

Field Trial of Salt-Tolerant Friction Reducer Attains 100% Re-Use of Produced Water

INNOVATIVE FRACPROCESSSM SERVICE CUSTOMIZES CHEMICAL DOSAGE TO OPTIMIZE FRICTION REDUCER PERFORMANCE

UNITED STATES

CHALLENGE

- » Optimize friction reducer (FR) dosage and type for high TDS environment
- » Improve performance over conventional FR (i.e., lower surface treating pressure and increase pumping rate)
- » Maximize re-use of produced water

SOLUTION

- » Field test new salt-tolerant FR system—designed to enable 100% use of flowback and produced water, without requiring fresh water dilution
- » Use Multi-Chem FRACProcessSM friction reducer assurance check process to provide on-location quality assurance of material usage

RESULT

- » Enabled on-the-fly adjustments to balance ratio between FR and FR booster
- » Out-performed previously used FR in earlier stages by major reduction in pipe friction
- » Maintained lower average treatment pressure and higher average treatment rate throughout all remaining stages
- » Pumped slickwater fracturing treatment with up to 100% of produced water

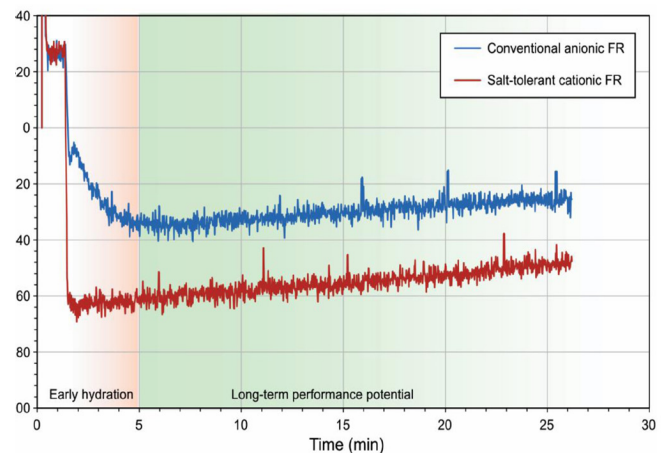
OVERVIEW

Friction reducers (FRs) are critical to certain unconventional well operations; in particular, slickwater hydraulic fracturing and coiled tubing stimulation applications, where chemicals are added to water to increase fluid flow. When performing a hydraulic fracturing job, operators typically make assumptions about the wellsite's water quality through direct measurement or approximation via historical data, and then select a FR that will perform through the worst-quality water they expect to encounter. This approach does not permit fine-tuning in response to the full range of potential water conditions, and can easily lead to over-treating, over-specifying and, in many cases, over-spending. Ideally, what's needed is a single FR system that can be applied for the entire treatment duration, with dosing adjustments made based on actual performance data.

A three-well field trial was conducted by an operator in the Marcellus Shale to test a more customized, salt-tolerant FR product and compare its performance against a standard anionic FR. This Middle Devonian age formation of marine sedimentary rock is located in eastern North America, where FRs are frequently used to mitigate high total dissolved solids (TDS) water conditions. The new FR treatment was delivered via the flexible Multi-Chem FRACProcessSM service to precisely control chemical dosage for optimum results.

SALT-TOLERANT FRICTION REDUCER (FR) VERSUS STANDARD FR

Initially, the operator had applied a standard FR for the first few stages of slickwater fluid treatment; however, this caused a lower pumping rate (less than 100 bbl/min) and an inability to keep the surface treating pressure between 8,000 and 8,500 psi. After switching to the Multi-Chem salt-tolerant FR, the average treatment pumping pressure immediately fell under 8,500 psi, and the average treatment pumping rates were increased and maintained at 100 bbl/min.



Friction loop test data from Marcellus Shale showing how the salt-tolerant cationic FR outperformed the conventional anionic FR in 250,000 ppm TDS water.

The combination of a water-in-oil cationic friction reducer and an FR booster were key to the success of this solution, as it allowed the operator to adjust the polymer-booster ratio, in real time, to achieve maximum friction reduction. This gave completions engineers and production engineers the ability to quickly react to unpredicted variances in water quality and manage the FR dosage rate “on-the-fly” to prevent over- or under-dosing. By requiring no other concurrent FRs, it also simplified onsite storage and quality assurance.

As part of the field study, friction loop testing was conducted on the three wells to measure the performance of the new FR compared to the conventional FR. Test data confirmed that the salt-tolerant cationic polymer FR more efficiently reduced pipe friction—regardless of water quality. Other test results, likewise, produced positive results in favor of the new FR, with a higher average treating rate and lower average treating pressure, and even requiring a lower FR concentration. These results suggest that this solution will be applicable to similar unconventional applications with high TDS water in the Northeastern U.S., as well as the Bakken and Permian regions.

BENEFITS OF SALT-TOLERANT FR

The field-proven, salt-tolerant FR provides the following benefits:

- » Handles TDS levels greater than 300,000 mg/L
- » Can be used in water containing a variety of dissolved salt ions (including chlorides, sulfates, sodium, calcium and magnesium)
- » Can be used in a wide range of pH (including low-pH, less than 4, fluid applications)
- » Tolerates a variety of unknown contaminants that render conventional FRs ineffective
- » Effective at low concentrations (.25 to 1 gal/1,000 gal) in clay control brines and produced and flowback water sources
- » Approaches performance of fresh water systems

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