AS SEEN IN
JANUARY 2018
E&P

Engineered friction reducers enhance proppant transport

A synthetic polymer friction reducer enables proppant loading and productivity in the wellbore.

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Friction is the conflict or animosity caused by a clash of wills, temperaments or opinions. In the case of hydraulic fracturing operations, it impedes the ability of fluids carrying proppant farther out from the wellbore and deep into a complex fracturing network.

Reducing friction is a long-established challenge that operators must overcome to decrease fluid flow friction and enable high-rate pumping without requiring more pressure generation at the surface. The ability to precisely drill ultralong laterals and a desire to create highly complex fracture networks has encouraged adoption of friction reducers. The use of friction reducers together with linear or crosslinked guar has traditionally introduced increased treatment cost and operational complexity to both achieve friction reduction and maximize proppant transport.

Reduced friction, increased viscosity

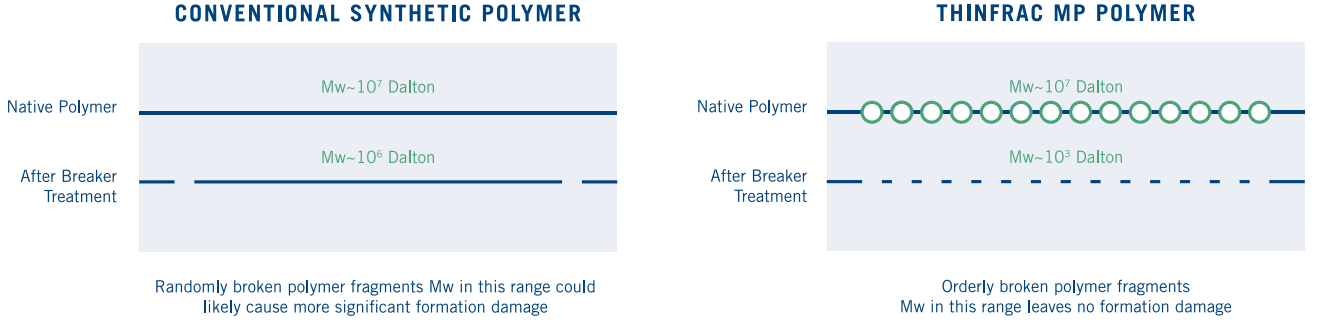
BJ Services has developed a broad portfolio of friction reducers that can provide specific fluid properties in challenging applications.

Recent advances in polymer chemistry have led to the creation of polyacrylamide-based technologies that can provide a greater reduction in pipe friction at lower loading because of its high molecular weight, providing improved proppant transport at higher loading during fracturing over conventional slickwater fluids.

The benefits of these polyacrylamide-based polymers are wide-ranging. For example, using one solution across the entire fracturing process instead of several can create lower project costs, reduce water requirements as compared to conventional slickwater fluids, use fewer chemicals, use less equipment on location and provide greater flexibility for a rapid design change. It also enables enhanced proppant loading with added productivity in the wellbore.

The company's ThinFrac MP is a cost-effective polyacrylamide polymer friction reducer with superior proppant-carrying properties. This synthetic polymer provides rapid hydration in 8 seconds to 10 seconds in cold water, developing instantaneous viscosity in slickwater fracturing operations, and delivers the proppant to the fractures. Rapid hydration reduces the pipe friction pressure, which has been proven to lower hydraulic horsepower and surface equipment requirements. The polymer friction reducer is compatible with freshwater, brines and low-pH fluids.

The oxidizable linkages along the polymer's backbone are a key feature. All current conventional friction reducers are polymers with carbon-carbon backbones. Difficult to break even in the presence of oxidizer breaker, these conventional reducers can cause formation damage (less than 90% regain permeability).



The enhanced polymer contains oxidizable linkages along its backbone, allowing a clean, efficient break with little to no formation or proppant pack damage. (Source: BJ Services)

However, the molecular structure of the engineered friction reducer allows a clean, efficient break with little to no formation or proppant pack damage, giving almost 100% regain permeability. No residue polymer or polymer fragments will be deposited on the fracture surface or in the proppant pack to impact the hydrocarbon production.

The use of the engineered friction reducer in North American shale plays has significantly increased production and lowered operational costs by up to 30% for operators. Use of the polymer enables a smaller footprint on location, easier flowback and fewer personnel.

Anadarko Basin

An operator completing wells in the Stack Meramec oil formation used a hybrid treatment schedule that began with a slickwater fluid system using a conventional friction reducer at the beginning of the process and moving to a 20-lb linear gel with a high concentration of proppant at the middle of the program to completion. The operator decided to adapt all of its slickwater designs to use the engineered friction reducer to simplify operations and reduce costs and logistics. The switch from linear and crosslinked gels generated 3% and 6% savings in chemicals costs, respectively. It reduced the number of chemicals on location and reduced transfer issues that can cause delays, screenouts or not pumping the stage as designed.

