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Optimization of the ionic liquid-based interfacial polymerization system for the preparation of high-performance, low-fouling RO membranes

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Abstract

Thin-film composite (TFC) membranes with a polyamide top layer are a widespread membrane type in reverse osmosis and nanofiltration applications. Despite their good initial performance, they often suffer from a high fouling tendency. A new form of interfacial polymerization, in which ionic liquids (ILs) are introduced as the non-aqueous reaction phase, was developed in our previous work. This resulted in a more sustainable TFC membrane preparation and an enhanced performance. In this work, the improved fouling resistance of these membranes was proven. Moreover, different steps in the synthesis were analyzed to further enhance time and cost efficiency, as well as environmental impact of the preparation process. Time efficiency was improved by shortening the interfacial polymerization time to 10 s, while waste generation was drastically lowered by recycling the IL for consecutive interfacial polymerization cycles. Moreover, residual trimesoyl chloride (TMC) in the IL could also be recycled, since the IL protected the TMC from being hydrolyzed, even at very high water contents in the IL (> 1000 ppm). Successful introduction of the recycling step, together with the possibility to dry the formed membrane sheets without loss of performance by conditioning with glycerol, clearly demonstrated the upscaling potential of the new preparation method.

Keywords: Interfacial polymerization; Ionic liquids; Reverse osmosis; Fouling