Nanocomposite membranes of multiwalled carbon nanotubes and aromatic polyamide: antifouling and chlorine resistance properties.

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Multiwalled carbon nanotubes (MWCNT) -aromatic polyamide (PA) nanocomposite membranes have been studied in the last years due to their improved permeation and salt rejection. Recently, we have shown that these membranes show improved chlorine resistance and antifouling properties as well. Here, we compare two different types of PA membranes: a laboratory-made PA and a commercial PA, against a multiwalled carbon nanotube (CNT) – PA nanocomposite membrane. Chlorine resistance studies were done by both active and passive chlorination tests. We evaluated the fouling of these membranes during cross-flow measurements using humic acid and alginate solutions. The fouling mechanism of these compounds was studied by classical molecular dynamics. MWCNT reinforced PA membrane showed excellent antifouling properties. The changes in salt rejection and permeation show that MWCNT can provide aromatic PA with chlorine resistance, extending its service-life. The simulations show that small molecular size humic substances quickly attach to the surface cavities on the PA surface, leading to irreversible adsorption. Fouling is consequently promoted by the surface roughness of the membranes. On the other hand, alginate molecules showed a different mechanism. This foulant can crosslink in presence of calcium ions to form an alginate-Ca^{2+} complexes. In a different mechanism, the alginate molcules get pinned to the membrane surface and uncoil due to the flow resulting in a strong attachment to the surface. This work shows that carbon nanotubes reduce the roughness and polymer mobility on the surface of the membranes, resulting in a novel mechanism that improves the antifouling properties.