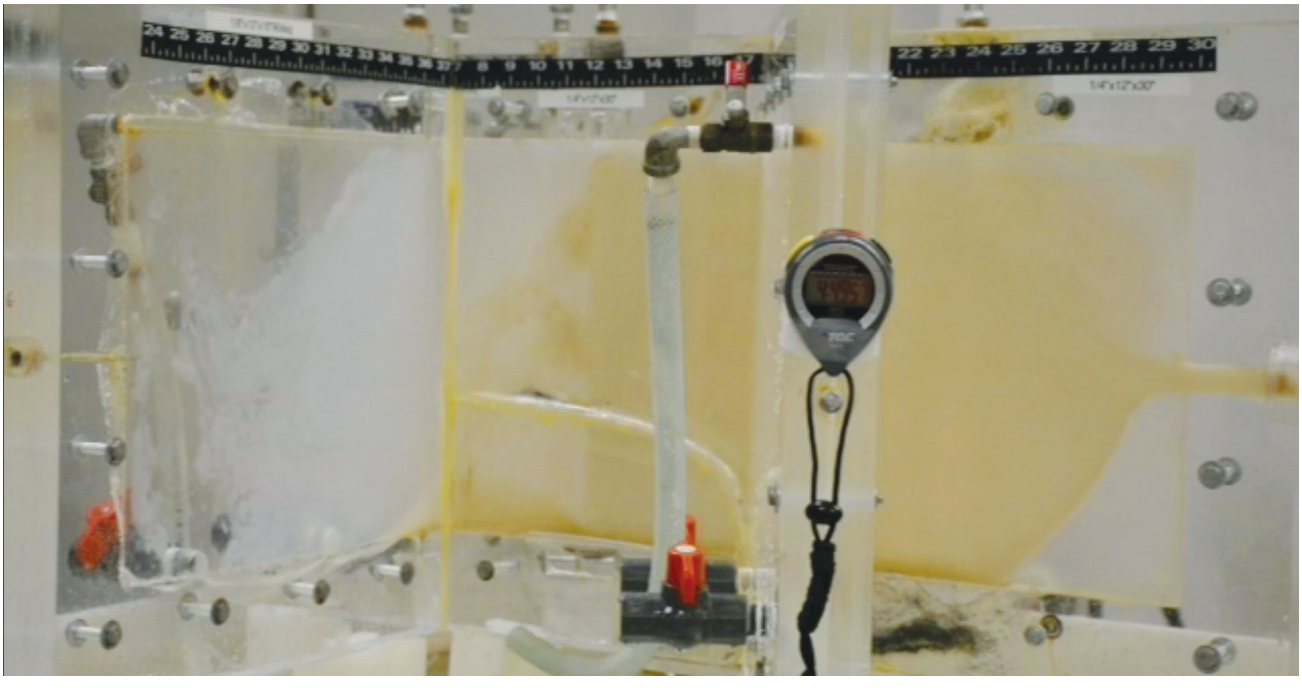
The technology is being deployed on a three-well pad and has effectively replaced a 20-lb linear gel on all 75 stages. It also is being deployed on a two-well pad with 100 stages for the operation. Each operation is being pumped at 80 bbl/min, surface treatment pressures are operating within acceptable ranges and no adverse issues have been identified.

The enhanced polymer was run at half the loading (0.5 gallons per thousand [gpt]) compared to the conventional friction reducer (run at above 1 gpt on previous treatments) and has demonstrated good friction reduction and lower surface treating pressures throughout the stages.

Marcellus Shale

An operator conducting horizontal multistage fracturing completions experienced nonproductive time, shutdowns and screenouts due to reservoir properties that were difficult to break down along with higher surface treating pressures.

It was recognized that the slickwater fracturing operation would require the addition of a linear gel to achieve the extra viscosity needed to effectively place the proppant. The engineered polymer's pipe friction reduction capabilities and ability to act as a linear fluid viscosifier enabled the operator to easily attain the additional viscosity needed for breakdown and effectively placed the proppant across the problem stages. A breaker was used to minimize formation damage and enhance regained permeability to greater than 95%.



The slot flow testing showed excellent proppant transport with no settling. (Source: BJ Services)

By transforming a conventional friction reducer to a linear fluid viscosifier, the operator could minimize delays or shutdowns. The solution prevented screenouts by adding viscosity instantly and reduced costs.

Utica Shale

An operator had completed five wells using a conventional linear gel fracturing fluid. Twenty-five wells were then completed using the ThinFrac MP friction reducer. Both sets of wells were treated with similar slickwater stages followed by sand-laden fluid stages. The sand and fluid volumes were identical. The wells treated with ThinFrac MP recorded a 79% increase in oil production.

Eagle Ford Shale

An operator performing multistage horizontal fracturing operations in the liquids-rich portion of the shale play required a product that would cost-effectively deliver higher regained permeability to enhance production. Seven wells were selected to demonstrate the effectiveness of the technology. The wells ranged in depths from 2,560 m to 4,419 m (8,400 ft to 14,500 ft) and lateral lengths averaging 1,219 m (4,000 ft). Four gpt of ThinFrac MP fluid was injected into the blender with additives and proppant. In the same field 20 offset wells were pumped with high-proppant concentrations using a hybrid (slickwater, linear gel and crosslinked) fluid system. Each well was completed similarly with 5½-in. casing and fractured in 14 stages to 17 stages using the plug-and-perf method. The wells using the engineered polymer showed production improvements averaging 30% to 70% when compared with direct offsets. The completion technique was equally effective in preventing abrasive wear and proppant settling in the high-pressure pumps.

In recent years the North American shale industry has been at the forefront of both technology identification and rapid adoption to maximize return on capital, outperform peer groups and achieve new benchmarks for production targets. The continued advancement in polymer chemistry has contributed directly to the reduction of operational complexity and efficient use of capital investments. E&P

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