

Fabrication of Thin Film Nanocomposite Forward Osmosis Membranes for the Treatment of Produced Water

Layla Ogletree, Hongbo Du, and Raghava Kommalapati

Center for Energy and Environmental Sustainability, Prairie View A&M University

Produced water (PW) is generated during the shale oil and gas production from fracking operations. Several PW treatments have been studied and implemented with varying outcomes and goals. One of the methods that have shown great potential is forward osmosis (FO), a membrane separation method that is frequently used for desalination. Because of its ability to efficiently remove minerals, salts, and other compounds from water, it is being considered for the treatment of PW. Thin-film nanocomposite (TFN) FO membranes have shown increased porosity, reduced concentration polarization, and increased water flux and permeability, thus reducing reverse solute diffusion. In previous studies, carbon nanotubes (CNTs) were incorporated into TFN FO membranes. They were able to increase the pore size, water flux, substrate porosity by 18%, tensile modulus by 53%, water flux by 20–30%, and reduce the S value by 30%, all connoting a reduced internal concentration polarization (ICP). In this study, we designed a three-layer FO membrane consisting of an active layer, a support layer, and a reverse solute repelling layer. The support layer was fabricated with polyetherimide (PEI) using the previously established methodology. This support layer was characterized using SEM. Once the process of the PEI support layer was finalized, graphene oxide (GO), a hydrophilic insulating nanomaterial, was incorporated into the support layer solution using the same methodology. The support layer was then fabricated via electrospinning. Several trials were done using various percentages of GO in the electrospinning solution for the support layer. The ultrathin film polyamide active layer was then fabricated utilizing the interfacial polymerization methodology. The support layer was coated with thiolated-2-methacryloyloxyethyl phosphorylcholine (MPC-SH) and the active layer was coated with sulfobetaine methacrylate (SBMA). Once the membrane was fabricated, FO testing was completed after each layer with DI water as the feed solution and 1 M NaCl as the draw solution. After these tests were completed, the optimized membranes were used to treat PW samples.