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ANALYSIS AND SELECTION OF THE METHOD OF PURIFICATION OF OILY WASTEWATER

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Abstract: This article is devoted to the analysis and selection of a method for wastewater treatment containing petroleum products. The advantages of baromembrane separation are given, as well as the rationale for choosing the ultrafiltration method as the most promising membrane method for wastewater treatment of transport enterprises. Ultrafiltration membranes have a wide range of applications in various industries. They are successfully used in the wastewater treatment processes of oil refineries and transport enterprises from emulsified petroleum products, in industrial wastewater reuse systems. For the purification of oily wastewater from transport enterprises, a design of a flat-chamber multi-section apparatus of the "filter press" type is proposed, which most fully meets the requirements for the purification of oily wastewater.

Keywords: treatment methods, baromembrane separation, ultrafiltration, oily wastewater, water purification, ultrafiltration membranes, flat-chamber membrane module, quality of wastewater

АНАЛИЗ И ВЫБОР МЕТОДА ОЧИСТКИ НЕФТЕСЫЩЕННЫХ СТОЧНЫХ ВОД

Аннотация: Данная статья посвящена анализу и выбору метода очистки сточных вод, содержащих нефтепродукты. Приведены преимущества баромембранного разделения, а также обосновано выбор метода ультрафильтрации как наиболее перспективного мембранного метода очистки сточных вод транспортных предприятий. Ультрафильтрационные мембраны имеют широкий спектр применения в различных отраслях промышленности. Их успешно применяют в процессах очистки сточных вод нефтеперерабатывающих и транспортных предприятий от эмульгированных нефтепродуктов, в системах повторного использования промышленных сточных вод. Для очистки нефтесодержащих сточных вод транспортных предприятий предложена конструкция плоскокамерного многосекционного аппарата типа «фильтр-пресс», наиболее полно отвечающего требованиям очистки нефтесодержащих сточных вод.

Ключевые слова: методы очистки, баромембранное разделение, ультрафильтрация, нефтесодержащие сточные воды, очистка воды, ультрафильтрационные мембраны, плоскокамерный мембранный модуль, качество сточных вод.

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The widespread use of oils and petroleum products in industry leads to the fact that wastewater from almost all transport enterprises contains emulsified petroleum products in greater or lesser quantities. The most common methods of wastewater treatment from emulsified petroleum products are based on the destruction of the emulsion structure by inorganic electrolytes, followed by separation of oil pollution by sedimentation, flotation, separation in the field of centrifugal forces. At the same time, the chemical composition of the water changes, making it difficult to reuse it.; significant consumption of reagents and electricity. Currently used methods and technological schemes for the purification of oily wastewater containing emulsified petroleum products most often do not reduce the content of harmful substances to concentrations that allow water to be reused or sent to urban sewers or dumped into a reservoir, which causes significant environmental pollution. Petroleum products in the wastewater of transport enterprises are polydisperse and can be in coarse form, with a droplet size of 100 microns; finely dispersed form, with a droplet size of 1-100 microns and colloidal form, with a droplet size of up to 1 microns [1]. Since petroleum products belong to high-molecular compounds, ultrafiltration has become the most widespread for the treatment of oily wastewater. Separation of dispersed particles by an ultrafiltration membrane. This is primarily due to the fact that the particle size exceeds the pore size of the membranes. Ultrafiltration membranes have a pore size from 0.01 to 0.1 microns. To carry out the ultrafiltration process, an excess pressure of 2 to 10 atm is required, while emulsified oils, metal hydroxides, colloids, emulsions, suspended particles and other high-molecular compounds are removed from water or other liquid medium. Ultrafiltration membranes have a wide range of applications in various industries. They are successfully used in the wastewater treatment processes of oil refineries and transport enterprises from emulsified petroleum products, in industrial wastewater reuse systems [2,3]. Industrial devices for conducting membrane processes should be easy to assemble and install, and have the ability to replace membranes. The liquid should be evenly distributed over the membrane surface and have sufficiently high flow velocities to reduce concentration polarization. The pressure drop in the device should be as minimal as possible. These requirements are most fully satisfied by the designs of flat-chamber type devices [4,5]. The diagram of the flat-chamber membrane module is shown in Fig. 1.

