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TECHNICAL AND ECONOMIC ASSESSMENT OF INNOVATIVE MEMBRANE TECHNOLOGIES

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Nowadays, the problem of salinization of water is very common in Ukraine due to natural and anthropogenic factors, and industrial regions suffer the most. The high level of mineralization is occurred due to the presence of coal, iron ore and uranium mines [1]. Great contribution to the salinity of water objects is made by the discharge of mine water, saline wastewater, water from cooling systems and brine infiltration of many slime storages. Unfortunately, modern methods of saline water treatment do not solve the problem, but only aggravate the situation in densely populated areas with well-developed industry [2].

The solution to this problem is the introduction of innovative complex water desalination technologies at the utilities and industrial enterprises. It will helps to use water that has an increased mineralization, which will ensure a significant reduction of discharges of mineralized sewage and will lead to improvement of the quality of groundwater [3].

Membrane technologies have high efficiency and can be used at different stages of water treatment, as well as together with other methods of purification. In regions with a lack of fresh water, membrane technologies are widely used to desalinate highly mineralized waters. Depending on the quality of the water and the requirements for the treated water, only membrane separation methods can be used for water treatment and wastewater treatment in a technologically grounded combination [4]

The model solution was used through experiments: hardness – 9.0 mg-eqv/dm^{-3}, alkalinity – 5.0 mg-eqv/dm^{-3}, SO_4^{2-} – 13.0 mg-eqv/dm^{-3}, Cl^- – 3.5 mg-eqv/dm^3, pH = 8.9.

For desalination of water, samples of 10 dm^3 were used. The degree of selection of permeate was changed from 10 to 90%. The concentrations of chlorides, sulfates, hardness and alkalinity were determined in initial solutions and in permeates. The selectivity and productivity of the membrane were calculated [5].

In the work, the effect of the mechanical water purification on the productivity and selectivity of the reverse osmosis membrane of low pressure Filmtec TW30−1812−50 was determined (Fig. 1, Fig. 2).

The membrane Filmtec TW-30-1812-50 provides en effective water desalting at pressures up to 1 MPa (in this case, P = 0.3 MPa) with high process efficiency. Despite the fact that through a cassette with a reverse osmosis membrane only 10 dm^3 of model solution was passed, its pre-lighting significantly influenced the

productivity of the membrane. During filtering an increase in membrane productivity on 12-20% is observed (Fig. 2).

The efficiency of removal of chlorides, sulfates and ions of hardness from water slightly depends on the pre-purification of water. When desalting the model solution, the highest residual concentrations of chlorides were fixed in the permeate. The residual concentrations of sulfates and hardness ions were rather low. The content of ions in concentrates was determined by their initial concentration and the effectiveness of detention on the membrane.

In concentrates, the increase in concentrations of all cations and anions that were controlled in this process were observed. The highest concentrations correspond to hardness ions and to sulfates.

Since the efficiency of water purification from any ions depends not only on the residual concentrations of ions, but also on their initial concentration, then the efficiency of the water purification process from any ions is better to evaluate by the values of the membrane selectivity (Fig. 1).

