in emergency situations;
- filtration Various kinds of interference;
- Measurements Physical parameters of the object controlled by the primary input transformations-verters;
- Remote And local government.

In the process of operation, control of the main parameters of the installation:

1. Pressure control on the pressure lines of pumps, lines filtrate concentrate each stage, differential pressure control, disabling reverse osmosis overpressure above the allowable pressure drop below a critical turning off when exceeding the allowable pressure drop across the reverse osmosis machines.
2. Control "dry run" pumps.
3. Flow control on the lines of the filtrate, concentrate, supplying raw water.
4. Monitoring of water quality conductivity sensor lines of source water, reverse osmosis filtrate, concentrate selectivity control.
5. Controlling the levels in raw water tanks, concentrate the filtrate. Turn-of on / off reverse osmosis plants in accordance with the water level in the tanks.