A Study on the CO₂ Corrosion Behavior of P110 Steel in High-Density Cement

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High-density cement slurry is commonly used for cementing deep and ultradeep wells. During service, corrosion problems at the interface between the cement and casing steel seriously affect the safety of oil and gas extraction. In this paper, a specimen of a high-density cement/casing steel system was prepared by using hematite powder as the weighting agent. The electrochemical properties and microstructure were investigated by electrochemical techniques, SEM, Raman spectroscopy and XPS. Samples were corroded in simulated formation water saturated with CO₂ at 90 °C for 7–49 days. The results show that with increasing immersion time, the corrosion rate of casing steel in cement gradually increases and the cement resistance first increases and then decreases. The pressure promotes the corrosion reaction; thus, the corrosion potential is more negative and the corrosion rate is higher. The corrosion product morphology on the surface of casing steel in cement is a distribution of cracks. The corrosion product is FeCO₃, showing that mainly CO₂ corrosion occurs. The microgap at the cement/casing steel interface is only 1.0 μm and accompanied by FeCO₃ production.

Keywords: High-density cement, P110 Steel, Cementing interface, CO₂ corrosion, Electrochemistry

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