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Self-healing cementitious blends with pozzolanic materials for subterranean applications

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Cement failure in subterrenean wells may compromize zonal isolation, cause corrosion of steel casing and, in the worst case scenarios result in a catostrphic event of well collapse. Portland cement and its blends are used for cementing the majority of subterrenean wells. Although they proved to provide a robust solution in many cases, they are not durable in aggresive environments with high total dissolved solids, acidic gases and fluids and large thermal and mechanical stresses. Although strong, cements in general are brittle and, as a result, may fractures or break under various stresses. Because of the difficulties in locating and accessing damaged areas in subterranean wells self-healing cements are of particular interest. Cementitious blends with pozzolanic materials may form resilient cements with self-reinforcing properties at longer curing times. This work revisits and updates applications of cementitious blends that include pozzolanic materials for carbonate-rich, strongly acidic high-temperature wells with large thermal and mechanical stresses. Data on strength recoveries and cracks sealing or bond re-formation for samples subjected to a repeated compressive damage followed by 5d 300oC healing periods in water, alkaline carbonate and geothermal brine are presented. Blend cements formation mechanisms, mechanical properties, resistance to mild and strong acids and cement/carbon steel bond characteristics and corrosion protection are discussed. Properties of the class G oil well Portland cement modified with silica for high-temperature applications are presented as a benchmark. Possible healing mechanisms based on XRD, Raman analyses and SEM coupled with EDX data are proposed. The evaluated pozollanic materials include fly ash F, ground granulated blast furnace slag, natural zeolites, and micro glass fibers type E.

References

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