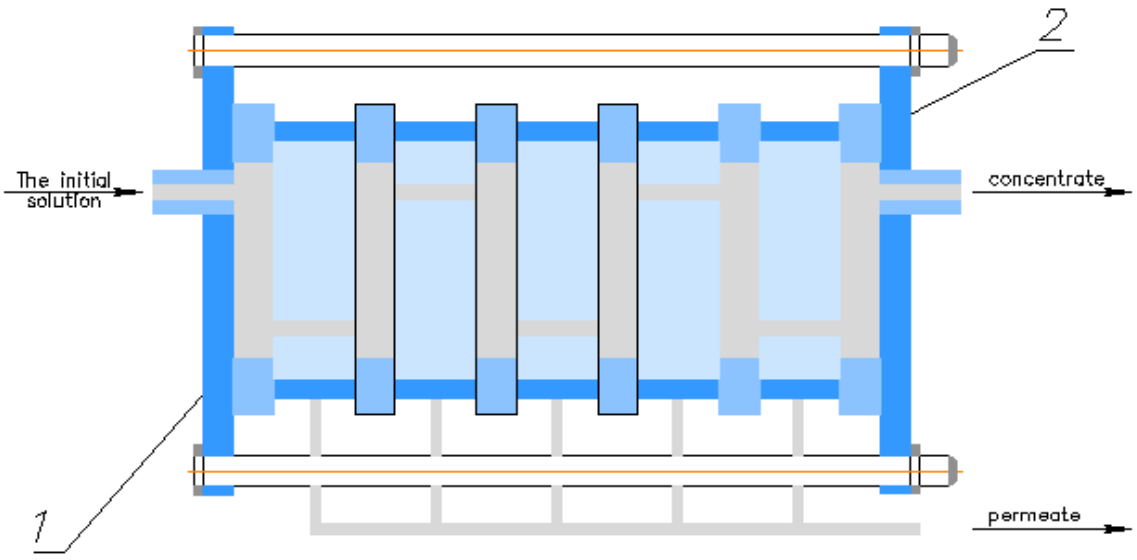

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Fig. 1. A flat-chamber multi-section apparatus of the "filter press" type (1 — membrane; 2 — drainage material)

The purified water moves in a space limited by a selectively permeable membrane. The transit flow passing through the filter unit returns to the source tank, the filtrate is discharged through the filtrate outlets. Continuous cleaning of the filter surface of the flat-chamber membrane module is achieved by a transit flow of waste liquid.

The treatment of oily wastewater by baromembrane methods is increasingly being used. Comparative studies were conducted [6,7] of different methods used for the treatment of oily wastewater from railway enterprises, according to the amount of costs per cubic meter of wastewater treatment. The use of gravity separation and flotation with dissolved air cost $3.65. The cost of wastewater treatment on the CURE electrocoagulator is $2. At the same time, after electrocoagulation treatment, about 2% of the sludge from the total volume of wastewater was obtained. The treatment of oily wastewater was also evaluated using semi-fiber ultrafiltration modules Romicon Sh 32-5 and tubular ultrafiltration modules Koch-nFM 276. The cost of cleaning on membrane modules is $1.03-$1.56. The paper also provides comparative data on the quality of purification on ultrafiltration modules, an electrocoagulator, a flotation device, see Table 1. At the same time, the initial content of petroleum products is 1g/l, COD is 1.5 g/l, suspended solids are 0.1 g/l.

Table 1 The quality of wastewater after various treatment methods

Indicators of purified water	Hollow fiber membrane modules	Tubular membrane modules	Electrocoagulation	Flotation
Petroleum products, g/l	0,01	0,005	0,03	0,024
COD, g/l	0,75	0,375	0,780	0,742
Suspended solids, g/l	<0,001	<0,001	0,03	0,049

It is advisable to pre-purify the purified water (sedimentation, filtration), since a high concentration of petroleum products and suspended particles requires frequent flushing of the membranes. [8].

Baromembrane separation is carried out without phase transformations and energy is spent mainly on creating the pressure of the initial solution, moving it in the apparatus and pushing it through the membrane [5-7]. Another advantage of baromembrane separation is the simplicity of the design of installations, which include two main elements: a pump for creating pressure of the initial liquid and a membrane apparatus [5-7]. The separation process takes place at ambient temperature, does not require the use of reagents, concentrated substances are easy to dispose of, purified waters or solutions can be reused [5,6], thereby saving natural resources and electricity.

Membrane technologies belong to the category of resource-saving technologies, the use of which makes it possible to improve the quality of wastewater discharged, reduce the quantitative discharge of pollutants into reservoirs and minimize the intake of natural waters due to the possibility of reuse of treated wastewater in closed water supply systems. The widespread use of membrane methods in many industrial processes is possible due to the fact that the properties of membranes can be adapted to the technical requirements, the satisfaction of which is necessary for

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the successful implementation of these processes [9-11]. Thus, it is necessary to conduct theoretical and experimental studies aimed at substantiating the choice of determining technological parameters of ultrafiltration plants, as well as choosing the optimal combination of methods for pretreatment of oily wastewater, which allows reducing environmental damage from transport enterprises and saving natural resources.

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