CRITICAL EVALUATION OF HIGH BRINE TOLERANT ADDITIVES USED IN SHALE SLICKWATER FRACS

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ABSTRACT
The primary purpose of stimulating shale reservoirs is to allow as much contact with the reservoir rock as possible, extend drainage radius, and maximize Stimulated Reservoir Volume. Slick water fracturing has increased significantly with the advent of horizontal shale stimulation. Technological advances, including multi-stage fracturing of horizontal wells, have brought about an increase in frac volume of up to several million gallons of slick water per well. Recent restrictions by local and state regulatory entities have put limits on fresh water usage. Concerns over the disposal and environmental impact of flowback water have created challenges for industry. To remedy some of these concerns and reduce operational cost, some operators are adopting different methods of managing large volumes of produced water by chemical and mechanical methods, in order to remove solids and iron from flowback water so it can be reused in fracturing. However, most treatments currently used do not remove dissolved salts from treated waters, therefore recycled water not only exhibits overall high salinity, but also increased multivalent ionic content. When these conditions exist, the current commercial additives perform under par, thus necessitating the development of high brine tolerant chemicals. Searches for and development of these types of chemicals began early in 2009, and were done in part to meet operational demands, while reducing chemical costs and environmental impact. These goals can be achieved by using less friction reducer per job. This paper describes friction reducer performance and other chemical selections that tolerate high salinity flowback waters.

This study critically examines the performance of a newly-developed slick water system in high salt concentration brines containing mono and multivalent ions. Average water analyses of different shale reservoirs were used to determine the performance characteristics of the additives used in slick water fracturing. A friction flow loop was used as the main measurement tool in evaluating the rheological properties of the polymers, as well as the effect of other additives used in slick water fracturing.

This new slick water system incorporates a high molecular weight polyacrylamide in a water internal emulsion as a friction reducer, which shows significant improvement over commercially available friction reducers of similar charge and molecular weight currently used in the industry. A ten gallon capacity friction loop was utilized to pump the fluid through one-quarter inch pipe at a Newtonian Reynolds number of 52,000. Results of this study, along with compatibility data, were used to select a polymer system that exhibits high resistance to brine. Experimental and field data illustrated in this study show significant performance improvement of slick water treatments where high brine water is used in shale fracturing.

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