Project: Excellence in Research: A Novel High Throughput Forward Osmosis Membrane for Produced Water Treatment, Kommalapati, Reeves and Shafer (UH), National Science Foundation, 08/19-07/22, $500,000

The goal of the proposed research is to develop a novel method for treating shale gas and oil produced water (PW) that employs a novel high throughput forward osmosis (FO) membrane with significantly improved antifouling and reverse draw solute repelling properties. The proposed high throughput FO membrane consists of a nanofibrous support layer, a thin coating layer at the bottom of the support layer, and an ultrathin active layer. A graphene oxide (GO)-embedded polyetherimide nanofibrous substrate will be fabricated and used as the support layer, and the bottom of the support layer will be modified with the zwitterionic polymer, 2-methacryloyloxyethyl phosphorylcholine (MPC). The ultrathin active layer will be synthesized at low temperature with phase conversion, and its top will be coated with zwitterionic sulfobetaine methacrylate (SBMA). To obtain clean product water, a conventional reverse osmosis (RO) process will be integrated with FO filtration to form a hybrid FO-RO process. After fabrication and characterization, the novel membrane will be tested in the FO filtration system. A mixed ammonia-carbon dioxide draw solute will be used in the FO filtration process to take advantage of the availability of recycling options by using low-grade waste heat or thermal energy collected with a solar heater. The water produced from the final RO process will be tested for comparison with environmental disposal standards. The repelling and antifouling mechanisms will be elucidated through molecular dynamics simulations. The economic and environmental impacts of the hybrid FO-RO process for shale gas and oil PW treatment will be evaluated using a life cycle assessment approach.

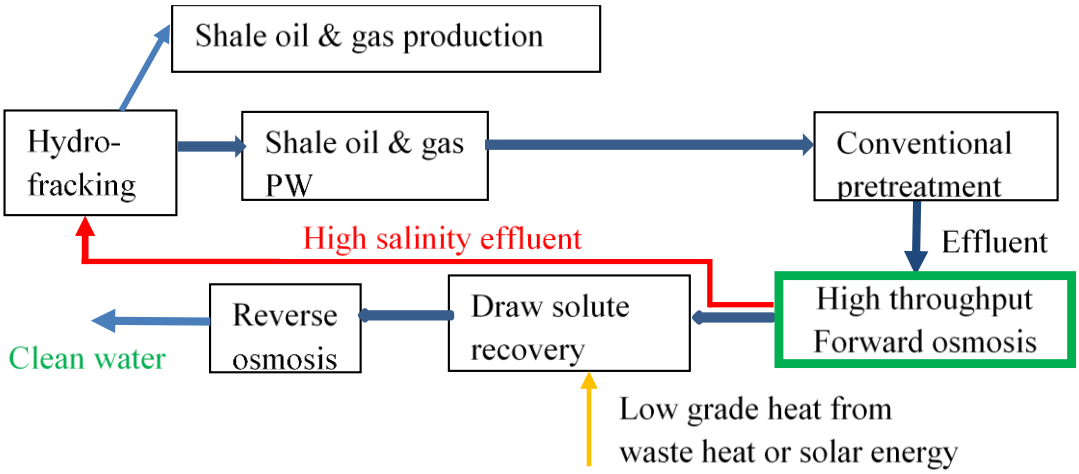

Figure: Schematic of a proposed PW treatment process