RECLAMATION Managing Water in the West

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The Knowledge Stream

Research Update

Variable Salinity Source Water Desalination

Developing flexible desalination systems design for both brackish and seawater desalination

Bottom Line

Re-configuring a one-stage seawater reverse osmosis system with energy recovery to a two-stage system for brackish water enabled higher recovery (75 percent rather than 50 percent), used no more power than the one-stage configuration, and produced water with comparable quality.

Better, Faster, Cheaper

Flexible advanced water treatment design enables adapting the system to changing inlet water quality. Flexible systems can be adjusted to optimize water or energy efficiency.

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Problem

Many potential sources of water go unused because they either have levels of salinity different from existing municipal water supplies or they have widely varying levels of salinity. It is difficult for a water treatment system designed for one level of salinity to use these varying supplies.

Solution

A desalination system designed with flexibility to handle various sources of water can address many challenges:

- Coastal areas with seawater could use one plant to treat both seawater and impaired waters from storm water, tidal influenced surface water, and/or brackish ground water.
- Rural water districts could treat irrigation return flow where salinity varies with precipitation level.
- Well fields could have one location to treat water from wells with a range of water qualities.
- Military operations and emergency personnel could immediately treat water until the site and source waters are evaluated.

Cities could use more effective seawater desalination systems, which typically require higher pressure and higher quality materials. The Long Beach, California Nano-Nano pilot study, for example, demonstrated that even low pressure systems can be adapted to treat seawater as long as corrosion resistant materials are incorporated into the feed and concentrate piping.

To pursue this idea, Reclamation's Science and Technology Program funded an evaluation of the practicality and power consumption of converting a seawater system capable of 50 to 60 percent recovery to a brackish ground water system capable of 75 to 80 percent recovery. The Reclamation Expeditionary Unit Water Purification (EUWP) system was converted from a one-stage configuration with three parallel trains using energy recovery to pressurize one train, to a two-stage configuration by diverting the concentrate from two trains from the energy recovery device to feed the third train.

Anna Hoag measures EUWP concentrate.

Reclamation has evaluated the EUWP's performance with seawater, highly brackish delta water, brackish waste water, brackish ground water and fresh water over the last 7 years. Previous operations used one stage, which recovered about 40 to 60 percent of the source water. During the summer of 2011 the re-configured EUWP was evaluated on brackish ground water at the Southmost Regional Desalination Plant in Brownsville, Texas.

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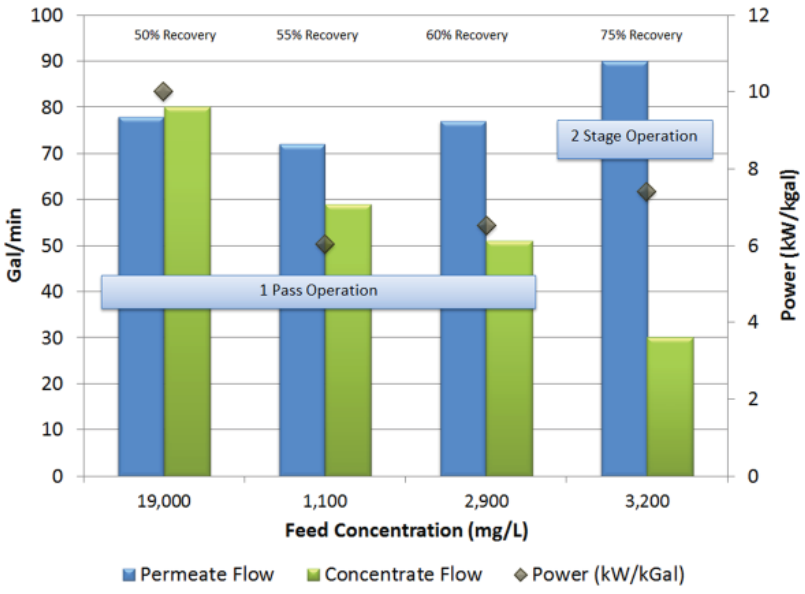
Application

Results of the comparison show that power usage for the EUWP as a two-stage configuration without energy recovery was no different than the previous testing as a one-stage configuration with energy recovery. This was to be expected since we used the same pumps. However, the configuration produced the same amount of product water from one-third less feed water. Recovering more usable water is important for desalination systems with significant infrastructure and energy cost.

Brownsville, Texas, for example, has a wide array of wells that are pumped from several miles to the treatment facility. The Southmost Regional Desalination Plant is a two-stage brackish water configuration 24 miles from the coast, but only 1.3 miles from a shipping channel that could be used to access seawater with an appropriate intake system. The Laguna Madre Water District on South Padre Island is also planning a new desalination plant that will have access to brackish tidal water and seawater. The Gulf often has high turbidity storm events and algal blooms that would be challenging to handle with a static treatment system. A flexible system could be re-configured to a two-stage brackish configuration by incorporating one or two valves.

Future Plans

Pending funding decisions in the state of Texas, a workshop highlighting the importance of desalination system design flexibility will be held in late summer 2013 to explore other methods for building flexibility in treatment process design. This is timely in that, due to the extreme drought in Texas over the past 2 years, the Texas Commission on Environmental Quality (TCEQ) has received several applications for desalination systems. Current regulations categorize membrane filtration for suspended solids, softening, or for desalination as "Innovative and Alternative" treatment processes that require a pilot study and or evaluation reports on the exact system tested with a similar feed water quality. With the drought, many communities are finding that their source water is changing, ground water becoming more brackish, and surface water having higher turbidity and total organic carbon from algae blooms. Existing systems are not able to maintain performance with deteriorating water conditions. TCEQ has been meeting with membrane system suppliers to formulate new regulations for membrane systems. It is important that flexible designs are considered in the new regulations.



Recovery, product water quality, and energy use in single stage and two-stage configuration at various locations: Biloxi, Texas; Gallup, New Mexico; Reclamation's Brackish Groundwater National Desalination Research Facility in Almagordo, New Mexico; and Brownsville, Texas, respectively.

"This project exemplifies the practical value of partnering to advance desalination research. This project was made possible through the creative leveraging of efforts and resources of at least six different organizations."

Jorge Arroyo,
Director, Texas Water Development Board,
Innovative Water Technologies

The EUWP stores purified drinking water.

More Information

Papers on variable source projects are at:

www.twdb.state.tx.us/innovativewater/desal/projects/burec/index.asp