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MICP in the Field: Enhancement of Wellbore Cement Integrity and Permeability Modification

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Microbially-induced calcite precipitation (MICP) is being widely researched as an emerging technology for subsurface engineering applications including sealing defects in wellbore cement and modifying the permeability of rock formations [1]. Our study team, including Montana State University's Energy Research Institute and Center for Biofilm Engineering, The University of Stuttgart, Montana Emergent Technologies, and Schlumberger Carbon Services, has conducted two successful MICP-based field trials. The first field test successfully used MICP to seal a horizontal "pancake fracture"in tight sandstone [2]. The following test resulted in MICP sealing of compromised wellbore cement. Both tests were carried out in the Gorgas well in Alabama and used the ureolytic bacteria, Sporosarcina pasteurii, to promote calcium carbonate precipitation. A third field test is now underway targeting an existing oil well, Rexing #4, in Indiana. The Rexing #4 well was previously used as an injection well to sweep residual oil to production wells. Several years ago, injection pressure was lost, and the well was removed from service. Subsequent well logging measurements suggested that, rather than entering the target injection formation, injectate was traveling up the wellbore through defects in the well cement to a sandstone thief zone approximately 50 feet above the target formation. The goal of the field demonstration project at the Rexing #4 well is to use MICP to reduce permeability in the thief zone and cement defect until the injection pressure reaches the pre-breakthrough condition necessary to return Rexing #4 to service as an injection well. The field demonstration in Indiana, funded by the US Department of Energy, will be conducted the first week of December 2017 using a custom mobile laboratory designed for field applications of MICP. Results presented at the conference will include a rationale for the injection strategy employed, as well as its success at sealing the leakage pathway.

References

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