

NOVEL POLYELECTROLYTE HYDROGEL MEMBRANE FOR ETHANOL DEHYDRATION VIA PERVAPORATION

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Pervaporation is an important membrane technology for separating azeotropic, close-boiling point, and heat sensitive mixtures, due to its cost-effective, energy-saving, and environment benignity. Recently, we fabricated a new composite membrane with a strong polyelectrolyte (PE) hydrogel as the active layer on polyethersulfone ultrafiltration support membrane. The active layer was graft polymerized using polyvinyl sulfonic acid as the polymer monomer and N,N'-methylenebisacrylamide (MBAA) as a cross linker monomer by the UV-photo initiation method. Due to the high ion-exchange capacity of the composite membrane, the goal of the current study was to investigate the new composite membrane for ethanol dehydration by pervaporation.

In this study, the effects of polymerization conditions on the pervaporation performance were investigated: monomer concentration (6.25-42% VSA), cross-linker concentration (1-10% MBAA), modification time (2.5-15 min), and molecular weight cut-off of the PES membranes (4 and 150KDa). The performances of the composite membrane for dehydration of ethanol were studied and the results were analyzed based on the membrane properties, namely ion exchange capacity and degree of grafting (thickness).

It was found that the DG increased with the VSA concentration, MBAA fraction, and irradiation time (at constant irradiation intensity 100 mW/cm²). However, the IEC was lower as the monomer concentration decreased or when a higher MBAA fraction was used. The performance of membrane was tested at 10% (water: ethanol) feed solution and 50 °C. The ethanol-water selectivity always went through a maximum and decreased as the DG increased. This was attributed to low IEC as the monomer concentration reduced or as the MBAA fraction increased. The selectivity changed in a non-linear manner and was 10-300 while the total flux was very high 15-6 kg m⁻² h⁻¹. The selectivity of the new composite membrane is the highest among the PE composite membranes and with outstanding total permeability PV membrane for ethanol dehydration. Furthermore, compared with other composite polymeric membranes, the performance of the new membrane is high (Figure 1). Further studies will focus on incorporating nanoparticles (NPs) to the PE hydrogel to improve the membrane selectivity.

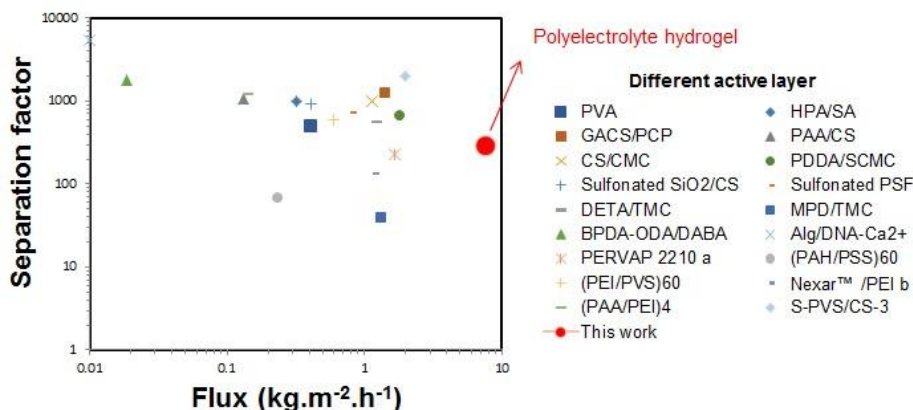


Figure 1 .Comparison of pervaporation performance in literature (Zheng et al. 2016).

Reference:

ZHENG P-Y, YE C-C, WANG X-S, CHEN K-F, AN Q-F, LEE K-R AND GAO C-J. 2016. Poly (sodium vinylsulfonate)/chitosan membranes with sulfonate ionic cross-linking and free sulfate groups: preparation and application in alcohol dehydration. Journal of Membrane Science 510: 220-228.