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Abstract

One of the major reasons for the limited commercial availability of the TFN membranes is the poor compatibility and adhesion between the embedded nanoparticles and polyamide matrix. Herein, we addressed this issue by functionalization of nanoscale additives to enhance their interactions with the polymer matrix and thereby reducing their leachability. Reverse osmosis TFN membranes were fabricated by in-situ interfacial polymerization of MPD and TMC, and incorporation of functionalized Halloysite Nanotubes (HNT). Exterior surfaces of the HNT were modified by adding three different functional groups: amine groups (HNT-NH_2), the first generation of poly(amidoamine) (PAMAM) dendrimers (HNT-G1), and carboxylic acid (HNT-COOH). The modified HNT were characterized by ATR-FTIR, TEM, SEM, zeta potential, and thermogravimetric TGA analyses. Surface morphology and physicochemical properties of the HNT-based TFN membranes were investigated by SEM, ATR-FTIR, XPS, and contact angle measurements. Potential reactions of the functionalized HNT with TMC were investigated by ATR-FTIR. Also, the leachability of HNT from the membranes was studied by using a leaching test in a batch incubator followed by their tracing with ICP-MS. Furthermore, membrane selectivity and permeate flux were evaluated in cross-flow reverse osmosis (RO) desalination experiments using a synthetic brackish water. The water flux of all HNT-based TFN membranes compared to the reference TFC membrane increased without sacrifice of salt rejection. The maximum increase of nearly 100% was observed for HNT-COOH-based TFN membrane with