Cementing Solutions for CCS Environments

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The fact that carbonation of Portland cement is a thermodynamically favorable process poses huge challenges to providing zonal isolation in CCS environments where 1000 years of safe trapping period is required. Chemical and mechanical integrity of different cement sheaths were tested at 200°F and 2,000 psi in a wet CO_2 environment for an extended time period. Cement sheaths of neat Portland cement and optimized blends were tested in a wet CO_2 environment at 200°F and 2,000 psi. Results show that the depth of CO_2 penetration and the extent of carbonation is a function of initial cement sheath permeability as well as the amount of Portland cement in the blend, respectively. The cement sheath mechanical properties at the above conditions were also measured at regular intervals for up to one year.

Tests show that a neat Portland cement sheath is at a greater risk of being damaged when it is exposed to CO_2 compared to the optimized blend that contained substantially reduced Portland cement and mechanical properties enhancing materials. The mechanical properties of the optimized blend did not undergo any degradation even after one year. However, minor surface dissolution of the cement samples has been observed as expected due to the acidic water in contact with the cement. In another set of experiments the cement slurries were cured inside a sandstone core and then tested under the same conditions for one year. Results show no evidence of dissolution related de-bonding at the sandstone-cement interface even after such prolonged exposure.