Mechanical and Geochemical Assessment of Hydraulic- Fracturing Proppants Exposed to Carbon Dioxide and Hydrogen Sulfide

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The Energy & Environmental Research Center (EERC) has conducted a study to evaluate mechanical and geochemical changes experienced in proppant as a result of exposure to CO_2 and H_2S under simulated reservoir conditions. This study was carried out from March 2009 until March 2010 with funding provided by the U.S. Department of Energy. Because of the near ubiquitous use of hydraulic fracturing in unconventional well completions, the interactions between potentially corrosive gases or fluids should be considered.

Although hydraulic fracturing is reasonably understood for stimulating wells, the methods and materials may not be chosen with regard to long-term conditions and potential reactions occurring as a result of reservoir souring or CO_2 enhanced oil recovery operations. The possibility exists for proppant degradation because of the large amount of fluids that travel through fractures, the high surface area of the proppant within the fractures, and the already taxing subsurface conditions. In order to understand the potential reactions and the effect that those reactions have on compressive strength, samples were acquired that represent common proppants, including both natural and synthetic materials. The samples were subjected to reactor vessels that simulated downhole conditions and exposure to supercritical CO_2 and to acid gas containing 85% CO_2 and 15% H_2S. The presence or absence of brine was also examined. Samples removed from the reactor were subjected to onedimensional confined compressive strength testing and sieve analysis to examine the amount and size of damaged material compared to baseline (as-received) material.

Preliminary results show that all proppants show varying degrees of strength loss postreaction, and current work is being performed to determine whether the causation is a product of brine interaction, reactor pressurization and depressurization, or is indeed because of mineralogical gas/proppant interactions. The results of this study will aid in the selection of optimal proppant materials for long-term or multiple-use performance in unconventional oil shale and gas shale production wells as well as potential for retrofitting a well for injection purposes. The work has further applications with the potential use of hydraulic fracturing for increasing the injectivity of CO_2 storage injection wells.