Membrane Science, Engineering and Technology Center (MAST)

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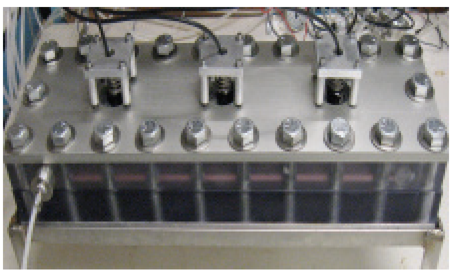
Center website: http://www.mastcenter.org/

High-Recovery Desalination Process for Brackish Groundwater



Bench-scale experimental system for testing ultrasonic sensor-controlled flow reversal.

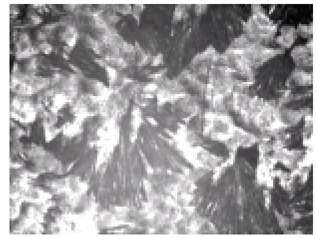
Many regions of the world including the Middle East are plagued by a severe scarcity of fresh water sources, and so seawater has been the most commonly used raw water source for desalination. Desalination is a well-established process that uses reverse osmosis (RO) for the removal of salt from seawater or other brackish (salt-containing) water sources. RO is a pressure-driven process in which water is forced through a polymeric membrane while salts are retained. A major barrier to efficient desalination processes is the potential for the precipitation by sparingly soluble salts on the surface of the membrane, a process termed scaling.

The overall goal of this work is to develop and build demonstration desalination pilot plants based on RO using brackish groundwater that would operate in Jordan and Israel. The innovation in this work is to delay the onset of scaling by a unique combination of the flow-reversal technology developed at Ben Gurion University and the ultrasonic sensor technology developed by the NSF Center for Membrane Science, Engineering and Technology at the University of Colorado Boulder. To date, the project has received support from the NATO Science for Peace (SfP) Program, the Middle East Desalination Research Center (MEDRC), and ROTEC, a small start-up company specifically formed to commercialize this technology.

Economic Impact: This new sensor-based separation process has the potential to significantly reduce costs associated with brackish water (BW) desalination, which is expected to have a market value of $30 billion by 2015. This technology enables higher recovery so that there is more fresh water and less salt produced per unit of feed water. For example, adding the technology to a 1200 m^3/day BW-RO plant (80% fresh water recovery) would enable operation at 92% recovery thus generating 1380 m^3/day of fresh water. The total cost for adding the technology would be about $11,000/year but the additional water produced is valued at about $31,000/year, a significant economic benefit, while the costs associated with reduced salt generation are estimated at about $62,000/year. In addition to the favorable economics, implementation of the technology will relieve pressure on existing water sources thereby reducing friction and facilitating cooperation between affected countries as they attempt to cope with dwindling freshwater supplies. This technology should help make it possible for water scarcity to become less of a driver of future conflict. It is difficult to overestimate impacts of avoiding the economic and human costs that would be associated with diminishing such future conflicts.

For more information, contact Alan R. Greenberg, 303.492.6613, alan.greenberg@colorado.edu.

SEM micrographs showing representative membrane surfaces from ultrasonic sensor-controlled flow reversal (left) and no flow reversal (right); minimal scaling visible on left, but significant scaling on right.



Reducing Membrane Fouling in Water Treatment Processes

The problem of membrane fouling by natural organic matter is critically important in the production of potable water from surface waters such as rivers and streams. Many such waters have a brown or tan appearance due to the natural organic matter they contain (humic and tannic substances). Those materials tend to bind to the surface of water treatment membranes in reverse osmosis and nanofiltration processes. Researchers at the Membrane Science, Engineering and Technology Center have evaluated and characterized several kinds of membranes to determine their fouling characteristics. In addition to published research, the Dow Chemical Company has evaluated the technology and is in the process of launching new products that benefited from the knowledge gained from this Center project.

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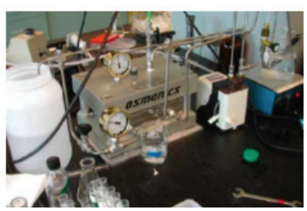
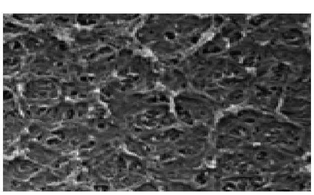
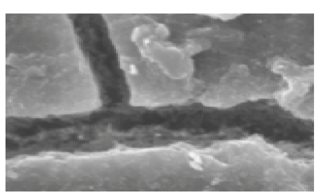


Bench-scale experimental system for measuring membrane flux decline (left) and membrane rejection (right).





SEM micrographs showing representative surfaces of clean (left) and fouled membrane (right).