Mitigating Kerogen Polymeric Characteristics in Unconventional Operations

Katherine Hull[1], Younane Abousleiman[2]
[1]Aramco Services Company; [2]Univ. of Oklahoma

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Unconventional reservoir rocks contain the polymeric source material (kerogen) for hydrocarbons. Kerogen has viscoelastic and viscoplastic characteristics that have shorter time-dependent scales than the mineral matrix in terms of creep, ductility and deformation. The time-dependent polymeric nature of kerogen may be responsible for proppant embedment and reduced hydraulic fracture conductivity observed after relatively short production times. To mitigate these effects, additives to hydraulic fracturing (HF) fluids were imagined, designed, and developed.In unconventionals, the organic matter is dispersed among silicate, aluminosilicate and other minerals as fine laminae comprising a substantial volume of the rock fabric. To mitigate the adverse effects of kerogen geopolymeric nature on hydraulic fracturing operation and enhance overall fracture conductivity, a new type of reactive fracturing fluid that is stable at high temperatures was developed. Micro-mechanical testing was conducted and the viscoplastic and ductile behavior of the kerogen vis-à-vis the shale matrix was observed, measured and documented. Organic-rich shale samples were treated with the reactive fluid and imaged at before and after treatment to identify the effects. High-resolution scanning electron microscopy (SEM) imaging of shale samples before and after fluid treatments demonstrate porosity and permeability enhancement on the fractured shale faces. The new kerogen control fluid (KCF) produces a loss of ductility in the shale samples, as demonstrated by the SEM images of treated shale surfaces. The TOC porosity increase and the new fractures created on the treated shale samples were used to calculate hydraulic conductivity and permeability enhancement. More than 20% porosity increase was observed, while an order of magnitude increase in permeability was

calculated from the conducted laboratory experiments. The field data are yet to be available, however early indications are promising. The KCF has no equivalent to date in either published literature or in commercial products. Many hydraulic fracturing fluid additives have been designed to address proppant placement, viscosity control, and other concerns in hydraulic fracturing. However, to date, no hydraulic fracturing fluid additives were designed and implemented to address the viscoelastic and viscoplastic behavior of the organic matter—a potential handicap to long-term fracture conductivity.

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.