Bakken Water Opportunities Assessment

Bethany Kurz

Energy & Environmental Research Center

Bakken Water Opportunities: Phase I

- Project to assess the technical and economic potential to recycle frac flowback water in the Bakken play.
- Project sponsors
  - North Dakota Industrial Commission Oil and Gas Research Council
  - U.S. Department of Energy
  - North Dakota Petroleum Council

Frac Flowback Water Characteristics

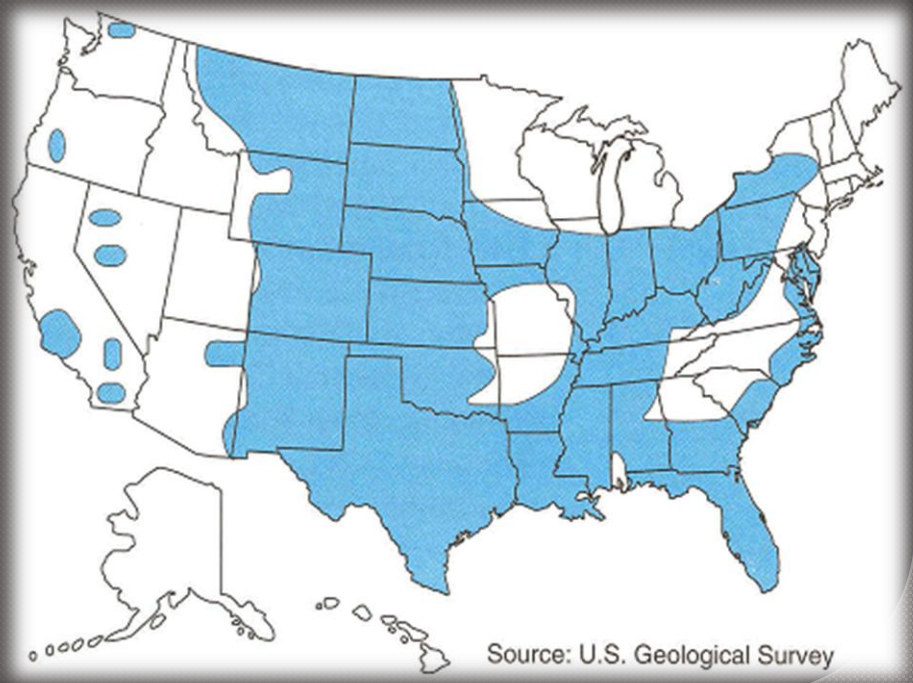
- Five different companies provided data from a total of 89 wells.
- Relatively low recovery of the original frac water within the first 10 days.
  - Ranges from 15% to 50% recovery
- Very high salinity in flowback water.
  - Salinity levels as high as 220,000 mg/L
  - Predominantly NaCl, with lesser amounts of calcium, potassium, and sulfate

Phase I Conclusions

- Treatment very challenging, even with the most robust technologies.
- Treatment very likely not cost-effective in most cases.
- However, multi-well pads ("Eco-Pads") may help overcome recovery issues, and treatment technologies continue to improve.

Phase II Project Goals

To assess the technical and economic feasibility of brackish groundwater treatment for use in western North Dakota's oil industry.



General location and extent of saline groundwater resources in the United States (Source: Mike Hightower, Sandia National Laboratories).

Project Status

- The EERC is partnering with a major oil producer in the state to conduct a pilot project using reverse osmosis (RO) to treat brackish groundwater.
- Site location is near Tioga, North Dakota
  - Existing water production well.
  - Excellent pumping capacity.

Groundwater Properties

- Dakota Aquifer (lower Cretaceous)
- Water temperature: ~150°F
  - Well screen depth: 5500 feet
- Total dissolved solids (TDS): ~9000–11,000 mg/L.

Water Classification	TDS Concentration, mg/L
Fresh	<1000
Slightly Saline	1000 – 3000
Moderately Saline	3000 – 10,000
Saline	10,000 – 35,000
Seawater	>35,000

RO Treatment System

- Mobile RO system provided by GE Water & Process Technologies.
- Trailer-mounted system.
- Includes two RO treatment trains each capable of producing 80 gpm of clean water (permeate).

Cooling System

- Water must be cooled to less than 100°F before entering the RO membranes.
- The EERC suggested that heat exchangers be used as part of the system to capitalize on the waste heat of the feedwater.
- GE provided tube-and-shell heat exchangers coupled with an air-cooled system (with foggers).


aggreko
aggreko

Corrosion Testing

- The EERC is evaluating the corrosivity of the feedwater, permeate, and concentrate.
- Corrosion test racks containing various metal and metal alloy coupons were installed at the site.

RACK S-5

Ti

316L

API5LX42

System Performance

- The RO system has been running intermittently since July 23.
  - ~ 70% recovery
  - Permeate production rate: 80 – 160 gpm (115,200 – 230,400 gallons per day)
- Treated water is stored in a lined and covered pond.
- An on-site hauling station allows 4 trucks to fill in 20 minutes.

Next Steps

- Continue to monitor the system and evaluate its performance, especially at steady-state conditions.
- Summarize existing corrosion test results, and conduct additional testing.
- Evaluate the economic feasibility of this approach as a water supply source for the oil industry and for other applications.