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Preparation of high-flux thin film nanocomposite reverse osmosis membranes by incorporating functionalized multi-walled carbon nanotubes

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ABSTRACT

To enhance the water flux of reverse osmosis membranes, thin film nanocomposite reverse osmosis membranes are prepared by incorporating functionalized multi-walled carbon nanotubes (MWNTs). The functionalized MWNTs are obtained by the treatment of pristine MWNTs with the mixed acid of H_2SO_4 and HNO_3 (3:1 v/v). The MWNTs are analyzed by Fourier transform infrared spectrometry (FTIR). The surface morphology and structure of membrane are characterized by scanning electronic microscopy (SEM), transmission electron microscopy (TEM) and contact angle measurement, respectively. Those results show that modified MWNTs yielded some hydrophilic groups, such as -COOH and -OH, which make acidified MWNTs disperse more evenly in the aqueous solution. The SEM and TEM results demonstrate that the functionalized MWNTs penetrated through the polyamide layer, and might play the role of water channel. Compared with the bare polyamide membrane, the MWNT-polyamide thin film nanocomposite membranes have more hydrophilic surface, and the water flux of MWNT-polyamide membranes improve dramatically. For 2000 ppm NaCl, the water permeability increases from 26 l/m^{2}h without MWNTs to 71 l/m^{2}h at the acidified MWNTs loading of 0.1% (w/v), while NaCl rejection of MWNT-polyamide membranes decreases obviously compared to bare polyamide membrane. However, for 200 ppm purified terephthalic acid (PTA) solution, the pure water flux increases from 19 l/m^{2}h up to 49 l/m^{2}h, while PTA rejection is all higher than 98%. The experimental results reveal that the modified MWNTs well dispersed in the polyamide thin film layer, and hence improve the water permeation.

Keywords: Multi-walled carbon nanotube; Acidulation; Polyamide film; Reverse osmosis nanocomposite membrane; Desalination; Terephthalic acid

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