

THE TECHNOLOGIES OF WATER TREATMENT IMPROVMENT FOR DISCHARGE OF SALINE WASTES SHORTEUING

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Comparison of operating parameters of membrane options at the use of the calculation programs of the "Filmtec and "Hydranautics" firms" is executed. Conducted analysis of influencing of technological charts of connecting of membrane equipment is conducted on productivity of equipment, maintenance of separate ions in permeate and expenses of electric power.

In industrials practice for the last 10 years the range of the use of membrane technologies of water treatment in chemical industry (business concern "Styrol", Gorlovka), in metallurgy ("Ystyl", Donetsk; Joint-stock COMPANY "Azovmash", Mariupol), production of food products (The "Sandora LTD.", Nykolaev) and other broadened considerably

In thermal and atomic energy to the present time ionexchange technology is basic in water treatment. Productivity of ionexchange options on large TES and AES arrives at a few handrid per heure ionexchange equipment of m^3 at o'clock.

However during exploitation of ionexchange filters the far of reagents which as dilute in salts flows enter superficial reservoirs is consumed. It results in degradation of superficial water sources and in a number of cases eliminates possibility of the use of water by priority users.

Toughening of requirements to the upcast of in salts flows causes the necessity of replacement of existent ionexchange technologies on membranes. The last possess in a number of dignities: practically complete exception of consumption of reagents on the process of ionexchange of water, high degree ionexchange for one passage-way and decline of upcast of salts to the level equivalent to contentes of salts in initial water. The considerable losses of water on own needs are the features of exploitation of membrane options. There is also the necessity of more careful water pre-treatment.

Use of reverse osmosis equipment, in spite of some simplicity of chart of connection of vehicles and service requires knowledge of partition of load between corps and membranes. Otherwise there are the losses of operating properties of technological process: increase of expenses of electric power, decline of degree of ionexchange and output of clean water – permeate or increases of capital costs on options.

Determination of influencing of configuration of connecting of reverse osmosis elements on the technological indexes of process of ionexchange of water in membrane equipment, determination of possibility of reduction of amount of flows at desalination of waters, and also determination of possibility of the use of mine waters,

for preparation of make up water for district heating and of thermal networks was the purpose of this work.

Membrane elements in the reverse osmosis setting can be collected on by different charts, to configurations. For example, at desalination of brackish waters with total dissolved solid 2000 ppm membranes can be united in a few corps united parallel (for the increase of productivity of equipment) and successive (for the increase of output of desalination water – permeate). On the fig. 1 and 2 different charts of connecting of membrane vehicles and possibility of rapid are shown transition to other configuration.

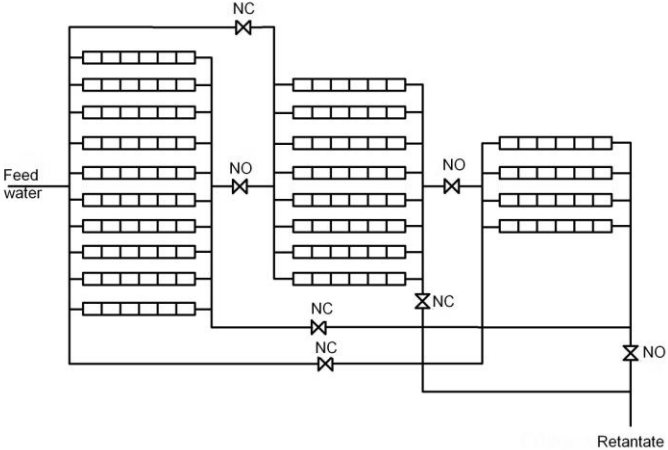


Fig. 1. Transition from the three-stage chart of including to two stages, (they are accordingly normally closed and opened valves (NC and NO))

