Reducing Fresh Water Use in Upstream O&G Hydraulic Fracturing

Michael Dunkel

Pioneer Natural Resources USA, Inc.

EPA Wastewater Treatment Workshop

April 18, 2013

O&G Definitions of Water

1. Fresh water – surface or ground water with total dissolved solids (TDS) less than 1,000 milligrams per liter (mg/l).
2. Produced water – naturally occurring water that is produced with the oil and gas and is normally high in TDS. This includes the initial water production that is occasionally referred to as flowback water.
3. Brackish Water – naturally occurring groundwater with TDS greater than 1,000 mg/l (not from an oil and gas reservoir).

Water quality needed for Hydraulic Fracturing

- Third-Party Study of PXD's 3 shale plays in Texas.
  1. Areas had different HF designs based on rock and formation fluids.
  2. Produced water minerals varied.
- Recommended solutions varied in these cases, but included Total Suspended Solids (TSS) removal and 50-80% combination of fresh water to reduce impact of specific minerals on frac design.

Water Treatment Technologies/Pilots

- Over 100 companies identified with water treatment and water management technology for Oil & Gas.
- 12 Pilot tests conducted to date.
- Results inconsistent, but TSS removal most important.

		Ceramic Coated Membrane	Ultrafiltration, Chemical, Forward Osmosis	Ultrafiltration, Chemical	Electro-coagulation	Reverse Osmosis, Nanofiltration	Electro-coagulation	Electro-coagulation
Constituent	Units	Avg. Change Inf to Eff	Avg. Change Inf to Eff	Avg. Change Inf to Eff	Avg. Change Inf to Eff	Avg. Change Inf to Eff	Avg. Change Inf	Avg. Change Inf to Eff
Barium	mg/L	9%	-27%	-92%	-9%	-86%	217%	-7%
Boron	mg/L	8%	-15%	-54%	-4%	-25%	3%	-12%
Calcium	mg/L	20%	-12%	-97%	1%	-79%	58%	-8%
Chloride	mg/L	-4%	63%	-38%	-4%	-28%	42%	-5%
Iron	mg/L	-24%	-44%	-100%	71%	-98%	-100%	-100%
Magnesium	mg/L	18%	-22%	-44%	2%	-92%	45%	-8%
Oil & Grease HEM	mg/L	-87%	-83%	0%	48%	0%	0%	-100%
SiO2, Silica	mg/L	2%	-19%	-80%	-5%	-45%	-72%	-84%
Sodium	mg/L	19%	64%	-4%	0%	-24%	38%	-1%
Strontium	mg/L	2%	-15%	-81%	3%	-85%	140%	-5%
Sulfate	mg/L	-15%	148%	33%	-30%	426%	-10%	-18%
Total Dissolved Solids	mg/L	0%	46%	-28%	-3%	-51%	58%	17%
Total Suspended Solids	mg/L	**-48%**	**-44%**	**-93%**	**113%**	**-98%**	**-81%**	**-49%**
Treatment Passed PXD Guidelines								
Treatment Failed PXD Guidelines								

Logistics of transporting produced water

1. Gather water to central site.
2. Treat large volumes for economics of scale.
3. Store treated water for re-use.
4. Transport to well site via temporary lines.

- These components of water logistics differ by play and region

Economics and environmental aspects

- Costs to recycle are highly variable due to frac type, infrastructure, water quality…
- Logistics are as important as treatment.
- Environmental factors to consider in transportation and storage of produced water.

Brackish water as a substitute

- 1,000+ mg/l TDS as an alternative to fresh surface or fresh groundwater.
- Often more expensive than groundwater, but less costly than recycling.
- More plentiful in some areas of Texas than fresh groundwater.
- Usually not useful to cities or farmers.

Prevention of evaporation from storage

- Evaporation losses are significant in hot dry climates.
- Pond covers that float on the surface can help prevent evaporation.
- Economical design for high winds is being researched and tested.
- In some cases, preventing evaporation may be more economical than recycling, but is a partial solution.

Conclusions

- Oil & Gas producers are advancing a variety of initiatives to conserve fresh water.
- Solutions vary based on differences in rock, frac type, produced water quality and logistics.