

Wellbore Leakage Mitigation Using Advanced Mineral Precipitation Strategies

Award Number: DE-FE0026513

Project Summary:

Montana State University developed new mineralization precipitation technologies capable of sealing near-wellbore leakage pathways under a variety of pressure and temperature conditions in the presence of carbon dioxide (CO₂) and brine to help ensure CO₂ permanence within the storage formation. The minerals are promoted by enzymatic and thermal degradation of urea, which results in mineral precipitation. The minerals can withstand significantly greater temperature than certain microbe precipitation techniques explored during previous development efforts. The project combined the use of laboratory testing at elevated temperatures and simulation modeling to determine the most applicable mineral sealing strategy. The selected strategy was deployed in a field experiment at the Gorgas Power Station in Walker County, Alabama, where an attempt was made to seal a previously identified fracture zone in a well at the plant site.

Project Outcomes:

Enzyme-induced calcium carbonate precipitation (EICP) leak-sealing technology was successfully tested in a 1,000-foot deep vertical well at the Gorgas power plant in Walker County, Alabama. The field test involved alternating injections of biologically produced enzymes and urea-calcium solutions into a leaking well over a four-day period. The enzyme-induced chemical reactions caused calcite crystals to precipitate within very fine channels in the wellbore cement, resulting in a 94% reduction of apparent permeability in the channels. The components of the EICP leak-sealing technology are much less viscous than existing wellbore sealing materials, typically fine cements. The reduced viscosity allows the sealant to penetrate very fine fractures, ultimately resulting in a more effective method of preventing leakage of stored CO₂ or other fluids through the wellbore.

Prime Performer:

Montana State University

Key Performers:

Montana Emergent Technologies, Inc.

Schlumberger Carbon Services

Principal Investigator:

Dr. Adrienne Phillips

Project Duration:

10/01/2015 – 9/30/2020

Performer Location:

Bozeman, Montana

Field Sites:

Gorgas, Alabama

Program:

Carbon Transport & Storage

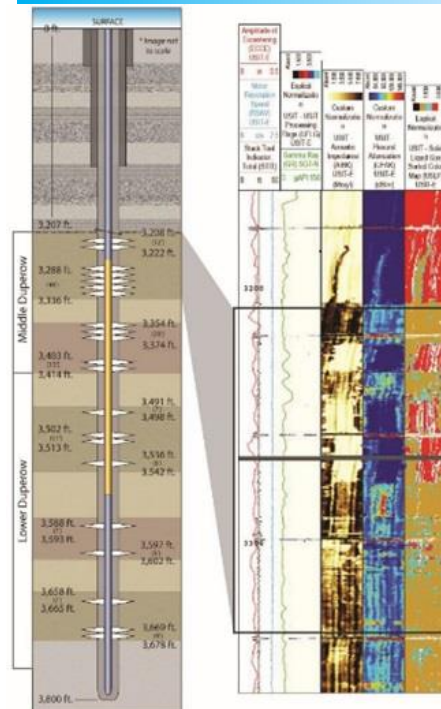


Figure 1: Well Diagram for the Montana State University Danielson well and cement evaluation log. Tan in the far right track indicated bonded cement, the red indicated gaps between the casing and cement.

Presentations, Papers, and Publications

Final Report:

[Final Scientific/Technical Report of Project Wellbore Leakage Mitigation Using Advanced Mineral Precipitation Strategies](#) (January 2021), Adrienne Phillips, Robin Gerlach, Lee Spangler, Al Cunningham, Rainer Helmig, Johannes Hommel, Randy Hiebert, Brian Park, Jay McCloskey, and Robert Hyatt