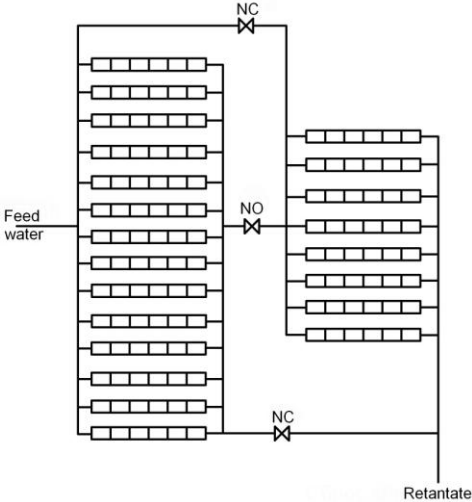


Fig. 2. Change of connecting of cases for the two stage with successive (on a concentrate) one on parallel

Obviously, in case of desalination of highly mineralized waters successive connection of reverse osmosis elements on a concentrate will cause as worsening of quality of permeate so the contamination hazard.

Using the “ROSA (Analysis of the system of reverse osmosis) programs”, developed by the “Dow Chemical company”, we executed the calculations of

efficiency of work of options with different configurations of connecting of membrane vehicles at desalination of mine water.

For the reverse osmosis equipment the stake of general output of desalination water is related to the output on every element as follows:

$$1 - (1 - \alpha)^n = r, \quad (1)$$

where α – it is stake of output of permeate on all setting;

r – it is stage of output of permeate on all setting.

It is thus assumed that α there is a permanent size, that small changes as far as ion exchange of water. Thus, interconnection between „ α ” and „ r ” it is described by equalization:

$$(1 - \alpha)^n = (1 - r), \quad (2)$$

$$\alpha = 1 - (1 - r)^{1/n}, \quad (3)$$

For example, at $n=12$ and $r=0,75$, $\alpha=0,11$.

A mean output on one element makes 0,15, the necessary amount of stages of desalination makes here:

$$n = \frac{\ln(1 - r)}{\ln(1 - \alpha)}, \quad (4)$$

For the output of permeate $r=0,75$, $n = \frac{1,386}{0,162} = 8,5$ degrees.

The estimation of reverse osmosis options were shown, that at identical pressure of acting water and identical amount of corps the change of configuration of connecting allows to a great extent to multiply the expense of desalination water – permeate.

Thus in transition from the three-stage chart of ion exchange of water (on motion of concentrate) to single-stage one, the output of permeate from 76 to 60 % and his total dissolved solid, and is multiplied the general expense of permeate in 1,3 times. There is the most complete and evenly distributed loading on separate elements at the two stage chart of including of membrane vehicles (output on every element).

At the unchanging expense of acting water and output permeate transition from the three-stage chart of connecting of corps to single-stage one allows to decrease

pressure of acting water approximately from 13 to a 10 bar and expenses of electric power from 0,55 to 0,43 kVt·h/m³.

The change of configuration of connecting of corps of reverse osmosis vehicles allows flexibly to regulate productivity of equipment due to the change of output of permeate. Thus at identical productivity it is possible to attain the considerable economy of electric energy.

The indicated decision enables to manage quality of permeate. It is most expedient to use the two stage chart of including of membrane vehicles, at which is achieved the best indexes of permeate as compared to other charts.

For diminishment of water desalination with salt content to a 2000 ppm optimum configuration of connecting of membrane vehicles can be executed as follows: $n \times 6/0,6n \times 6$ or $1,5(n \times 4/0,6n \times 4)$ for identical productivity of equipment (n is amount of corps of vehicles)

Optimum pressure of acting water at modern prices on electric power and on membrane vehicles makes an approximately 14 bar.

It is thus multiplied the general output of permeate to 93,75 %. Parameters of process of concentration of brine, got at desalination of mine water.

