PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Petroleum Environmental Solutions

05/2005

ADVANCED MEMBRANE FILTRATION TECHNOLOGY FOR COST EFFECTIVE RECOVERY OF FRESH WATER FROM OIL & GAS PRODUCED BRINE

PARTNERS

Department of Petroleum Engineering-Texas A&M University

Texas Water Resources Institute-Texas A&M University

College Station, TX

MAIN SITE

Texas A&M University

College Station, TX

TEST SITES

Barnett Shale

Parker County, TX

Alonusa Refinery

Big Spring, TX

Background

Oil and gas development brings significant volumes of water to the surface. However, the water contains salts and minerals of sufficiently high content to require disposal or reinjection. In Texas there are over 300,000 operating wells producing over 500 million gallons of water per day. Texas citizens need large volumes of water for agriculture and human use, and the diminishing water supply from the major aquifers supplying water has resulted in a search for additional water resources in the state. The potential for reclaiming water from oil and gas production waste streams for beneficial use in agriculture and commercial industry prompted research at Texas A & M University.

Reverse osmosis (RO) has been used for decades for desalination of seawater, primarily in arid, costal countries where fresh water for human consumption is scarce. The process works extremely well but is expensive and requires a disposal site for the concentrated brine produced. Desalination projects located in coastal areas traditionally dispose of the concentrated brine into the ocean. Modifying RO techniques for onshore use remains a challenge.

Texas A&M researchers addressed four questions: Can you sell oil field produced water? What do you have to do to show that desalinated produced water has value? What is that value? What is the cost of treatment? The goals of the project were to develop cost-effective methods to desalinate oil field brine and to develop fresh water resources from unconventional sources.

Project Description/Accomplishments

Work with the Texas Water Resources Institute has shown that brackish produced water with moderate salinity (less than 40,000 ppm total dissolved solids, or TDS) can be desalinated with the advanced membrane filtration RO system. The key to cost-effective RO desalination is the pre-treatment of the water to remove particulate matter, heavy minerals, and to reduce the saline content. The process relies on improved filters and new methods to clean the filters daily. The concentrated brine produced by the filtration system has been classified as a hazardous waste requiring special precautions for disposal. Texas A&M recently has received permission for a pilot test of a mobile processing system to treat produced water and reinject it into deeper formations onsite. This would significantly reduce the cost of disposal of the concentrated brine, make cleaning the produced water for beneficial use affordable for agricultural and human use.

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COST

Total Project Value
$459,000

DOE/Non-DOE Share
$350,000/$109,000

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov

Currently, the membrane filtration system is capable of treating 2 gallons per minute, or roughly 6,000-10,000 gallons per day. Brackish water is cleaned to a quality level of 100 ppm TDS. The mobile unit developed by Texas A&M includes pre-treatment filtration, RO, and a cleaning unit for the filters. The unit can clean the produced water for 50-98 cents per gallon depending on the salinity of the water treated. Use of variable frequency pumps for the power generation and refinements on the filter cleaning system are expected to lower the costs to 2 cents per gallon.

Pilot studies using the mobile advanced membrane filtration system in the Barnett Shale play in North Texas found that proper pre-treatment of water used to hydraulically fracture new gas wells could save an average of $8,000 per completion, or $40,000 per well. Operators in the active Barnett Shale play are drilling 5 new wells a day, with each well using 10,000-15,000 bbl of fresh water per frac treatment. Savings for one company operating in the Barnett Shale that cooperated in the pilot was estimated at $250,000 per month.

Benefits/Impacts

The reduced costs of water disposal for the operator could save independent operators thousands of dollars per well over disposal by reinjection, including trucking produced water to EPA-specified sites. Cost reduction is estimated at 10% of the operating budget. If the pilot onsite brine reinjection is successful and EPA approves this method, the savings in disposal costs would be significant. In addition, operators would have large volumes of marketable fresh water. For hydraulic frac jobs and waterflooding projects membrane filtration of produced water would reduce the cost of water needed by allowing recycling of produced water.

Low-cost, clean produced water could provide much needed water for crops, livestock, and human consumption in Texas and other western states. In Texas depleted aquifers are a growing problem, suggesting an inability to provide adequate water supplies to a number of communities in the near future and possibly water rationing in the long term. Many of these small communities are in the Permian Basin and South Texas where oil production is high. In the Permian Basin 8 barrels of water are produced for each barrel of oil. In many areas produced water could become a valuable asset to the producers and the communities.

Mobile desalination unit.The trailer can process up to 10,000 gallons per day of water suitalbe for local ranching and small communities' water use.