ABSTRACT

The existence of the petroleum industry is vital to many industries and accounts for a large percentage of the world's energy supply. However, it also poses a serious threat due to the amount of wastewater produced daily, which needs to be treated to meet the EPA regulatory standards before disposal to the environment. In this study, blended Polysulfone (PSF) and Polyethersulfone (PES) polymeric membranes were synthesized for the treatment of phenol-containing wastewater. The main aim was to enhance the quality and separation performance of the membranes by improving its mechanical strength, morphology, and hydrophilicity. This is because polymeric membranes are commonly brittle and foul easily due to their hydrophobic nature, and this limits their commercial application. Polymer blending is one of the modifying techniques currently being explored to develop materials with unique anticipated properties depending on the type of membrane needed.

The blended membranes were synthesized at different PSF: PES ratio (100%:0%, 0%:100%, 50%:50%, 80%:20%, 20%:80% and 25%:75%) via the phase inversion method using N-Methyl- 2-pyrrolidone (NMP) as the solvent. The thermal property, surface roughness, and mechanical strength of the membranes were checked using Thermogravimetric analysis (TGA), Atomic force microscopy (AFM), and nano-tensile measurement, respectively. The performance of the membrane was tested through pure water permeation and separation of phenol and benzene from synthetic wastewater containing 20 ppm of phenol and 20 ppm of benzene using a dead-end filtration cell at a feed pressure of 100 kPa. AFM images show lower roughness in the pure PSF membrane as compared to the blended membranes. The tensile strength only improved on the 25%:75% membrane while the elasticity increased with an increase in PES concentration in the blended membranes. The flux, % rejection, and porosity as the performance criteria of membranes showed an improvement in the majority of the

blended membranes than in pure PES and PSF membranes. The PSF/PES blend of 25:75 wt% produced highly desirable results based on its performance and quality. These results demonstrate the significance of blending polymeric membranes to modify their specific properties for the desired function and highlight the possibility of more commercial applications.

Furthermore, the best-performing blended membrane obtained from the previous experiment was then embedded with pure CNTs (pCNTs) to investigate if CNTs will further enhance the quality and separation performance of the membrane due to the unique physicochemical and antifouling properties of pCNTs. The pCNTs were also functionalized using acid treatment to enhance their hydrophilicity, mechanical strength and dispersion capability, and then dispersed into the best- performed blended membrane. The best-performing blended membrane was loaded at different concentrations of pCNT, e.g. 0.5% pCNT, 1% pCNT, 1.5% pCNT and one with 1% functionalized CNTs (fCNTs). The same characterization methods used to evaluate the blended membranes were applied. The performance of these membranes was also tested through pure water permeation and separation of phenol and benzene from synthetic wastewater containing 20 ppm of phenol and 20 ppm of benzene using a dead-end filtration cell at a feed pressure of 100-300 kPa.The results show that embedding CNTs in the blended polymer (PSF/PES) increased both the porosity and water absorption capacity of the membranes, thereby resulting in enhanced water flux up to 309 L/m2h for the 1.5 wt.% pure CNTs loaded membrane and 326 L/m2h for 1 wt.% functionalized CNT- loaded membrane. Infusing the PSF/PES membrane with CNTs enhanced the thermal stability, and mechanical strength as well. Results from AFM indicate enhanced hydrophilicity of the membranes, translating in the enhancement of the anti-fouling property of the membranes. The % rejection of benzene and phenol in membranes with CNTs decreased with an increase in pCNTs concentration and pressure, while it increased in membranes embedded with fCNTs. The % rejection of benzene in pCNTs membrane decreased with 13.5% and 7.55% in fCNT membrane while phenol decreased with 55.6% in pCNT membrane and 42.9% in the FCNT membrane. This can be attributed to poor CNT dispersion resulting in increased pore size observed when CNT concentration increased. Optimization of membrane synthesis might be required to enhance the separation performance of the membranes.