386b Enhanced Surface Flow Membranes for Ethanol Separation

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Separation of ethanol from water has been achieved by pervaporation using dense skin membranes. Pervaporation process involves phase change so requires high energy. Since dense membrane is used, the specific permeation rate is low, approximately in the range of 10^{-9} to 10^{-10} g cm/cm^2 min. In this paper, the emphasis is on the development of porous membranes with specific interaction with ethanol to enhance selective surface flow of ethanol from its mixture in aqueous phase. Usually, porous membranes exhibit no specificity towards the permeate molecules other than exclusion by size. In this study, surface flow is attempted to increase membrane specificity to ethanol by the hydrophobic interaction between the surface of membrane pores and ethanol molecules. Experimental results show that ethanol can selectively permeate through membranes by facilitated permeation through hydrophobic membrane. The selectivity of ethanol over water is about 2.5 depending on the membrane hydrophobicity and pore size. The specific permeation rate is in the order of 10^{-6} g cm/cm^2 min. Since excess ethanol is preferentially removed instead of bulk phase water, membrane area requirement is reduced substantially. Both the surface hydrophobicity and membrane pore size play important roles in the selective permeation process. A theoretical model has been developed to describe this surface flow process through membrane, which provides a guideline for the selection of membrane with high specificity towards permeate molecules.