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Synthesis and characterization of CMC/PVA/PVP composite microfiltration membrane

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ABSTRACT

The aim of this study was to develop a composite membrane by phase inversion using carboxymethyl cellulose (CMC) as a basic material followed by characterization and performance testing. CMC was prepared from cellulose by alkalization and etherification of cellulose. CMC along with polyvinylpyrrolidone (PVP) and polyvinyl alcohol (PVA) were used to prepare composite membranes. Polyethylene glycol (PEG) was used as a pore forming agent. Characterization was done using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FT-IR), thermo-gravimetric analysis (TGA), and universal testing machine. SEM results indicated that the addition of PVP resulted in a smoother surface with a pore size ranged 0.1–10 micron as compared to the membrane fabricated without PVP. FTIR spectroscopy gave the bands that are attributed to the dispersion of PVA and PVP in substrate matrix. Weight loss started at 270°C with PVP treatment as compared to 210°C in the absence of PVP indicating the improved thermal stability of the membrane. Salt rejection efficiency was in the following order: NaCl < KCl < $CaCl_2$ with solutions passed through having 0.1%, 0.3%, 1.0%, and 3.0% salinity. Overall salt removal or salt rejection efficiency ranged from 27% to 37%. It was concluded that PVP had a positive effect on thermal stability, surface morphology, and mechanical properties of the membrane. The properties highlight the potential usage of the synthesized membrane in pretreatment for removal of larger particles such as macromolecules, proteins, colloids, and microbes.

Keywords: Carboxymethyl cellulose; Composite membranes; Polyvinyl alcohol; Polyvinylpyrrolidone

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