Ionic liquid surfactant assisted interfacial polymerization for high flux composite reverse osmosis membranes

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Many countries in the world are suffering from extreme water scarcity and our solution to the water crisis is to purify seawater (3.5% NaCl) into freshwater by removing the salt and ions in seawater through reverse osmosis (RO). The core of the RO membrane is the polyamide (PA) layer, which is fabricated by interfacial polymerization (IP) formed when 0.1% m-phenylenediamine (MPD) dissolved in water reacts with 0.04% trimesoyl chloride (TMC) dissolved in hexane. The performance of the RO membrane is determined by its flux, permeability of the membrane, and rejection, retention of the salt. IP formed using the two monomers will result in a low flux. Therefore, surfactant is incorporated because they can assist with IP by directing MPD monomers. This is possible because of the polar imidazole head of the surfactant is immersed in the aqueous solvent and a hydrophobic hydrocarbon tail immersed in the organic phase; surfactant would self-assemble themselves around the PA. Surfactants of different carbon length and concentrations (below, near, and above the concentration of critical micelle concentration) were tested to demonstrate how they improve the performance of the membranes. Briefly, with increasing concentration of surfactant, the flux increased by at least fourfold with only a minor decrease in salt rejection compared to the ones without surfactant indicating the effect of surfactant on IP. Additionally, atomic force microscopy (AFM) and scanning electron microscopy (SEM) results indicate possible correlations between the surfactant concentration, increased surface area, and enhanced flux.