Photo by Jim Lyle

The Future of Desalination in Texas

Brine can transform water supplies in Texas communities

As Texas' population grows, the ever-present threat of water shortages looms. However, technology is also advancing, providing possible solutions for water deficiencies. One such solution is desalination–a cost-effective method of producing potable and useable water from existing saltwater resources.

While desalination use has advanced along the Texas Gulf Coast after Governor Rick Perry's 2002 desalination initiative announcement, water treatment opportunities in other areas still exist. The Texas Water Development Board (TWDB) published a report identifying the location and amount of brackish and saline groundwater in Texas available for desalination.

Oil production brings contaminated or produced water (also called brackish water) to the surface. There are more than 200,000 producing wells in Texas, and most of them produce about seven times more water than oil. Handling this water is expensive because it must be transported for storage and injection into another well.

However, if produced water is desalinated on site, the pollutants can be reinjected into the formation without an Environmental Protection Agency (EPA) Class I hazardous injection permit; salts from the brackish water came from the original formation. Presently, several research efforts are underway to find beneficial uses for waters produced from oil and gas exploration in Texas.

Even with its obstacles, desalination of produced water is a more cost-efficient method of dealing with brine. For example, produced water

management and disposal costs can amount to $2,000 a day for every 1,000 barrels of oil (bbl) produced. Using on-site desalination could save half of this cost, producing an annual net profit of more than a quarter million dollars. If only 10 percent of operators take advantage of desalination, they can save $3.5 million annually, dramatically demonstrating the profitability of brine desalination.

To better understand desalination, here are terms used to describe water and groundwater.

- Freshwater contains less than 1,000 milligrams per liter (mg/L) of total dissolved solids (TDS).
- Brackish groundwater includes slightly-saline (between 1,000 to 3,000 mg/L TDS) and moderately-saline (3,000 to 10,000 mg/L TDS) levels.
- Saline water has more than 10,000 mg/L TDS and seawater has about 35,000 mg/L TDS.

Both water produced from oil wells and some groundwater contain brackish and saline water. In terms of desalination, brackish water is the best treatment candidate, and approximately one-third of the produced water in Texas falls into this category.

Desalinating produced brackish water comes with its drawbacks. Produced water can be up to four times saltier than seawater, making it difficult to work with. In addition, it contains crude petroleum which can be somewhat soluble in water and metal salts leached from rock formations. Furthermore, because of the oil in this produced water, it requires more pre-treatment than seawater does.

Even with the additional cost of pre-treatment, the total operating costs during 7-hour days average less than $10 for 23,000 gallons of brackish water processed. For an average $1 bottle of water (16.9 fl. oz.), the cost of producing this water would be approximately $.000057 per bottle, for a profit of nearly 100 percent. To be fair, standards for drinking water are high, and such treatment would receive intense examination by the state before approval.

If drinking water is not the ideal use for this water, there are several other alternatives. Because minimal regulations exist for livestock drinking water, ranchers can use desalinated water for their purposes. More than 133 million gallons of treatable water are produced each day, which is a sufficient irrigation amount for farmers as well, even if no other sources for irrigation existed.

Besides the economic benefits, on-site treatment is less hazardous than transporting large qualities of brine on public roads. As researchers assess the environmental efficiency of desalination, it is clear that desalination will play an integral part in the future of water production and conservation.

Many universities, state agencies and other organizations have been key players in desalination studies. By 2020, the U.S. Bureau of Reclamation, EPA, Department of Energy, Bureau of Land Management and Sandia National Laboratories are anticipating that desalination and water purification technologies will contribute significantly to ensuring a safe, sustainable, affordable, and adequate water supply for the United States. These organizations address both the potential for groundwater purification and the challenges that lie ahead.

Researchers from Texas A&M University, University of Texas at Austin, Rice University, University of Houston, Lamar University, Texas Tech University, University of Texas at El Paso and Texas A&M University-Kingsville are also making key advances in desalination research.

Texas A&M University
- Modeling and designing pretreatment processes and strategies that influence performance of desalination processes
- Evaluating patented capacitive deionization technology
- Finding methods to desalinate brackish and saline groundwater, and treat oilfield-produced water
- Evaluating operational issues related to proposed desalination plants
- Modeling how salinity constraints affect usable water yield in river and reservoir systems

University of Texas at Austin
- Differentiating traits of ideal membranes to develop a total recycle membrane system
- Modifying polymers to improve membrane performance through a unique stretching process
- Assessing desalination byproducts
- Evaluating effects of brine reject waters discharged with bays and estuaries and on dissolved oxygen levels
- Assessing how plant operations might affect temperature and salinity regimens in Lavaca Bay
- Examining public attitudes toward desalination projects

Rice University
- Evaluating parameters that optimize pretreatment processes
- Assessing use of certain membranes to treat waters with high levels of dissolved organic matter and suspended solids
- Developing data about water quality parameters associated with oilfield-produced water
- Assessing whether additional water via desalination may improve long-term peace between Israel and the Gaza Strip

Lamar University
- Comparing performance of conventional pretreatment methods used in desalination with the use of membranes and deoxygenation methods
- Developing membranes resistant to inorganic scaling and characterizing how desalination processes affect the stability of the membranes

Texas Tech University
- Developing closed loop pretreatment systems for space travel
- Creating methods to reuse desalination byproducts

University of Houston
- Evaluating and testing effects of pretreatment and operating conditions on membrane performance
- Monitoring and predicting membrane performance with other technologies
- Developing integrated portable membrane systems for use in remote locations

University of Texas at El Paso
- Evaluating use of desalination technologies to treat impaired and saline waters
- Incorporating thermal energy to power membrane distillation


Photo by: Jerrold Summerlin