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A SURVEY OF STRUCTURE CHARACTERIZATION METHODS FOR ULTRAFILTRATION AND REVERSE OSMOSIS MEMBRANES

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ABSTRACT

Asymmetric membranes consist of a thin skin, which is permselective to certain molecules in solution, and a porous support, serving as a mechanical support layer and also as a transport layer for the permeate. Both in ultrafiltration and in hyperfiltration (reverse osmosis) asymmetric membranes are in use. Two different types of methods can be distinguished for the characterization of porous properties of membranes, aiming resp. at *morphological structure* and *permeability* of membranes.
The methods at hand to characterize the morphological structure of membranes are akin to those used for wet spun polymer fibers. Thus, scanning electron microscopy, thanks to its large depth of focus has given insight as to the type of pores existing in support layers (closed or open cells). It is much more difficult to get relevant information on morphological structures existing in the skin. Transmission electron microscopy, which is able to show domain structures ($\gtrsim$ 500 Å) in thin films of block-copolymers, should give some of the answers here.
Further ways to characterize porous membrane structures are to be explored in mercury porosimetry (pressing mercury in dried and evacuated membrane materials) and through gas adsorption measurements (BET-method). In both cases membrane treatment must be such that the pores are kept in their original size and shape (liquid exchange to non-swelling liquids before drying).

The second and more direct way in defining membrane performance concerns selective permeability and is characterized by the so-called cut-off of membranes. A basic assumption made very often here is that permeability decreases with molecular size, because of a given pore size distribution in the skin. It should be realized that except for the pore sizes in the membrane and the size of the permeating substance, also the chemical nature (charge, extent of hydration) of the substances to be separated and that of the membrane material are important. Some relevant criteria for the choice of testing compounds in cut-off studies will be given, and typical results for all the foregoing topics will be presented.