NATIONAL UNIVERSITY OF „KYIV-MOHYLA ACADEMY”
SCIENTIFIC CENTER OF POLISH ACADEMY OF SCIENCES IN KYIV

III Ukrainian-Polish scientific conference

„MEMBRANE AND SORPTION PROCESSES AND TECHNOLOGIES”

BOOK OF ABSTRACTS

December 12-14, 2017
Kyiv, Ukraine

УДК 544.076.34 (063)
ББК 24.5 я2
U31

Editors:
P. Vakuliuk

Design and typesetting
P. Vakuliuk

III Ukrainian-Polish scientific conference „Membrane and Sorption processes and technologies" (Kyiv, December 12-14, 2017). Abstracts / Editors: Vakuliuk P. – Kyiv: NaUKMA, 2017. – 315 p.

ISBN

This III Ukrainian-Polish scientific conference is devoted to the problems in the field of membrane and sorption technologies, their fundamental, applied and industrial aspects, is aimed at international integration of science and education, forming cooperation between universities and research institutions.
Scholars, students and other representatives from scientific, educational and industrial institutions are invited to take part in the conference. The conference will include oral presentations and posters. Additionally, leading experts and scientists in the area of membrane and sorption technologies will present the plenary sections.

TOPICS
Scientific program of the conference includes:
membrane and sorption processes: baromembrane processes; electromembrane processes; membrane gas separation; membrane distillation and pervaporation; novel and non-traditional membrane processes; sorption processes and sorption from liquids and gases; sorption with nanodispersed materials; sorption processes in catalysis; biosorption; hybrid membrane-sorption processes and technologies; nanotechnologies in membrane and sorption processes andmaterials; fuel cells and batteries; membrane contactors; membrane reactors;
membrane and sorption processes applications: membrane and sorption materials for medical application; membrane materials for alternative energy sources; membrane technology in food industry; membrane bioreactors; nanomaterials of biomedical application; heterogeneous catalysis; wastewater treatment and water purification;
membrane and sorbent formation and modification: polymeric and inorganic membranes: formation, structure, properties; sorbents: preparation, structure, properties; nanocomposite membranes and sorbents; tissue engineering; functional nanomaterials and polymers; catalytic membrane and sorptionsystems; hydrogel membranes; supramolecular systems.

УДК 544.076.34 (063)
ББК 24.5 я2
U31

ISBN

Authors are fully responsible for the content of the abstracts.
No technical or language corrections were made during editing.

PERSPECTIVE METHOD OF CLEANING WATER FROM TOXIC SUBSTANCES

Pashchenko B.[a], Shtefan E. [a], Lytvynenko A [a].
[a] National University of Food Technologies
Kyiv, Volodymyrska st. 68, Ukraine, 01601
e-mail: hoykke@gmail.com

Introduction of new technological processes in industry, the using of mineral fertilizers and pesticides in agriculture the shortage and imperfection of water purification facilities reduce the efficiency of wastewater treatment. Most of the toxic pollutants in the water is compounds of chemical and biological origin are discharged into natural reservoirs with industrial and municipal waste water. Traditional water purification technologies do not always provide the necessary sanitary-hygienic requirements. It is necessary the increasing the efficiency of all components of the system of treatment facilities and the using of promising ways to intensify the purification for improving the quality of water purification [1].

The authors conducted experimental research for determining the effectiveness of the simultaneous action of hydrodynamic cavitation and oxidants on ions of toxic metals with further separation of reaction products on ceramic filtration membranes.

The content of toxic substances in the samples was determined by gas chromatography with previous concentration. A polymer sorbent – tenax – with a specific surface area was used for concentration 30 m^2/g. Water was passed through a soroxial tube with a tenax on which pollutants were adsorbed. The impurities were washed from the sorption tube with an organic solvent and chromatographic analysis of the extract was conduct.

Sample analysis was conduct on a "Hewlett Packard" chromatograph in a temperature range 40…200 °C at programming 5 °C/min. Quantitative analysis was performed by using of absolute calibration method.

The waste water of galvanic production was subjected by reagent clearing with pH 8.5, which contaminated with ions of heavy and non-ferrous metals. The reagent-oxidant (water solution of $Ca(OH)_2$) was introduced into the cavitation flow of the environment through the means of creating a cavitation.

Water with a similar composition of pollutants was treated in the traditional way for comparison.

The sediment, which was formed in the neutralization of toxic pollutants, was separated with using a ceramic membrane module based on Al_2O_3 with an internal selective layer based on ZrO_2 [2].

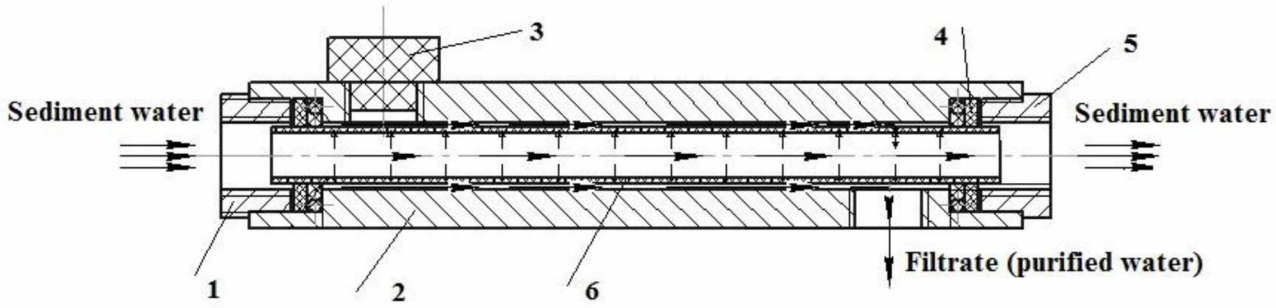

Fig. 1. Scheme of the cleaning ceramic module: 1, 5 – fitting, 2 – housing, 3 – plug, 4 – sealing rings, 6 – ceramic membrane.

