

Separation of CO₂ from CH₄ by pure PSF and PSF/PVP blend membranes : effects of type of nonsolvent, solvent, and PVP concentration

ABSTRACT

Complete CO₂/CH₄ gas separation was aimed in this study. Accordingly, asymmetric neat polysulfone (PSF) and PSF/polyvinylpyrrolidone (PVP) blend membranes were prepared by wet/wet phase inversion technique. The effects of two different variables such as type of external nonsolvent and type of solvent on morphology and gas separation ability of neat PSF membranes were examined. Moreover, the influence of PVP concentration on structure, thermal properties, and gas separation properties of PSF/PVP blend membrane were tested. The SEM results presented the variation in membrane morphology in different membrane preparation conditions. Atomic force microscopic images displayed that surface roughness parameters increased significantly in higher PVP loading and then gas separation properties of membrane improved. Thermal gravimetric analysis confirms higher thermal stability of membrane in higher PVP loading. Differential scanning calorimetric results prove miscibility and compatibility of PSF and PVP in the blend membrane. The permeation results indicate that, the CO₂ permeance through prepared PSF membrane reached the maximum (275 ± 1 GPU) using 1-methyl-2-pyrrolidone as a solvent and butanol (BuOH) as an external nonsolvent. While, a higher CO₂/CH₄ selectivity (5.75 ± 0.1) was obtained using N,N-dimethyl-acetamide (DMAc) as a solvent and propanol (PrOH) as an external nonsolvent. The obtained results show that PSF/PVP blend membrane containing 10 wt % of PVP was able to separate CO₂ from CH₄ completely up to three bar as feed pressure.

Keyword: Membranes; Separation techniques; Morphology.