Highly mono-to-divalent cation selective nanofiltration membrane for seawater reverse osmosis desalination

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In this work, we have developed a nanofiltration membrane with superior rejection values for divalent ions. Divalent cations are considered as important sorbents for carbon mineralization of CO_2. The novelty of the work in the sense of separation of ionic species is on the performance under such a condition of a feed that has a high concentration. The feed solution which was rich in Mg^{2+} and Ca^{2+} followed the composition of seawater of reverse osmosis brine. Meanwhile, the operation pressure was set to the same residual pressure from the reverse osmosis process. The target performance was achieved by controlling membrane surface properties. A positively charged active skin layer formed by interfacial polymerization of polyethyleneimine and cyanuric chloride has greatly facilitated the mono-to-divalent ion selectivity while keeping a decent water flux. The rejections for Mg^{2+} and Ca^{2+} are found to be 99% and 98%, respectively, whereas that of Na^{+} was 30%. The rejection rates imply that the membrane we fabricated can effectively recover the divalent cations from reverse osmosis brine.