Water Management Trends Toward Reuse

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The largest environmental concern related to hydraulic fracturing is water use. With millions of gallons at stake for each horizontal lateral, pressure on water resources is felt both by the industry and by the general public.

For most regions, water quality is a hot-button topic. In areas such as South Texas and Oklahoma, severe drought can amplify pressures on water demand. Awareness of these concerns has been the impetus for most of the major shale players adopting reuse as a means of keeping cost at a minimum, ensuring water is always available, and harmonizing their efforts to protect the natural environment.

Historically, most frac jobs were performed with freshwater. It was once thought that high levels of constituents such as chlorides were an impedance to successful deployment of fluids. Reuse technology spawned from the need to treat frac flowback at the surface for additional jobs. Treatment was expensive, and the outcome of using treated water was unknown.

In 2010, Cabot Oil & Gas in a joint effort with Superior Well Services and Kroff Well Services Inc. completed the world's first frac job using 100% treated flowback water in Susquehanna County, Pa., in the eastern Marcellus shale. At the time, the well registered among the highest producers in the same geology and geographical region. Today, reuse technology has advanced almost to the point of common practice.

Beginning this year, major players including Chevron, Atlas, and Range Resources committed to reusing 90% of their water by year-end 2011. This number was increased to 100% for 2012.

As reuse technology has become more common, cost has significantly gone down. In addition to saving time and capital, companies are finding it much more feasible from an environmental perspective to reuse water than to release it.

Benefits of analysis

In its ongoing effort to advance water reuse in North American shale plays, Kroff Well Services has pursued data acquisition for water quality both before and after frac deployment in a number of regions.

The company's database contains analyses from more than 5,000 prefrac samples and about 7,000 post-frac sequential flowback samples. This information is in addition to produced water

analysis from aging wells in the vicinity, according to Dave Grottenthaler, general manager, Kroff Well Services. “We are sampling water in all the basins,” he said.

Part of the interest in water reuse is generated from the lack of water resources in many areas. “Most operators are paying to dispose of spent water,” Grottenthaler said. “Why not just keep it and safely reuse it?”

Well configuration and the close proximity of laterals in today’s shale gas environment are highly conducive to water treatment and reuse. In addition to access, the company has been successful in delineating focused examples of water quality in most of the major shale plays.

Analysis began in the Marcellus, where Kroff has been most active, but the range of information is expanding to plays such as the Haynesville and Eagle Ford, among others. Water samples are collected for every 500 bbl of flowback and fully analyzed. “You end up with a county-by-county analysis of water quality both before the frac job and after,” Grottenthaler said.

What can you learn from this type of information? According to Grottenthaler, “The Marcellus is completely different from east to west.” For the Marcellus, divalent cations such as barium and calcium vary by geography and outweigh other constituents in the eastern part of the play, and this ratio reverses to the west of the play. Citing another example garnered from sequential flowback analysis, Grottenthaler added, “We know that the Haynesville contains much more iron than most of the other plays, and adjustments to your frac fluid design should occur as a result.”

Grottenthaler also believes the flowback data impact water treatment efforts, telling companies and the general public “what indeed comes back in the water over time.” Sequential flowback analysis is helping operators learn what dissolved constituents are involved and provides time-weighted averages of what will come back out of their wells over time.

“Our goal is to leave the operator with a residue-free formation with maximum initial production,” Grottenthaler said.

Understanding the geology can prevent scaling. “These constituents do not just foul the proppant pack,” he said. “They physically form on the formation wall and impede permeability through the rock.” Understanding this process allows operators to adjust their frac programs on a per well basis.

Beyond flowback

Water is the universal solvent. Produced water from aging wells is one of the challenges faced in managing mature assets. “It’s a much more difficult resource because its concentration of chemistries can be three to five fold higher than flowback water,” Grottenthaler said.

While reusing flowback water has become a standard practice for many operators, produced water continues to flow. In areas like the Marcellus, there is a huge number of older Upper Devonian two-stage vertical wells producing a lot of water that requires disposal.

“Even the thousands of wells drilled within the next five to 10 years will begin producing water over time,” Grottenthaler said.

The necessity for water at new drill sites and the abundance of produced water in the region recently combined to provide a new solution for several operators.

“We have recently done frac jobs with 100% treated production brine,” Grottenthaler said. The process began with a question of whether or not Kroff could remediate produced water. “After treatment, we gave the customer clean saltwater,” Grottenthaler said, adding, “you want the chlorides in there.”

Meanwhile, slickwater fracs are becoming more common. “I am a huge proponent of fracing with clean saltwater,” he said.

According to Grottenthaler, the use of clean brine is not unprecedented. Historically, reservoir flooding used water containing high levels of brine to push oil from depleted zones into neighboring zones where the oil could then be brought to surface.

In a recent test, Kroff worked with an operator in the Marcellus to drill two identical offset wells. The goal was to make them as mirror images. One well was fracked with freshwater and the other was treated with remediated produced water (brine). The operator targeted frac water with 80,000 mg of chlorides and low divalent cation concentrations. Once completed, the brine well produced >10% more gas than the freshwater lateral, and is now producing >20% above the freshwater well.

Looking ahead

Today, companies have a better understanding of what frac water qualities are acceptable. “You do not need distilled water for the perfect frac job,” Grottenthaler said. In some cases, certain chemistries can actually aid the completion by keeping more constituents soluble or changing the crystalline structure such that more of these impurities return to surface leaving less behind in formation.

“Our goal is to give operators the capability of reusing every bit of water that can be collected, treated, and effectively remediated or blended for additional use,” he said.

And as more wells come online requiring more produced water over the next 10 to 15 years, “we will have to know how to reuse (this resource) safely and effectively,” Grottenthaler said.