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Preparation and characterization of cross-linked poly (vinyl alcohol)/hyperbranched polyester membrane for the pervaporation dehydration of ethylene glycol solution

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Abstract: A novel composite membrane of cross-linked poly (vinyl alcohol) /hyperbranched polyester (PVA/HBPE) was prepared using glutaraldehyde (GA) as cross-linking agent for the dehydration of ethylene glycol/water (EG/water) mixtures. Hyperbranched polyester (HBPE) used in the preparation of PVA/HBPE membrane was synthesized through a pseudo one-step reaction of molten state 2,2-bis(hydroxymethyl)propionic acid (bis-MPA) and 1,1,1-trimethylol propane (TMP) using p-Toluene sulfonic acid (p-TSA) as the catalyst. The branching degree of prepared HBPE was 0.4551 determined by 13C NMR. FTIR, SEM, XRD, DSC, TGA, water contact angle and mechanical properties of PVA/HBPE membranes were measured to investigate the effects of HBPE on membrane structures and properties. PVA/HBPE membrane had a cross-linked structure and exhibited good thermal stability, good hydrophilicity and superior mechanical strength. When HBPE content was above 20 wt. %, HBPE particles formed on the surfaces of membranes and phase separation between PVA and HBPE occurred. With the increasing of HBPE content, feed water content and feed temperature, permeation flux increased significantly and separation factor decreased dramatically. The membrane containing 10 wt. % HBPE exhibited the best PV performance (water flux and separation factor were 43.77 g/(m^2·h) and 312 respectively for the 90 wt. % EG solution at 25ºC). The variation of permeation flux via feed temperature followed the Arrhenius relationship and the activation energy values were 12.83 and 39.29 KJ/mol for water and EG, respectively.

Keywords: Hyperbranched polyester; Poly (vinyl alcohol); Pervaporation membrane; Ethylene glycol solution

1. Introduction

Nowadays, environmental pollution and energy shortage are two thorny issues. In traditional industry, over

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