Development of polysulfone membrane via vapor-induced phase separation for oil/water emulsion filtration

ABSTRACT

The discharge of improperly treated oil/water emulsion by industries imposes detrimental effects on human health and the environment. The membrane process is a promising technology for oil/water emulsion treatment. However, it faces the challenge of being maintaining due to membrane fouling. It occurs as a result of the strong interaction between the hydrophobic oil droplets and the hydrophobic membrane surface. This issue has attracted research interest in developing the membrane material that possesses high hydraulic and fouling resistance performances. This research explores the vapor-induced phase separation (VIPS) method for the fabrication of a hydrophilic polysulfone (PSF) membrane with the presence of polyethylene glycol (PEG) as the additive for the treatment of oil/water emulsion. Results show that the slow nonsolvent intake in VIPS greatly influences the resulting membrane structure that allows the higher retention of the additive within the membrane matrix. By extending the exposure time of the cast film under humid air, both surface chemistry and morphology of the resulting membrane can be enhanced. By extending the exposure time from 0 to 60 s, the water contact angle decreases from 70.28 ± 0.61◦ to 57.72 ± 0.61◦ , and the clean water permeability increases from 328.70 ± 8.27 to 501.89 ± 8.92 (L·m−2 ·h −1 ·bar−1). Moreover, the oil rejection also improves from 85.06 ± 1.6 to 98.48 ± 1.2%. The membrane structure was transformed from a porous top layer with a finger-like macrovoid sub-structure to a relatively thick top layer with a sponge-like macrovoid-free sub-structure. Overall results demonstrate the potential of the VIPS process to enhance both surface chemistry and morphology of the PSF membrane.