The Effect of Acetic Acid on the Localized Corrosion of 3Cr Steel in the CO₂-saturated Oilfield Formation Water

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The effect of acetic acid on the localized corrosion of 3Cr steel in the CO₂-saturated oilfield formation water was investigated using weight loss tests, surface characterization, and electrochemical measurements. Weight loss tests revealed that acetic acid and increased concentration can dramatically accelerate the general rate of 3Cr steel when the general corrosion rate increased from 0.2841 to 1.2236 mm/y in tandem with an increase in the acetic acid concentration from 0 to 5,000 ppm. Surface characterization measurements were performed by scanning electron microscopy, energy-dispersive X-ray spectroscopy, X-ray powder diffraction, and three-dimensional profilometry. The results revealed that FeCO₃ and Cr compounds dominated the corrosion scales and that the corrosion scales gradually became looser and shed off with increased acetic acid concentration. The localized corrosion rate increased from 0.2663 to 4.2416 mm/y in tandem with an increase in acetic acid concentration from 0 to 5,000 ppm. The electrochemical measurements showed that the reduced reaction of undissociated acetic acid in the solution participated in the cathodic reaction process. Moreover, acetic acid was shown to affect the adsorption process of the corrosion product scales, with the entire corrosion reaction drastically accelerating. In this paper, the localized corrosion mechanism of 3Cr steel in the CO₂-saturated oilfield formation water is discussed. Acetic acid significantly contributes to the generation of localized corrosion. Moreover, the combined effect of Cl⁻ stimulates the formation and development of localized corrosion on 3Cr steel's surface.

Keywords: acetic acid, CO₂-saturated oilfield formation water, 3Cr steel, localized corrosion, localized corrosion depth.

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