Optimizing Rheological Measurement For Friction Reducer Selection: From Laboratory To Field


Abstract

Objectives/Scope: The shift to produced water in the oil and gas industry has challenged the chemical additives necessary for hydraulic fracturing. The variability of water chemistry necessitates laboratory testing of chemical additives for each hydraulic fracturing job. Friction reducers (FRs) are tested for friction reduction and viscosity; however, these results alone do not give insight into the ability of FRs to suspend and transport proppant into the fracture networks.

Methods, Procedures, Process: Slot flow experiments can be conducted for proppant suspension, but these experiments are time-consuming and expensive. We have utilized three rheological tests that monitor the material and mechanical properties of FRs to more accurately predict proppant suspension capabilities. The stability, recoverability, and ability to withstand deformation are crucial properties of an FR. The stability of FRs is monitored by varying the shear rate in the three-step flow method. The recoverability of FRs is monitored by varying the strain percentage in the three-step oscillation method. Finally, the ability for FRs to withstand deformation of the polymer backbone is monitored via creep testing.

Results, Observations, Conclusions: Two FRs, FR-A and FR-B, were laboratory tested for friction reduction and viscosity. FR-A and FR-B had very similar friction reduction and viscosity profiles and were therefore recommended for use in a field trial. Although laboratory testing showed similar profiles, FR-B struggled to successfully place proppant. FR-A and FR-B were subjected to rheological tests to monitor the material properties. The three-step flow method and three-step oscillation method showed that FR-B lacked stability and recoverability compared to FR-A. The creep test showed that FR-B had more deformation to the polymer backbone in comparison to FR-A. The results from the rheological testing confirmed those seen in the field; FR-A had better material and mechanical properties and therefore was able to suspend and transport proppant better than FR-B.

Novel/Additive Information: By combining material testing with friction reduction and viscosity testing, we can quickly design, synthesize, and screen FRs for optimal performance in fresh and produced waters. Combined with traditional methods, these new testing methods will optimize FR selection and dosage for each hydraulic fracturing job, ultimately saving time and money while increasing production.