Opinions Differ On Whether Friction Reducers Do More Harm Than Good

During the Society of Petroleum Engineers' Hydraulic Fracturing Technology Conference (HFTC) in early February, I found myself in a conversation about the impact of friction reducers (FRs) on the modern hydraulically fractured reservoir. To my surprise, there seems to be some debate about how much impact FRs really have on the reservoir and what companies should do to mitigate any damage that may occur.

Many folks assert that the large amounts of largely polymer-based friction reducers employed must be causing some formation damage. Others counter that, based on production over time, it really isn't much of a concern. After some digging, I realized this issue has been around for some time, multiple studies have been done, and at least one company has developed and patented technology to address it.

In their paper published at the 2007 SPE HFTC titled, "Successful Breaker Optimization for Polyacrylamide Friction Reducers Used in Slickwater Fracturing," Paul Scott Carman and Kay Cawizel explain how the issue of friction reducers causing formation damage has evolved over the years.

The authors discuss how, during the late 1990s when operators were seeing big success using slickwater fractures–specifically in the Cotton Valley Sand in East Texas and further refined in the Barnett Shale–formulations typically consisted of freshwater and friction reducer. Although operators were seeing success, these jobs typically had proppant placement issues and generally used small volumes of FR, so worries about damage really didn't exist.

Over the next few years and with the development of new technology, operators began pumping larger and larger jobs using increased amounts of fluid and proppant. As rates increased, fluid volumes increased as well, with roughly the same percentage of FR being used. However, when treatments rise to the level of more than 2 million gallons of water, the cumulative concentration of chemical additives becomes much larger.

This is when the industry began worrying about formation damage caused by polymers used in the typical FR. Many friction reducers are polyacrylamides, which are synthetic polymers, and the school of thought was that these would be difficult to break.

Carman and Cawizel highlight how they undertook their study in response to producing company concerns regarding possible fracture and formation damage caused by these friction reducers. According to the authors, today's service companies pump friction reducers as liquid emulsions, which make them easier to pump.

There are several types of polyacrylamides, and each has different molecular chain lengths. It is these chain lengths that give the polyacrylamide its friction reducing properties. A short chain will not reduce friction enough, and one that is too long may break with high shear, and again, not work properly.

The researchers evaluated a variety of breakers to see which ones could effectively reduce the size of the molecular chain and ultimately reduce formation damage. They used several common oxidizers to see if they could reduce viscosity. To measure this, they used a molecular weight, cutoff filtration technique to determine the size and percentage of polymer fragments.

> *"Folks seem to be concerned about formation damage caused by FR treatments."*

To their surprise, the breakers they tested did show some reduction in molecular chain length and a reduction of viscosity.

As fracturing treatments get larger, the issue of formation damage caused by FRs remains a concern for many. Finoric LLC, located in Beasley, Tx., has patented an alternative to the oxidizers commonly used for breaking friction reducers. The additive effectively reduces the viscosity of the FR at all shear rates, but more importantly, does so at a very low sheer rate, helping to ensure that the FR is removed from even the smallest of micro-fractures.

The amount of breaker used in this process is determined by bottom hole temperature and the speed at which it will need to begin working. Added live, when it begins to work, it helps to make the FR more water soluble, allowing it to be flowed back effectively. Samples from the field also show success in completely dispersing the solids into soluble polymer by increasing the water solubility, even if the FR reacted with in situ divalent and trivalent metals.

It would appear the conversation I found myself in at this year's HFTC was valuable. Folks seem to be concerned about formation damage caused by FR treatments, and ongoing evaluation and use of technology will be necessary to continually optimize wells in order to maximize hydrocarbon production.

As hydraulic fracturing treatments continue to grow, and the associated fluid regimes grow with them, friction reducers will continue to play a key role in formulations. However, as operators look for more ways to increase long-term production on a well by well basis, optimized technology that can help minimize and even eliminate formation damage caused by the fracturing process will become more and more important. ❒

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