Removal of remazol red dyes using zeolites-loaded nanofibre Coated on fabric substrates

ABSTRACT

Nanofibre-based membranes have shown great potential for removing textile wastewater due to their high porosity and surface area. However, nanofibre membranes exhibit lower dye removal efficiency. Hence, this study aims to improve the dye removal performance of nanofibre membranes by incorporating zeolites. The research involved fabricating composite membranes by electrospinning polyvinyl alcohol (PVA) nanofibres incorporated with zeolites. Mechanical strength was enhanced by placing the PVA/zeolite nanofibre membrane between fusible nonwoven interfacing and woven polyester fabric, followed by heat treatment. Morphological analysis revealed the uniform dispersion of zeolite particles within the PVA nanofibres. EDX analysis confirmed the successful incorporation of zeolites into the fibres. Among all membrane samples, the PZ-0.75 membrane exhibited the highest pure water flux (PWF) with approximately 1358.57 L·m−2 ·min−1 for distilled water and 499.85 L·m−2 ·min−1 for batik wastewater. Turbidity of batik wastewater increased proportionally with zeolite concentration, with removal rates of 84.79%, 78.8%, 76.96%, and 74.19% for PZ-0.75, PZ-0.5, PZ-0.25, and PVA membranes, respectively. Furthermore, the UV/Vis spectrophotometer demonstrated that dye removal efficiency increased from 2.22% to 8.89% as the zeolite concentration increased from 0% to 0.75%. In addition, the PZ-0.75 membrane effectively removed RR dye at a concentration of 1 mg/L, with an optimal contact time of approximately 60 min. The adsorption mechanism of the PZ-0.75 membrane aligns with the Freundlich model, with an R2 value of 0.983. Overall, this study demonstrates the efficiency of zeolite in the fabric substrates to improve the filtration and adsorption properties for wastewater treatment, particularly in textile industries.