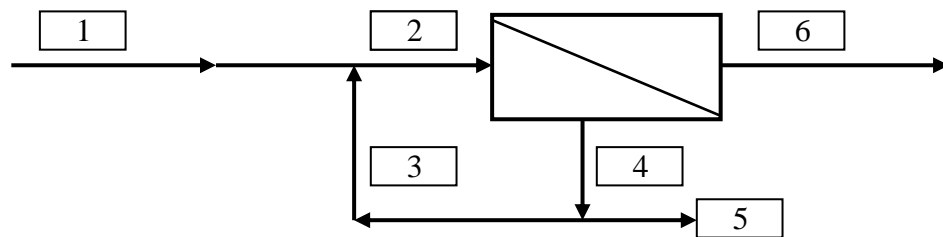


Fig. 3. Technological parameters of concentration of brine after reverse osmosis desalination of water (the names of positions and parameters of streams are resulted in tabl. 1)

Table 1. Basic parameters of streams of the membrane setting

Stream	Name of stream	Flow, m ³ /h	Pressure, bar	Total dissolved solid, mg/l (ppm)
1	Input stream	25,00	21,00	5602
2	Input stream with recycling	45,00	20,75	12927
3	Recirculation	20,00	19,74	22138
4	Brine (total stream)	26,25	19,74	22138
5	Brine	6,25	19,74	22138
6	Permeate	18,75	-	31
6/1	Output, %			75

In accordance with the resulted information, connecting of membrane retentate allows considerably to cut down expenses water from 25 to 6,25 % on each a 100 ton desalinated water. It is thus multiplied the general output of permeate to 93,75 %.

For concentrated flows processing of energy sources is expedient

The most simple by the method of desalination of in salts flows there is sun desalination.

Sun desalination equipment consists of the pool covered by tape or glass. The bottom of pool is laid out by black polyethylene tape, ceramic tiles or thin layer of asphalt. Sunbeams getting through transparent coverage and achieving a bottom heat salt water. Water evaporates appearing vapor and air mixture, adjoining with relatively more cold surface tapes or glasses, is condensed. Drops of condensate, flowing down on tape or glass is going in a chamfer and hatch from desalination equipment. The brine got after evaporation is periodically blown through. A level in a pool is supported the simplest by a regulator. Saline water is going in a tank, from where by gravity through a regulator enters desalination equipment.

Sun desalinator performance depends on intensity of stream of sun radiation and, naturally, changes depending on weather terms in the flow of days and in the flow of year.

The annual sum of direct sun radiation on the TSRD territory makes 4100-4700 MDJ/m² /yr. It corresponds to average daily productivity of desalination equipment 4-5 l/m². Although it is the value in 150-200 times less specific productivity of industrial thermal desalination equipment, it should be remembered about a free energy source. For small mine settlements with the amount of habitants, for example, 3000 persons desalination equipment provides 100x60 m population by a drinking-water at consumption of drinking-water 20l in days on one man.

Concentrate of reverse osmosis vehicles of sulfate and sulfate and chlorine class with salt contents to 3-4 g/l at correlation of the ions $Na/(Ca + Mg) < 0,7$ black earth soils suitable for watering and, accordingly, can be used as «nourishing» water of sun vaporizers of hotbed type.

Stabilization of industrial enterprises opens wide prospect for investments aimed at applying the technologies for mine waters desalination. It will provide one more source of water-supply.

Conclusions

Mine water with heightened TDS can be used for preparation of make up water of thermal networks at application of the options equipped by nanofiltration elements.

The change of configuration of connecting of corps of reverse osmosis vehicles allows flexibly to regulate productivity of equipment. Thus at identical productivity of setting it is possible to attain the considerable economy of electric energy.

For introduction of the systems of water treatment with the exception of up casts of in salts flows application of the reverse osmosis systems of concentration of salts with the use of membranes for waters of high TDS is grounded.

Diminishment of volumes of sewage which head for vehicles with phase transition, can be attained due to desalination of concentrates of reverse osmosis equipment with recirculation concentrate (retentate). For more effective process of concentration of correlation of concentrate recycled solution in relation to the amount of make up water must make 1:1.

At desalination of water with initial TDS a 2 g/l (typical for mine waters) amount of water, which is thrown down in vehicles with phase transition, can be diminished to 3,75% at total dissolved solid of brine to 20 g/l. Increases of level of recirculation in relation to an input stream to 1,6/1 results in the increase of expenses of electric power approximately in 1,3 times.

Optimum pressure of acting water for modern prices on electric power and on membrane vehicles makes an approximately 14 bar.

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