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II Ukrainian-Polish scientific conference
**„MEMBRANE AND SORPTION PROCESSES AND
TECHNOLOGIES”**

BOOK OF ABSTRACTS

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This II 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; biosorption; hybrid membrane-sorption processes and technologies; nanotechnologies in membrane materials and processes; fuel cells and batteries; membrane contactors; membrane reactors; membrane spacers;

membrane and sorption applications: membrane materials for medical application; membrane materials for alternative energy sources; membrane technology in food industry; membrane bioreactor; water purification; wastewater treatment;

membrane and sorption development: polymeric and inorganic membranes: formation, structure, properties; sorbents: preparation, structure, properties; nanocomposite membranes; electrochemical membrane processes; tissue engineering.

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SOME KIND OF DEAD-END ULTRAFILTRATION MODULES FOR FOOD INDUSTRIES

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Membrane processes are being more and more widely used in food industry as a means for separating or concentrating chemical or biological substances. Among the different types of separators, hollow-fiber modules are commonly used for applications as different as a milk whey, artificial kidneys, water clarification, etc. Because of their tubular geometry, hollow fibers can be used for inside-out or outside-in flow. In the first case, the feed flows inside while the permeate is collected on the fiber outside. Permeate flows back through the membrane, lifts off the cake and flushes it out of the module. Each operating cycle is thus made up of a filtration phase followed by a backwash phase that allows the membrane to recover its initial properties [1].

In a membrane separation process two main operative designs are possible: cross-flow and dead-end. A schematic representation of a dead-end membrane separation stage is reported in figure 1 [2].

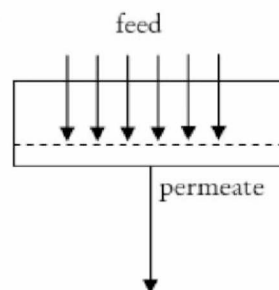


Fig. 1. Schematic drawing of a dead-end membrane separation stage [2]

For example, C. Serra gives a description the structure of this module in his published work as: the modules operate in the dead-end mode, the feed and permeate flow rates are identical ($Q'_s = Q''_p = Q_f$) [1]. The permeate outlet and the feed inlet are at opposite ends of the module. The fibers are closed at one end by a resin plug of length l_1 located on the inlet end; the fibers are held in the carter by a length l_2 of potting resin located at the outlet end (see Fig. 2). The longitudinal z axis has its origin at the right-hand end of the resin plug and the useful length of the fibers is L . So the pressure within the fiber bundle after the resin plug is denoted by p'_0 ; the pressure inside the fiber just before the potting resin is p''_L . The inlet feed pressure (before the resin plug) is $p'_\&$ and the outlet permeate pressure (to the right of the potting resin) is p''_p [1].

An overall balance on the water gives these expressions:

$$Q'_s = Q''_p = Q' + nQ'' = Q_f. \quad (1)$$

Capillary and hollow fiber modules have the highest membrane surface area per element; however, due to the high density packaging, these modules appear to be very sensitive to the feed stream quality in terms of fouling potential.

Membrane operations, with their intrinsic characteristics of efficiency and operational simplicity, high selectivity and permeability for the transport of specific components, compatibility between different membrane operations in integrated systems, low energetic requirement, good stability under operative conditions, advanced control, easy scale-up and elevated flexibility, are today used in a large number of industrial applications.

