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Preparation and characterization of PEG/PVDF composite membranes and effects of solvents on its pervaporation performance in heptane desulfurization

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ABSTRACT

Polyethylene glycol/polyvinylidene fluoride (PEG/PVDF) composite membranes were prepared using different water–organic solvent mixtures and the composite membranes obtained were characterized by Fourier transform infrared spectroscopy (FTIR-ATR), scanning electron microscopy, wide-angle X-ray diffraction (WAXD), and X photoelectron spectroscopy (XPS). Pervaporation (PV) experiments were conducted to characterize the sulfur removal properties of the PEG/PVDF composite membranes using a feed mixture of heptane and ethyl thioether with a sulfur concentration of 300 ng/μL over the temperature range of 65–80°C. All membranes investigated in this work showed proper PV performance and the E-PEG exhibited the highest PV flux and the highest sulfur enrichment factor of 5.17 at 65°C. The correlation of membrane crystallinity and surface oxygen content with PV performance was established. A decrease in membrane crystallinity or an increase in surface oxygen content greatly improved the membrane desulfurization property which was due to a decrease in mass transport resistance and an increase in sorption at membrane surface respectively. Finally, suggestions on the establishment of mass transfer model in PV process were made based on the results of the WAXD, FTIR-ATR, XPS studies and PV experiments.

Keywords: Composite membrane; Pervaporation; Desulfurization; Solvent effect

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