NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE
Singapore Membrane Technology Centre
Nanyang Environment and Water Research Institute

Low-Pressure Hollow Fiber Nanofiltration (NF) Membranes for Softening of High Salt Concentration Water

Prof. WANG Rong E-mail: rwang@ntu.edu.sg

Water softening using membrane

To remove divalent cations (in particular, Ca^{2+} and Mg^{2+}) from aqueous streams using membranes, the separation mechanisms involve both steric-hindrance and electrostatic (Donnan exclusion) effects. Therefore membrane pore structure and charge characteristics play an important role to determine the separation performance.

Desired membrane properties

- ✓ High flux and rejection of divalent cations
- ✓ Low operating pressure so as to reduce energy consumption and fouling tendency
- ✓ Chemical and physical robust

Major Challenges

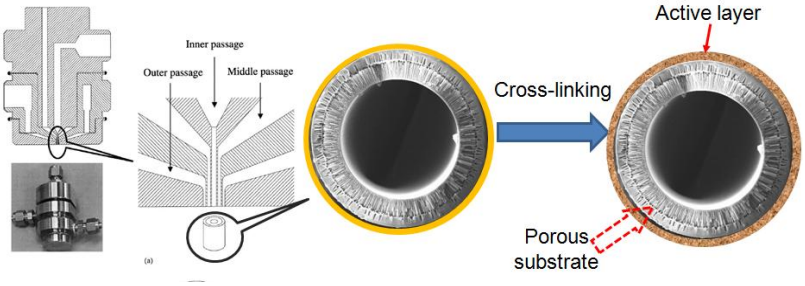
- ❑ Lack of commercial NF in the configurations of hollow fiber membrane
- ❑ To make membrane fabrication route economical on a large scale
- ❑ Achieve and maintain high performance of high water permeation and high divalent ion rejection at low pressure(<3 bar)

Approach	Dual-Layer	IP	LBL
Water permeability (l/m^2 h bar)	15.7	11.4	8.1
Mg^{2+} rejection (%)	95.4	95.6	99.5
Ca^{2+} rejection (%)	93.8	91	99
Na^{+} rejection (%)	12.5	13.4	13.7

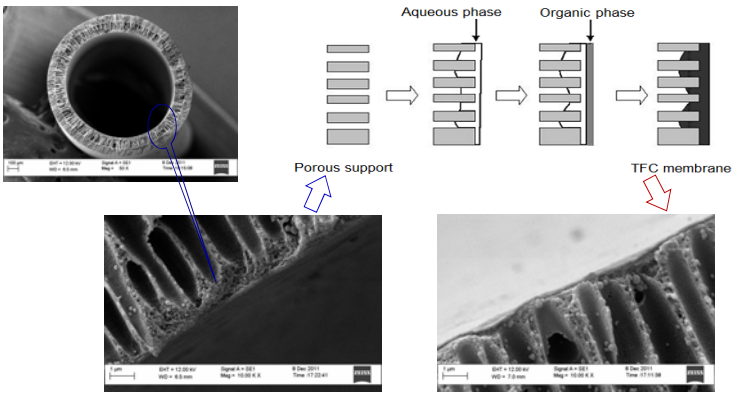
Feed: Hard water with 3000 ppm TDS;
Operating pressure: 2 bar

Acknowledgements
Collaboration with Siemens Global R&D Centre (Water Technologies)
Environment and Water Industry Programme Office (EWI) of Singapore for funding support under the project # EWI 0901-IRIS-20

Approach 1: Dual-Layer Hollow Fiber Membranes



Approach 2: Thin Film Composite membrane by in-situ interfacial polymerization (IP)



Approach 3: Layer-by-Layer (LBL) Deposition of Polyelectrolytes