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Photochemical modification of poly(ether sulfone) and sulfonated poly(sulfone) nanofiltration membranes for control of fouling by natural organic matter

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Abstract: Poly(ether sulfone) and sulfonated poly(sulfone) nanofiltration membranes were modified by UV irradiation and UV-assisted graft polymerization of N-vinyl-2-pyrrolidinone (NVP) as a strategy for mitigating fouling by naturally occurring organic compounds (NOM) found in surface waters. Exposure to UV (254 nm) alone increased membrane hydrophilicity, interpreted in terms of either the contact angle, theta, or surface wettability (cos theta). It was possible to increase cos theta above 0.94. FTIR analysis suggests that this was due, in part, to the formation of surface hydroxyl groups. The membrane structure was opened, as evidenced by increased clean water permeability. Fouling by natural organic matter (isolated from a surface water source using reverse osmosis) was reduced significantly, but conditions that minimized fouling also decreased solute (NOM as organic carbon) rejection. In contrast, it is possible to identify UV-assisted graft polymerization reaction conditions which significantly reduced fouling, with clean water permeability and solute rejection similar to as-received membranes. When short reaction times (10 s) were used, clean water permeability decreased and solute rejection increased, presumably as a result of pore blockage by graft polymer chains. The opposite behavior in each respect was observed for long irradiation time (180 s); however, while fouling tendency was reduced relative to as-received membranes, it was not reduced to the same extent as membranes irradiated for 60 s. This observation could be explained by an increase in pore fouling resulting from increased access to enlarged pores by larger molecular weight natural organic matter components.

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