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Nanofiltration Membranes with Deposyted Polyelectrolytes: Caracterisation and Antifouling Potential

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Abstract : The main problem arising upon water treatment and desalination using pressure driven membrane processes such as microfiltration, ultrafiltration, nanofiltration and reverse osmosis is membrane fouling that seriously hampers the application of the membrane technologies. One of the main approaches to mitigate membrane fouling is to minimize adhesion interactions between a foulant and a membrane and the surface coating of the membranes with polyelectrolytes seems to be a simple and flexible technique to improve the membrane fouling resistance. In this study composite polyamide membranes NF-90, NF-270, and BW-30 were modified using electrostatic deposition of polyelectrolyte multilayers made from various polycationic and polyanionic polymers of different molecular weights. Different anionic polyelectrolytes such as: poly(sodium 4-styrene sulfonate), poly(vinyl sulfonic acid, sodium salt), poly(4-styrene sulfonic acid-co-maleic acid) sodium salt, poly(acrylic acid) sodium salt (PA) and cationic polyelectrolytes such as poly(diallyldimethylammonium chloride), poly(ethylenimine) and poly(hexamethylene biguanide were used for membrane modification. An effect of deposition time and a number of polyelectrolyte layers on the membrane modification has been evaluated. It was found that degree of membrane modification depends on chemical nature and molecular weight of polyelectrolytes used. The surface morphology of the prepared composite membranes was studied using atomic force microscopy. It was shown that the surface membrane roughness decreases significantly as a number of the polyelectrolyte layers on the membrane surface increases. This smoothening of the membrane surface might contribute to the reduction of membrane fouling as lower roughness most often associated with a decrease in surface fouling. Zeta potentials and water contact angles on the membrane surface before and after modification have also been evaluated to provide addition information regarding membrane fouling issues. It was shown that the surface charge of the membranes modified with polyelectrolytes could be switched between positive and negative after coating with a cationic or an anionic polyelectrolyte. On the other hand, the water contact angle was strongly affected when the outermost polyelectrolyte layer was changed. Finally, a distinct difference in the performance of the noncoated membranes and the polyelectrolyte modified membranes was found during treatment of seawater in the non-continuous regime. A possible mechanism of the higher fouling resistance of the modified membranes has been discussed.

Keywords : contact angle, membrane fouling, polyelectrolytes, surface modification
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