Use of Switchable Solvents as Forward Osmosis Draw Solutes

Water Purification/Desalination Methods
• Switchable polarity solvents (SPS) as FO draw solutes
  – Reduced fouling vs RO
  – Higher water recovery and reduced waste stream
• Moderate energy requirements without distillation

Osmotically Driven Membrane Process
• Reverse osmosis
• Membrane fouling
• Distillation
• Energy intensive

Brief History of Switchable Materials

Forward Osmosis Applications
1) Draw solute is incorporated into the product
   • Concentrated product)
   • FO Cell
2) Draw solution must be removed through membrane:
   • Desalination
   • Low and constant pressure food product concentration
   • Landfill/Mining Lecture

Industrial Leaders in FO
• Applied Technology Innovation (ATI)
• Elemental microporous membranes (EMM) membrane supplier.

Freezing Point Osmometry
• Monitoring the freezing point of a solution to determine its concentration.

Water Flux Experiments
• Permeate flux against 5 mol/L NaCl 225,000 ppm (TDS) 275 atm

Total SPS FO System
• Filtration
• CO2 Degasser
• Feed solution
• Forward Osmosis Loop
• Concentrated Y2O3
• Gas Contacter
• Mechanical Liquid Separators
• Low Pressure Filtration Cell
• Fully Processed Water

Low and Constant Pressure FO Finishing
• Low pressure vs. RO:
  • Expected to require slightly lower pressures than conventional FO
  • Demonstrated in 4 L round-bottom flask with 25 g of total solids and 500 g of water.

Energy Cost of Ammonia-CO2 vs. SPS FO
• Comparing the energy cost of ammonia-CO2 and SPS FO:
  • CO2 degradation:
  • Conversion: 100.3% (TDS 93%)

Conclusion
• Switchable solvents are the draw solutes that allow an entirely new FO process for the purification of water and concentration of solutes.
• The SPS FO system is expected to save costs because it can be driven with less energy than RO.
• The SPS FO system removes substantial osmotic pressures and can be scaled for industrial use.
• The water recovery is achieved by the draw solution.
• The membrane compatibility remains the greatest challenge but can be solved by selecting appropriate solvents with the right characteristics.

Acknowledgements
• LFD – Royally Fund