Halliburton's PERMVIS VFR-10 agent is a novel Plug-N-Play friction reducer that enables the use of a wide range of TDS waters, from fresh to flowback/produced waters, for hydraulic fracturing applications. It consists of an oil-external emulsion that is easy to invert and disperse in aqueous fluids. PERMVIS VFR-10 unique polymer exhibiting chemistry enables it to be very effective in high TDS waters at low concentrations.

The advantages of using PERMVIS VFR-10 friction reducer include the following:

- High tolerance of a variety of ions in water as compared to other leading friction reducers
- Superior performance at low concentrations in fresh water, in flowback and in produced water in comparison to other leading friction reducers
- Less residue than conventional friction reducers on the market (Figure 1)
- Exhibits unique properties that provide superior conductivity and cleanup compared to other friction reducer chemistries.
- Yields higher viscosity than conventional friction reducers to enable placement of higher proppant concentration slurries for liquids rich reservoirs

PERMVIS™ VFR-10 friction reducer can effectively perform in waters with a variety of ions (sodium, calcium, sulfates, strontium, magnesium, iron, chlorides). Effective friction reduction has been demonstrated in waters of TDS levels up to 300,000 ppm. Figure 2 demonstrates the superior friction reduction performance of PERMVIS VFR-10 agent in a wide range of TDS compared to a conventional friction reducer. The case study shows PERMVIS VFR-10 agent reduces the treating pressure significantly with 100,000 ppm TDS water.

**Advanced Properties**

**Viscosification:**
By adding slightly higher concentrations, PERMVIS VFR-10 friction reducer can achieve viscosities similar to guar, assisting in proppant transportation. (Figure 3)

**Unique Breaking Performance:**
A clean technology has been deployed. The viscosity of PERMVIS VFR-10 agent can decrease to water-like levels at high temperatures, as shown in Figure 4. The higher the formation temperature, the faster PERMVIS VFR-10 agent viscosity decreases, and in combination with a breaker enables good cleanup as well as good conductivity.

**Acidizing:**
PERMVIS VFR-10 friction reducer is very effective in low pH fluids, such as 20% hydrochloride acid.
Figure 2. Comparison of friction reduction performance of PERMVIS VFR-10 friction reducer and a commercially available friction reducer: a case study in 100,000 ppm TDS water (left) and laboratory data with a wide range of TDS levels (right). PERMVIS VFR-10 friction reducer shows a superior margin in friction reduction performance.

Figure 3. By employing slightly higher treating rate concentrations, PERMVIS VFR-10 friction reducer exhibits viscosities similar to and higher than linear guar gum at 10 lbm/1,000 gallons. This enhanced viscosity capability allows improved proppant transport.

Figure 4. Example of the breaking profiles in fresh water at 150°F for PERMVIS VFR-10 friction reducer and a commercially available anionic friction reducer without breakers. The viscosity of PERMVIS VFR-10 decreases to water-like levels, contributing to the advanced breaking performance of this clean friction reducer technology for improved proppant conductivity.

For more information on PERMVIS™ VFR-10 Friction Reducer, please call your local Halliburton representative or email us at stimulation@halliburton.com.

© 2014 Halliburton. All rights reserved. Sales of Halliburton products and services will be in accord solely with the terms and conditions contained in the contract between Halliburton and the customer that is applicable to the sale.