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Physicochemical characterization of tight nanofiltration membranes for dairy wastewater treatment

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Abstract

Interrelationship between physicochemical properties and separation performance of nine commercial nanofiltration (NF) membranes was systematically investigated. Seven NF membranes, NT103 and NT102 from Microdyn-Nadir, DF90 and DF30 from OriginWater, NF70, NF40-I and NF40-II from Hangzhou Development Center of Water Treatment Technology, were reported for the first time. FTIR spectra demonstrated that the skin layer of NF90, NT103 and DF90 was made from fully aromatic polyamide, while other membranes were the semi-aromatic ones. The fully aromatic membranes had rougher, thicker and less hydrophilic polyamide layer as well as lower permeability than the semi-aromatic ones. When applying these membranes to concentrate the pretreated dairy wastewater, NF270, DF30 and NF40-I with high lactose rejection, low salt retention, low transmembrane pressure (TMP) and negligible irreversible fouling (IF) are preferable. Furthermore, it was found that the pore size and skin thickness dominated the membrane permeability. Meanwhile, the pore size and TMP produced a negligible effect on the IF, while the higher roughness and contact angle resulted in the higher IF, implying that the main fouling mechanism in this case is the foulants adsorption at membrane surface rather than pore blocking (affected by pore size) or cake