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Development of Hydrophilic Materials for Nanofiltration Membrane Achieving Dual Resistance to Fouling and Chlorine

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A hydrophilic thin-film-composite (TFC) nanofiltration (NF) membrane has been developed through the interfacial polymerization (IP) of amino-functional polyethylene glycol (PEG) and trimesoyl chloride. The selective layer is formed on a polyethersulfone (PES) support that is characterized using FTIR, XPS and SEM, and is dependent on monomer immersion duration, and the concentration of monomers and additives. The higher hydrophilicity alongside the larger pore size of the PEG-based selective layer is the key to a high water flux of 66.0 L m-2 h-1 at 5.0 bar. With mean pore radius of 0.42 nm and narrow pore size distribution, the MgSO4 rejections of the PEG based PA TFC NF membranes can reach up to 80.2 %. The hydrophilic PEG based membranes shows positive charged since the isoelectric points range from pH=8.9 to pH=9.1 and the rejection rates for different salts of the novel membranes are in the order of R(MgCl2)>R(MgSO4)>R(NaCl)>R(Na2SO4). The pore sizes and water permeability of these membranes are tailored by varying the molecular weight and molecular architecture of amino-functional PEG. Due to the unique structure of the selective layer of the PEG based membranes consisting of saturated aliphatic construction unit (CH2-CH2-O), the membranes demonstrate dual resistance to fouling and chlorine. The membranes maintain good salt rejections and high water flux of PEG based membranes after treatment by 2000 ppm NaClO for 24 hours. Interestingly, the PEG based membranes exhibit excellent fouling resistance with a water flux recovery of 90.2 % using BSA as a model molecule. More importantly, the hydrophilic PEG based NF membranes have been exploited to separate several water soluble antibiotics (such as tobramycin, an aminoglycoside antibiotic applied in the treatment of various types of bacterial infections), showing excellent performance in concentration or removal of antibioics.

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