The membrane module of the treatment plant (Fig. 1) consists of: fitting 1,5; housing 2, plug 3, sealing rings 4, ceramic ultrafiltration membrane 6. Water was fed under pressure P_1 = 0.4 MPa at a flow rate ϑ = 55 l/h and at P_2 = 0.6 MPa at a flow rate ϑ = 60 l/h in accordance. At the same time there was a gradual change in productivity, depending on the duration of the filtration process as a result of sediment compaction on the inner surface of the membrane (Fig. 2).

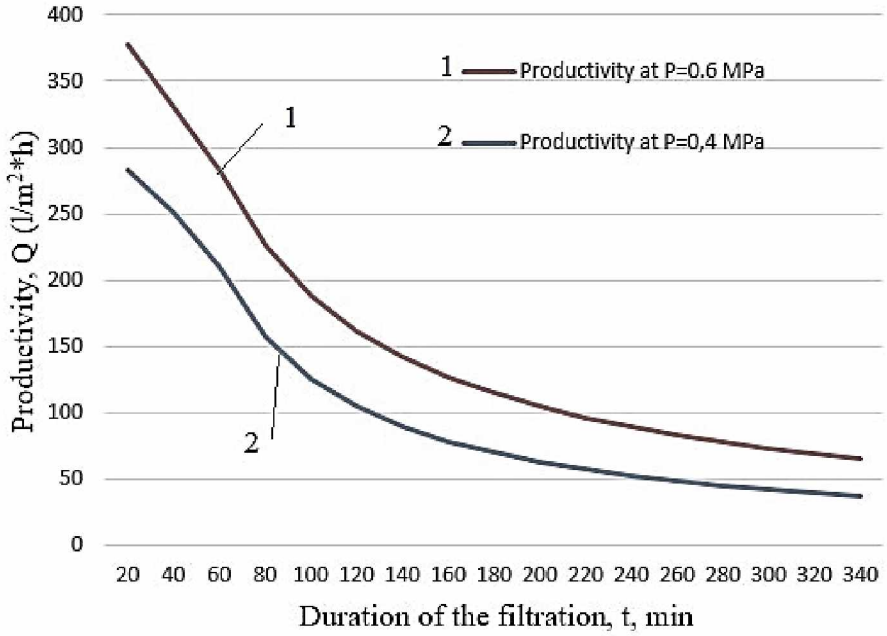

Fig. 2. Dependence of productivity on the duration of filtration.

The process of ultrafiltration, which occurred during separation of the sediment, is described by equations of balance. The equation is represented in the form of the law of conservation of the amount of motion with taking into account the law of mass conservation. At the same time for each of the phases the equation of relative motion has the form:

$$\alpha_1\left(\rho_1\frac{d\mathbf{u}}{dt}-\rho_2\frac{d\mathbf{v}}{dt}\right)-\nabla\boldsymbol{\sigma}^{\mathbf{f}}-\frac{\mathbf{R}}{\alpha_2}-\alpha_1(\rho_1-\rho_2)\mathbf{G}=0\ , \tag{1}$$

$$\rho_2\frac{d\mathbf{v}}{dt}=-\nabla\mathbf{P}-\frac{\mathbf{R}}{\alpha_2}+\rho_2\mathbf{G}=0\ , \tag{2}$$

The force R, which is proportional to the relative average flow velocity of the fluid, is taken into account in accordance with the specific mechanism of interpenetration of the phases of the system [3]:

$$\mathbf{R} = \frac{\mu}{a^2}\alpha_1\alpha_2(\mathbf{v} - \mathbf{u}), \quad (3)$$

where μ – coefficient of dynamic viscosity; a – a generalized coefficient, which taking into account the type of pore material of the membrane [3].

The purification results are shown in Table 1.

Table 1

The results of purification of the treatment water

Composition of pollutants	Waste water before cleaning	Waste water purified in a mechanical stirring reactor	The waste water is purified in a new method
	The content of pollutants, mg/l		
Cr^{B+}	0,15	0,03	0
Fe*	2,4	0,01	0
Fe^{-+}	7,8	0,20	traces
Cu	0,04	0	0
Pb	0,05	0	0
Mg	46,0	0,27	traces

Conclusions. The authors propose a promising method of wastewater treatment from toxic pollutants. It involves the combined decontamination from ions of heavy and non-ferrous metals in conditions of hydrodynamic cavitation. Further purification was realized out by ultrafiltration on modules with ceramic membranes. The expediency of this method is substantiated and their results are given in comparison with typical cleaning technologies. A more detailed mathematical modeling of the process is planned in the future which is intended for in-depth analysis of deformation of filter elements.

References:

1. Lytvynenko A.**:** Perspective equipment for cleaning wastewater from greenhouses. Technological audit and production reserves, 2014, vol. 3/5(17), pp. 42-44.
2. Pashchenko, B., Shtefan, E.: Determination of phase concentrations at the membrane filtration of liquid environments. Sci. Works. ONAFT, 2016, vol. 80, pp. 94-97, Odessa, ONAFT.
3. Shtefan, E., Blazhenko S.: Construction of an analytical model of deformation processes of dispersed materials. Int. Per. Sat. Sci. Works. "Processing of dispersed materials and environment. Theory, research, technology, equipment", 2003, vol. 13, pp. 26-33. Odessa, NPO "VOTUM".