15,000
hydraulic fracturing wellheads in Ndakota and Montana

One million gallons (almost 24,000 barrels) of fresh water per wellhead to complete the fracing process alone. This has sparked huge anti-shale protests in Europe.

SHALE EFFECT

The Water Dilemma

CENTRALISED TREATMENT OF WASTEWATER IS EMERGING AS A VIABLE SOLUTION FOR WASTEWATER TREATMENT IN HYDRAULIC FRACTURING ARGUES JEFF EASTON, PROCESS ENGINEERING MANAGER, FROM WESTECH ENGINEERING, INC.

The number of hydraulic fracturing (fracing) shale oil and gas wells in the United States and worldwide continues to increase. Within the Bakken Shale formation alone, in North Dakota and Montana, upwards of 15,000 hydraulic fracturing wellheads are in operation, with another 20,000 wells planned for opening.

The U.S. has vast reserves of oil and natural gas that are commercially reachable as a result of advances in horizontal drilling and hydraulic fracturing technologies, which have enabled improved access to oil and gas in shale formations, such as the Bakken. But as more hydraulic fracturing wells come into operation, so does the stress on surface water and ground water supplies from the withdrawal of large volumes of H^2O used in the process – needing up to one million gallons (almost 24,000 barrels) of fresh water per wellhead to complete the fracing process alone. Equally important is the growing volume of wastewater generated from fracing wells, requiring disposal or recycling.

Up to 60 per cent of the water injected into a wellhead (potentially 600,000 gallons) during the fracing process will discharge back out of the well

one million
gallons of fresh water per wellhead to complete the fracing process

100,000
gallons per day of produced wastewater per wellhead.

shortly thereafter, as flowback wastewater. Thereafter, and for the life of the wellhead, it will discharge up to 100,000 gallons per day of produced wastewater. This wastewater needs to be captured, and disposed of or recycled. Because water is the base fluid and biggest component used in hydraulic fracturing, its importance remains a critical factor in the operation and economics of shale oil and gas production.

But significant and growing water management challenges are impacting hydraulic fracturing. Fresh water and wastewater operating procedures which have been in place since the late 1990s are experiencing increasingly stiffer governmental regulations on water availability and disposal limitations. These factors are prompting oil and gas executives to reassess their current water utilisation activities regarding fracing, and adopt a more unified, and longer-range perspective on their water life-cycle management.

"A centralised approach to the treatment and reuse of wastewater solution is needed"
Jeff Easton, WesTech Engineering, Inc

One solution that promises a truly comprehensive approach to integrating all aspects of fresh water and wastewater management in shale oil and gas production, while optimising the utilisation of water resources throughout the entire lifecycle of well production, is a centralised approach to the treatment and reuse of wastewater. Centralisation not only provides treatment and reuse of flowback wastewater from a large number of wellheads when the wells are fraced, but also provides treatment and reuse of produced wastewaters for the long-term, full lifecycle of the wells – which represent the vast majority of wastewater flowing from wellheads.

Further, a centralised system can more easily access and utilise alternative water

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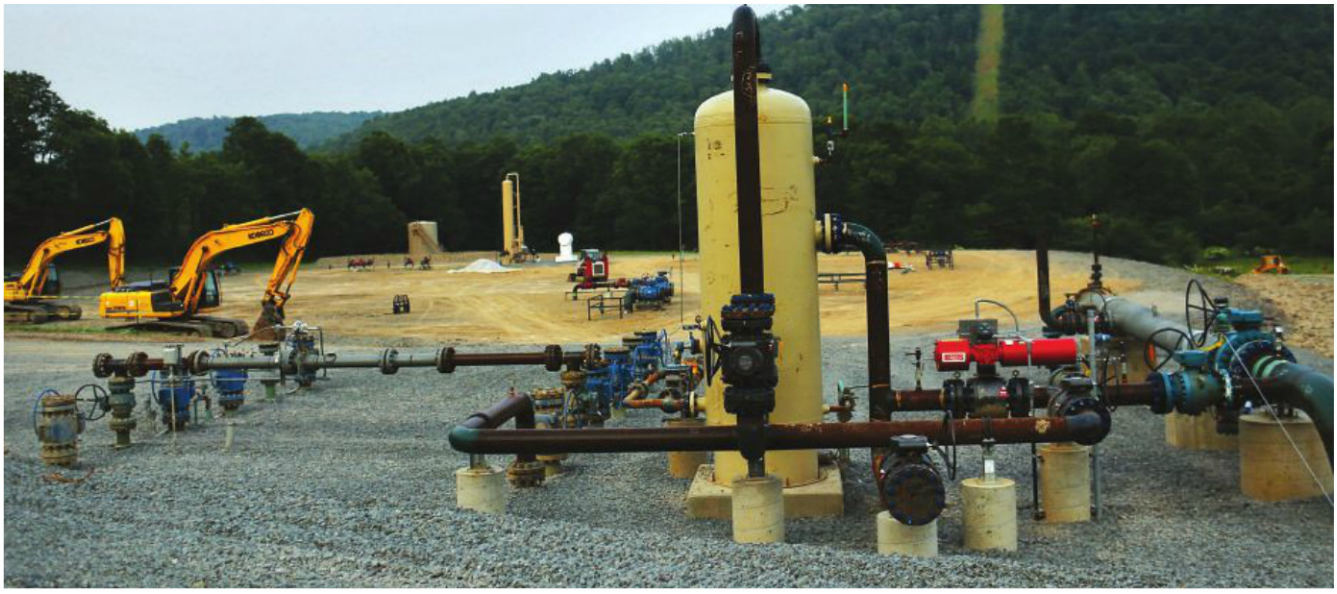

EPA is currently evaluating industry practices and state requirements and water sources for hydraulic fracking will only become more scarce in the days to come.

sources, such as from municipal wastewater facilities, which otherwise would be highly unlikely to be accessed.

