A NEW-TYPE MEMBRANE MODULE REDUCING THE FOULING AND BOUNDARY LAYER PHENOMENA

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Membrane processes become common techniques in nuclear technologies nowadays. Various membrane methods were applied in nuclear centers in the world, including full-scale installations operated in continuous mode and cleaning different kinds of radioactive waste. One of the serious problems of pressure driven membrane processes is the permeate flux decline that occurs in time of operation of filtration systems. The phenomena responsible for this are concentration polarization and progressive fouling of the membranes that implicate the regular cleaning of the membranes and interrupting the processing. One of the effective methods of fouling minimization is the regulation of hydrodynamic conditions in the module. This can be attained by the use of special baffles in the apparatus, which improve mass exchange conditions or by the application of pulse flow. The application of Taylor flow creating the vortices by the use of movable parts that results in self-cleaning effect of the membrane surface, was considered, as well. The SpinTek Membrane Technology based on rotating membrane discs was successfully tested in the Los Alamos Nuclear Laboratory and its implementation for the processing of the U.S. Department of Energy (DOE) tank radioactive waste was considered [1,2].

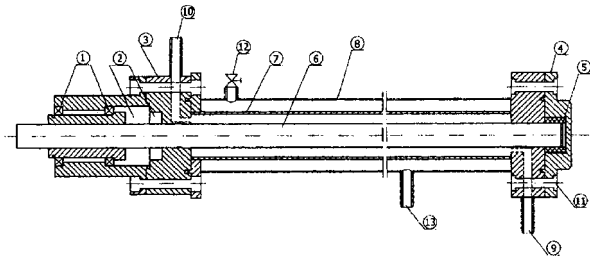

Fig. A scheme of the helical membrane apparatus for radioactive waste processing: 1 – ball bearings, 2 – seal gap, 3 – front shield, 4 – shield with the socket, 5 – socket, 6 – rotor, 7 – tubular membrane, 8 – housing, 9 – feed inlet, 10 – retentate outlet, 11 – clamping screw, 12 – vent, 13 – permeate outlet.

A new membrane contactor with helical Couette-Taylor flow (CTF) in the annular space between the tubular membrane and the surface of rotating shaft (Fig.) was applied to separate radioactive compounds after precipitation or complexation by macromolecular ligands. CTF is a combination of the axial Poiseuille flow and the rotating Couette flow with axisymmetric Taylor vortices. Such a combination results in limited axial dispersion coefficients in relation with dispersion coefficients in other directions, independence of intensity of mixing on residence time in the apparatus and good transport parameters.

The new construction of the membrane apparatus that changes the hydrodynamic conditions in the module and promotes turbulence, allows increasing efficiency of separation and reduction of the membrane fouling. The advantages of helical apparatus with porous tubular membrane are expected in:

- simplicity of the construction in comparison with dynamic filtration by use of rotating discs;
- high mass transfer coefficients to the membrane surface;
- good effects of mixing, especially when the rotor is asymmetrically assembled or pulse flow is applied;
- the possibility of replacement of the rotating shaft by spiral insert creating helical flow.

The experiments with suspensions of different concentration were carried out in static and dynamic conditions. The apparatus can be used as a filtration stage after formation of precipitate or metal complexes, as well as a membrane contactor in the process of solvent extraction used for radioactive waste processing [3].

References

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GROUNDWATER MONITORING IN THE AREA OF OPENCAST BEŁCHATÓW

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Groundwater analyses in the area of the opencast lignite mine Bełchatów and Szczerców have been continued since 2000. The field work contains analyses of macro- and microion concentrations as well as measurements of tritium, radon-222 and mean radioactivity (^{40}K). Complementary to these