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Developing Effective and Environmentally Suitable Fracturing Fluids Using Hydraulic Fracturing Flowback Waters

M.E. Blauch, Superior Well Services, Inc.

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Abstract

This paper presents methods, materials, and procedures that can enable operators to prepare safe and effective fracturing fluids from returned fracturing fluid (commonly called "flowback") and produced formation water. Reuse of frac fluid and formation water especially focused on high volume and rate (HVR) fracturing requires establishment of a number of interrelated chemical and geochemical solutions. Specifically addressed are environmental attributes of the chemical additive components and whole fluid, geochemical precipitates, scale, microbially induced biogeochemical interactions, water analysis, friction reducer compatibilities, and saline content.

Materials discussed in the paper include:

- Friction reducer chemistry and attributes that enable reuse of frac water in actual flowbacks from shale reservoirs.
- Solutions and need for complexing iron and converting to insoluble precipitates that can damage fracture conductivity, reduce production potential, and negatively impact scale inhibition.
- Methods for protection against an assemblage of naturally occurring geochemical precipitates.
- A solution for environmentally sound quick-kill of microorganisms responsible for producing damaging downhole biogeochemical byproducts, including hydrogen sulfide.

Fracture-stimulation of shale-gas wells requires an enormous volume of frac fluid, which traditionally has been developed from fresh water purchased from sources near the drilling location or municipalities. Along with the chemicals introduced by the frac fluid, the flowback may contain a wide variety of dissolved constituents such as salts and metal ions. The constituents can make wastewater disposal environmentally prohibitive, difficult, and expensive, and may impair gas production by placing damaging precipitates within the fracture, perforations, and wellbore. The paper presents and discusses practical, cost-effective remediation of frac fluid to minimum standards required to achieve environmental, technical, and economic goals. Keys to successful reuse of frac fluids are chemical additive developments and processes involving analysis of water chemistry, flow-loop testing, and geochemical modeling in the establishment of treatment and/or dilution standards to enable fracturing fluid reuse.