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Modeling flux decline during nanofiltration of NOM with poly(arylsulfone) membranes modified using UV-assisted graft polymerization

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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 increasing the wettability of membrane surfaces and mitigating fouling by naturally occurring organic compounds present in surface waters. The UV-assisted graft polymerization approach with 3% NVP and a reaction time of 60 s increased the wettability (increased cos theta) of membrane surfaces, which exhibited a significantly lower propensity to foul. For these conditions, clean water permeability and solute rejection (as organic carbon) were maintained close to that of the as-received membranes. Graft polymerization was carried out using two different methods. With the dip method, membrane coupons coated with a 3% N-vinyl-2-pyrrolidinone solution were UV irradiated under nitrogen. With the immersion method, membrane coupons were irradiated directly in nitrogen-purged 3% NVP solution. Both techniques increased membrane wettability; however, the immersion technique required much longer reaction times resulting from the absorption of UV radiation by the monomer solution. Flux decline of modified membranes was well described using a combined pore blockage/cake filtration model that was modified to incorporate back-transport. Model results provide support for the interpretation that the enlargement of the membrane pore structure caused by long irradiation times allowed additional pore fouling by larger molecular weight natural organic matter components that were previously rejected.

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PHOTOCHEMICAL MODIFICATION; POLY(ETHER SULFONE); IONIC-STRENGTH; GROUND WATERS; MICROFILTRATION; FILTRATION

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