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Weak polyelectrolyte multilayers as tunable separation layers for micro-pollutant removal by hollow fiber nanofiltration membranes

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Abstract

The presence of micro-pollutants in wastewater and in drinking water and its sources, is posing both environmental and health concerns. This work describes the development of weak polyelectrolyte multilayer (PEM) based hollow fiber nanofiltration (NF) membranes to remove micro-pollutants from aqueous sources. The charge density of weak polyelectrolytes (PEs) can be controlled by the pH of the coating solution, providing an additional parameter to tune the performance of the prepared membranes. In this study, PEMs of weak PEs poly(allylamine hydrochloride) (PAH) and poly(acrylic acid) (PAA) were coated in a layer by layer (LbL) fashion on top of an ultrafiltration support to obtain PEM based NF membranes. Before coating the membranes, the role of the pH during coating on the buildup of multilayers was studied on model surfaces via reflectometry. Detailed investigations were then carried out on the membrane performance, by studying the pure water permeability, salt retention (NaCl, $CaCl_2$ and Na_2SO_4) and the retention of micro-pollutants of varying size (~200 – 400 $g \cdot mol^{-1}$), charge and hydrophilicity. Variation of the coating pH provided a large degree of control over the separation performance of the weak PEM based membranes. The rejection was found to be dominated by size