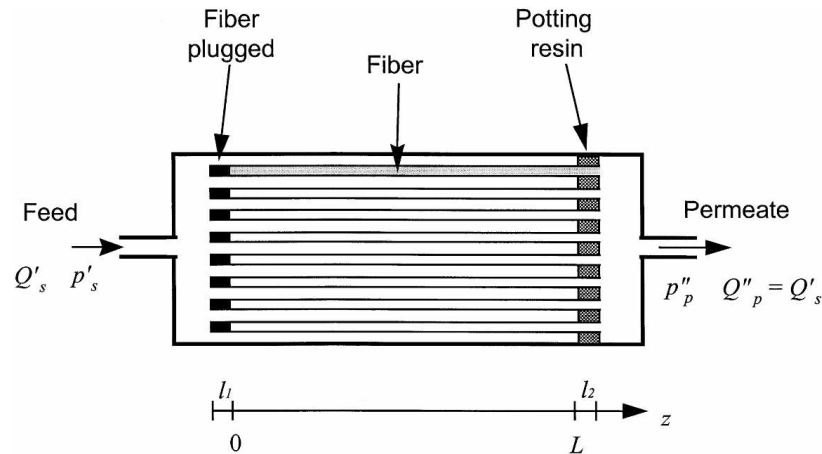


Fig. 2. Schematic diagram of a hollow-fiber module operating in outside-in and dead-end mode [1]

The vast majority of membrane materials are nowadays polymeric, although the demand for non polymeric materials for special applications, including ceramic, metal and composite types, registers a rapid growth. Typical examples are zeolite membranes applied to promote the molecular separation and the catalytic act [7,8] ceramic membranes for high temperature applications [9], and perovskite type membranes for oxygen separation and catalytic reactors for syngas production and the partial oxidation of hydrocarbons [6, 9].

Ultrafiltration (UF) involves pressure-driven separation of materials from a feed solution. The technology achieves separation through sieving and is used to remove particulate and microbial contaminants, but does not remove ions or molecules of low molecular weight. The process typically operates with a feed pressure of 4 to 100 psig (0.28 to 6.9 bar). UF plants are automated and have low operational labor requirements. Depending on the feed water quality, these systems can require frequent cleaning. UF membranes generally may have a service life of five years or longer, depending on system operations. UF technology is commercially available in tubular, hollow-fiber, plate and frame, flat sheet, and spiral wound configurations.

UF membranes reject solutes ranging in size from 0.005 microns and larger. The UF membrane process separates molecules in solution on the basis of size. The pore size and molecular weight cut-off (MWCO) are often used to characterize a membrane. The pore size is the nominal diameter of the openings or micropores in the membrane expressed in micron (micron meters μm). The MWCO is the molecular mass or weight of a solute that rejects greater than 90 percent. The unit of measurement for MWCO is the Dalton (D).

Very promising for using there are modules IntegraPacTM. These modules are made from high strength, hollow fiber membranes and are engineered to reduce design and fabrication requirements with features and benefits including:

- 0.03 μm pore size for removal of bacteria, viruses, and particulates, a 6 log removal of bacteria, a 2.5 log removal on viruses and a <2.5 SDI guarantee with proper operation;
- PVDF fibers which offer strength, chemical and fouling resistance which allows for extended membrane life and consistent long term performance;

Outside-In flow configuration which allows higher TSS feed waters, while maintaining reliable system performance and producing high quality filtrate.

Innovative end-cap design enables direct coupling of modules reducing the need for piping and manifolds. The outside-in flow configuration allows the use of highly effective air scour cleaning which enhances particle removal and improves recovery. A dead-end flow format achieves higher recovery and energy savings. The module housing design eliminates the need for separate pressure vessels while the vertical orientation allows easy removal of air from cleaning and integrity testing processes.



The IntegraPac™ module is shown in Figure 3. There are six connections on each module. The top end cap includes 4” DN 100 concentrate ports and an 1/2” DN 40 union for the. The bottom end cap includes 4” DN 100 feed ports and a 3/8” air inlet connection on the side allowing for easy access. Included with the module are the couplers, air fitting, and transparent filtrate elbow.

The influence of the fiber properties is apparent in the fact that the net production rate could be clearly improved by increasing the hydraulic permeability coefficient of the membrane or by raising the pressure threshold that fixes the beginning of the backwash phase. However the latter parameter is only partly determined by the mechanical strength of the fibers.

The current pre-treatment of milk whey uses ultrafiltration modules that have been designed to withstand high temperatures and pressures whilst occupying a smaller footprint. Each module vessel is self-supported and resistant to corrosion and accommodates easy removal and replacement of the module without the cost of replacing the vessel itself.

Implementation of these technologies in the food industry of Ukraine is an important step on the road to economic independence and well-being life.

Fig. 3. IntegraPac™ Module

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