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## Characterization of the corrosion of oilwell cement exposed to H<sub>2</sub>S under high-sulfur gas reservoir conditions

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H<sub>2</sub>S is an acidic and toxic gas and the corrosion of H<sub>2</sub>S on oilwell cement is considered to be a great challenge for wellbore integrity and environmental safety in the exploitation of high-sulfur gas reservoir. In our work, an unidirectional sample was designed to simulate the actual downhole condition, and the corrosion performances of oilwell cement exposed to humid H<sub>2</sub>S gas and H<sub>2</sub>S-rich brine were investigated using designed unidirectional samples. Compressive strength, microhardness, porosity, gas permeability, SEM, EDS, and XRD analyses were conducted to compare the dissimilarity of H<sub>2</sub>S attack in two exposure scenarios. The experimental results show that the corrosion degree of cement exposed to humid H<sub>2</sub>S gas was lower due to a dense gypsum layer formed on the cement surface; this layer inhibited inward penetration of H<sub>2</sub>S by blocking diffusion. On the contrary, a porous and loose amorphous silica gel section formed on the headspace of brine-exposed cement for dissolution and migration effects of brine, which facilitated the penetration of H<sub>2</sub>S to the interior of cement. The degradation mechanism of cement and the effects of exposure scenario on cement properties are proposed.

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