Performance of silica-filled hybrid membranes dispersed by applying mediating surfactant in pervaporative removal of toluene from water

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ABSTRACT

Novel hybrid membranes were prepared by dispersing silica nanoparticles in the active layer of the composite membrane using polyoxyethylene sorbitan monopalmitate (Tween 40) as the mediating surfactant. The fabricated membranes were characterized by Fourier transform infrared spectroscopy, wide-angle X-ray diffraction, thermal gravimetric analysis, scanning electron microscopy, energy-dispersive X-ray spectroscopy, optical contact angle, and swelling degree measurements. The pervaporative performances of these membranes for removal of toluene from mixtures with water were investigated in terms of mediating concentration. By increasing the mediating content in the membrane’s matrix up to an optimum value of 2 wt.%, both toluene permeation flux and selectivity factor of the membrane were increased due to enhancement in the hydrophobicity and selective adsorption resulted from proper dispersion of the filler in the polymeric matrix. It was found that the membrane containing 2 wt.% mediating surfactant exhibits the highest selectivity factor of 7,779 and a permeation flux of 36.71 gm⁻²h for the feed with 150 ppm toluene at 25°C.

Keywords: Hybrid membrane; Silica nanoparticle; Mediating surfactant; Pervaporation; Volatile organic compounds

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