Inherently, wellheads providing shale oil and gas production are long-term processes, typically exceeding 20-year terms, but conventional solutions in play for handling fresh water resources and wastewater are geared towards the short-term.

Diminishing Options for Water Sourcing

Fresh water supplies for use in hydraulic fracturing are becoming more expensive and more unobtainable.

In Texas, where hydraulic fracturing wells work the Eagle Ford, Barnett Shale or Permian Basin formations and deal with the constant threat of drought, fracing operators compete with farmers and ranchers for their share of fresh water. As with North Dakota, water sourcing is the main fracing challenge in Texas. In both of these areas, there does not exist an indefinite supply of water for expansion of hydraulic fracturing operations.

These large water withdrawals may come from streams, rivers, privately-owned lakes and ponds, or groundwater, and could affect availability of nearby drinking water sources and other uses, increasing the potential for conflicts between water users.

Wastewater Disposal Limitations

States and some local governments have primary responsibility for adopting and implementing programs to ensure proper management of hydraulic fracturing wastewater. Many fracturing wells operating in the Bakken formation in North Dakota and Montana, and those functioning in the Eagle Ford, Barnett Shale and Permian Basin formations in Texas use surface ponds to store hydraulic fracturing fluids (flowback and produced wastewater) for evaporation, or until arrangements are made for disposal. Almost 50 percent of the wastewater generated from hydraulic fracturing in these states is diverted and stored in surface ponds.

But the future use of surface ponds is surely to become more regulated.

Wellhead Wastewater Treatment

Wastewater associated with shale oil and gas extraction can contain high levels of total dissolved solids (TDS), fracturing fluid additives, total suspended solids (TSS), hardness compounds, metals, oil and gas, bacteria and bacteria disinfection agents, and naturally occurring radioactive materials. These contaminants are partially a combination of chemicals and agents inserted deep into the well (9,000 feet and deeper) which facilitate fracing by modifying the water chemistry to increase viscosity, carry more sand and improve conductivity. Effectively, the fracing process is pushing the water down into the rock formation, trying to wedge the rock cracks open.

The sand fills in between the cracks that the hydraulic fluid has propped open. Once the fracing is done, much of the water comes back up the well as flowback wastewater. Along with it comes bacteria and characteristics of the geologic formation, including minerals, radioactive materials and oil and gas.

Some drilling operators elect to re-use a portion of the wastewater to replace and/or supplement fresh water in formulating fracturing fluid for a future well or re-fracturing the same well. Re-use of shale oil and gas wastewater is, in part, dependent on the levels of pollutants in the wastewater and the proximity of other fracturing sites that might re-use the wastewater. This practice has the potential to reduce discharges to surface ponds, minimise underground injection of

A wellhead will discharge up to 100,000 gallons per day of produced water.

Shale oil and gas will have huge effects on the water table.

wastewater, and conserve and reuse water resources.

Mobile solutions to treat wastewater at the wellhead enable recycling and reuse of flowback without the need for storing wastewater in surface ponds on-site, or for trucking flowback wastewater for disposal at off-site deep-well injection locations.

The recycled wastewater is treated specifically for a different well site frac. The treatment is customised for the geology of that specified well site.

The drawback of wellhead mobile solutions is that they do not provide continuous processing to handle produced wastewaters, which would need to be processed for potentially 20 years following fracing.

Since produced wastewater represents 95 per cent, or more, of the wastewater generated during the lifecycle of a well, mobile processing systems do not provide a solution adequate to solving the long-term problems of diminished water sourcing and tightening wastewater disposal limitations.

Centralised Water Management

Centralised treatment of wastewater is emerging as a viable solution for long-term efficiency in managing water sourcing and wastewater treatment in hydraulic fracturing.

Centralised treatment facilities handle both the flowback wastewater and produced wastewater from oil and gas wells within a region, at a radius of 40 to 50 miles. Pipelines connect all wellheads directly with the central treatment plant.

Wastewater received by the plant is identified as originating from a specific well. The targeted usage requirements for that wastewater are specified, then the wastewater is processed to meet that usage. Once processed, the wastewater is then piped directly to the targeted well site.

Central wastewater treatment facilities are in a better position to provide a broader scope of treatment options than what would be available otherwise, such as with mobile wellhead treatment plants.

They can provide a just-in-time processing capability, whether it is for a slickwater application in a well, or suitable for discharge to a watercourse. These processes can include:

- Primary three-phase separation to remove dissolved natural gas, floating gel, oil, sand and suspended solids, followed by storage for equalisation of chemical composition and flow
- Secondary separation utilising dissolved air or gas flotation for removal of a wide variety of contaminants including polymers, oils and suspended solids. Bactericide is added to control bacterial growth.
- Removal of metals by precipitation, and removal of salts by reverse osmosis;
- Sludge management for dewatering collected solids.

The development of an integrated infrastructure for water management in shale oil and gas production has lagged behind improvements in drilling technology, which have been successful in spearheading this industry into recent national prominence.

In the face of increasingly constricting traditional water sourcing options and tightening wastewater treatment regulations, the need for an industry initiative to develop this infrastructure network to deal with these water related issues is of critical importance if oil and gas producers are to effectively manage their frac well operations and maximise profits.

Centralised water management allows wastewater processing to be implemented on an economy of scale that has not before been realised in the shale oil and gas production industry. Oil&Gas

ABOUT THE AUTHOR

Jeff Easton is a principal process engineer at WesTech Engineering. He has a Bachelor of Engineering degree from the University of Utah and is a registered professional engineer.