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In-Situ Fabrication of ZnO PES Membranes for Treatment of Pharmaceuticals

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Abstract : The occurrence of trace organic compounds (TOrCs) in water has raised health concerns for living organisms. The majority of TorCs, including pharmaceuticals and volatile organic compounds, are poorly monitored, partly due to the high cost of analysis and less strict water quality guidelines in South Africa. Therefore, the removal of TorCs is important to guarantee safe potable water. In this study, ZnO nanoparticles were fabricated in situ in polyethersulfone (PES) polymer solutions. This was followed by membrane synthesis using the phase inversion technique. Techniques such as FTIR, Raman, SEM, AFM, EDS, and contact angle measurements were used to characterize the membranes for several physicochemical properties. The membranes were then evaluated for their efficiency in treating pharmaceutical wastewater and resistance to organic (sodium alginate) and protein (bovine serum albumin) fouling. EDS micrographs revealed uniform distribution of ZnO nanoparticles within the polymer matrix, while SEM images showed uniform fingerlike structures. The addition of ZnO increased membrane roughness as well as hydrophilicity (which in turn improved water fluxes). The membranes poorly rejected monovalent and divalent salts (< 10%), making them resistant to flux decline due to concentration polarization effects. However, the membranes effectively removed carbamazepine, caffeine, sulfamethoxazole, ibuprofen, and naproxen by over 50%. ZnO PES membranes were resistant to organic and protein fouling compared to the neat membrane. ZnO PES ultrafiltration membranes may provide a solution in the reclamation of wastewater.

Keywords : trace organic compounds, pharmaceuticals, membrane fouling, wastewater reclamation
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