A novel semi-aromatic polyamide TFC nanofiltration membrane

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Nowadays, nanofiltration has been applied in the production of drinking water, recovery and removal of small organic compounds, treatment of industrial waste water, separation and purification of biologicals and pharmaceuticals, and the extraction and refining of food and petroleum substances and so on. Nanofiltration membrane is the core of nanofiltration technology. In order to meet the requirement of the complex practical application system, it is necessary to develop excellent nanofiltration membranes with high perm-selectivity, good stability and anti-fouling properties. In recent years, we have successfully synthesized a new type of dendrimer, trimesoyl amide amine (TMAAM), which comprises multiple hydroxyl groups and aliphatic amines. In order to improve the flux and antifouling of the thin film composite (TFC) nanofiltration (NF) membranes, in this study, TMAAM was used as the diamine in the aqueous solution and successfully incorporated into the skin layers via interfacial polymerization between trimesoyl chloride and the mixtures of hydroxyl-terminated TMAAM/piperazine (PIP). The resultant NF membranes were characterized using ATR-FTIR, FESEM, AFM, surface water contact angle and surface zeta potential, while their performance was evaluated in terms of permeate flux and rejection rates of different inorganic salts, dyes and neutral solutes. When the TMAAM content was lower than 50 wt% in TMAAM/PIP mixtures, the permeate flux got obviously enhanced without sacrificing salt rejection for the prepared TFC NF membranes, and its performance high rejection of dyes. Due to the improvement of surface hydrophilicity and the smoother surface of the TFC membrane, the NF membrane showed stability in a long-term antifouling experiment. The possible reason is that the three-dimensional dendritic structure and multiple hydroxyl groups in TMAAM contribute to forming the water channels and/or aggregate pores within the TMAAM-based NF membranes, which can improve the water flux as well as fouling resistance of the membrane.

Fig. 1: Schematic diagram for preparing TMAAM modified TFC membranes and their chemical structure.

Fig. 2: Rejection of the NF membrane to different dye molecules tested with 100mg/l feed aqueous solution at 6.0 bar and 25.0 °C.

Fig. 3: Effect of operation time on flux and solute retention of the NF membrane tested with Na₂SO₄ 1000mg/l aqueous solution at at 6.0 bar and 25.0 °C.

Recent Publications


Biography

Lifen Liu has her expertise in research on the pressure-driven membranes including NF and RO, which focuses on 1) the development of new RO/NF membrane materials with advanced functional features such as antifouling (i.e., polyamide-urea), chlorine-tolerance (i.e., polyamide-urethane) and high flux without sacrificing salt rejection (i.e., TMAAM-based semi-aromatic material) and 2) the new synthesis and polymerization technologies for TFC membrane fabrication such as the two-step interfacial polymerization method and the two-step amine-immersion method and so on.

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