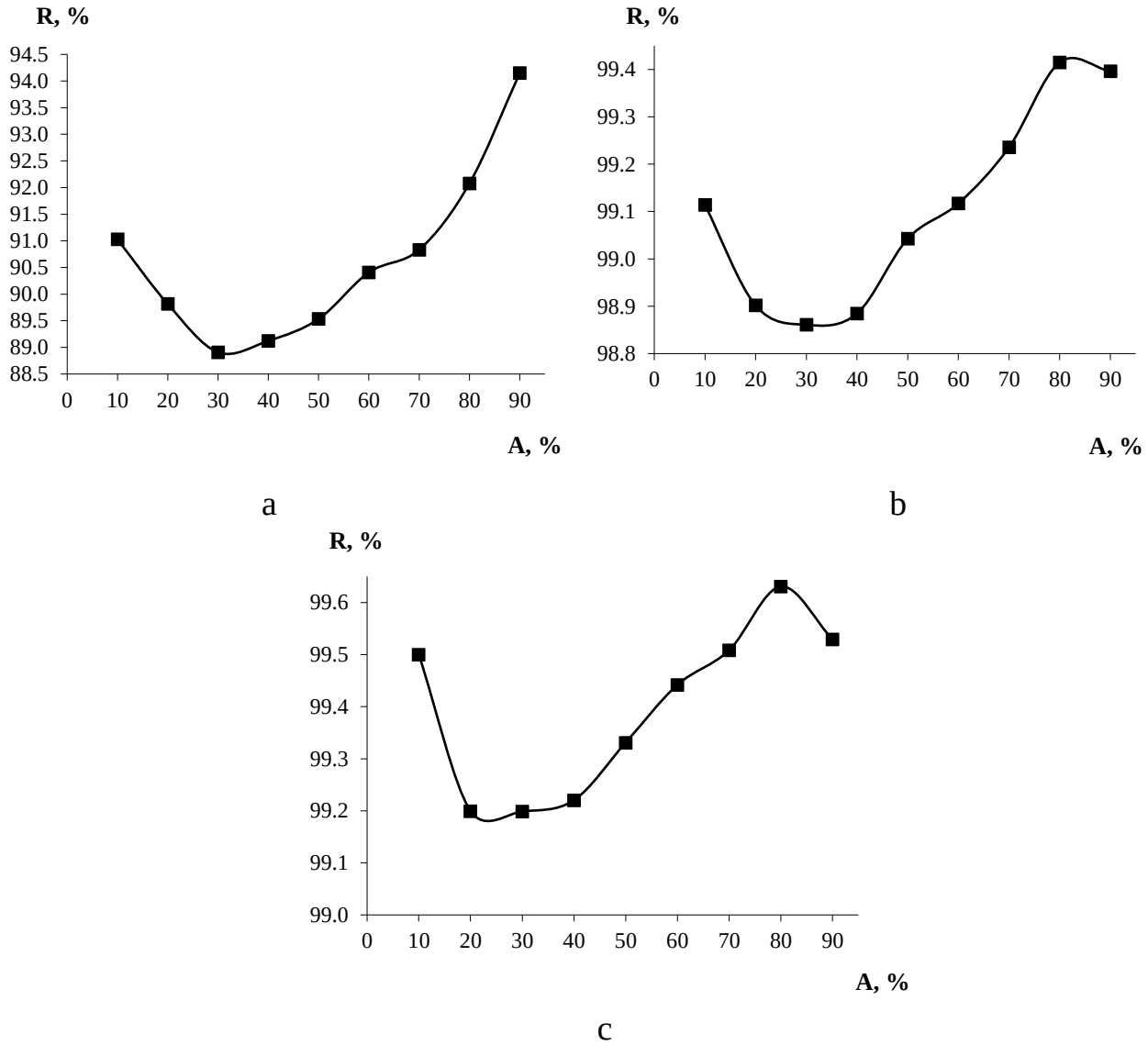

Figure 1. Dependence of the selectivity of the reverse osmosis membrane on chlorides (a), sulfates (b), ions of hardness (c)

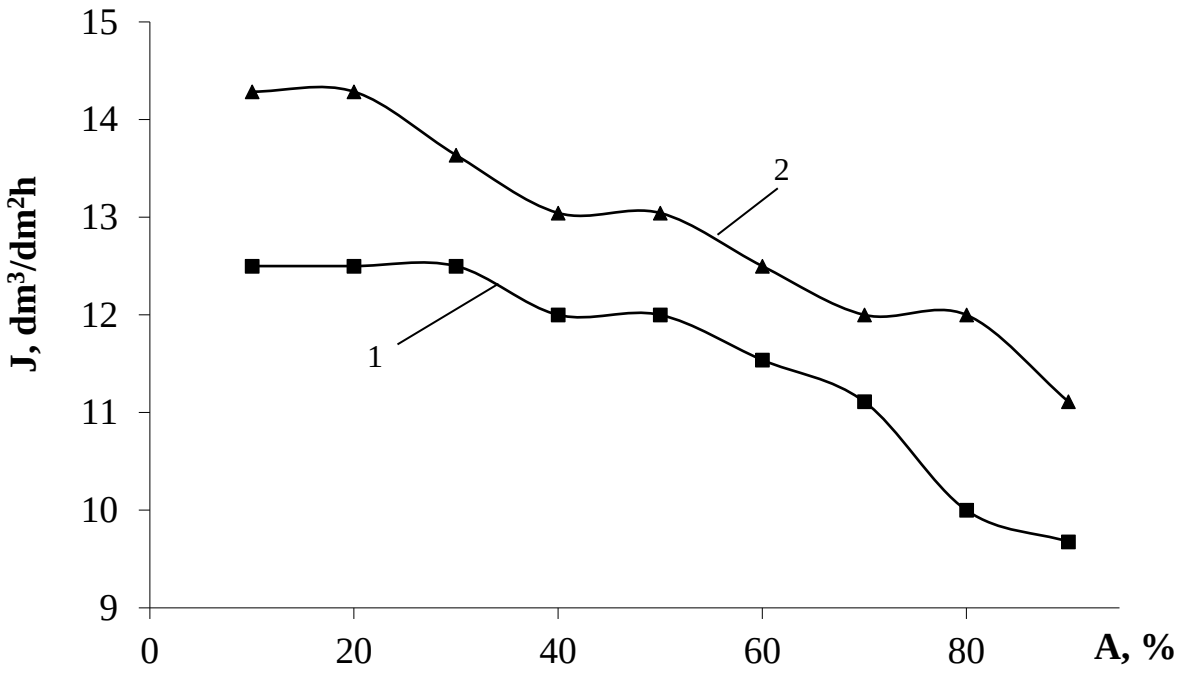

Figure 2. Dependence of the productivity of the reverse osmosis membrane Filmtec TW-30-1812-50 on the degree of selection of permeate during desalination of unfiltered (1) and filtered model solution (2)

During filtering, the Filmtec TW30-1812-50 membrane was characterized by the lowest selectivity of 89-95% in relation to chlorides; the selectivity towards sulfates and ions of hardness reached the values 98.8 - 99.7%.

Thus, initial lighting of water leads to a decrease in water turbidity from 0.5 to 0.1 mg/dm^3 and to increase in membrane productivity up to 1.2-2.0 times.

The optimal parameters of membrane desalinization of solutions providing high water quality were determined in the work.

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