Effect of Cr Content on the Electrochemical Behavior of Low-chromium X65 Steel in CO₂ Environment

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The electrochemical behavior of 1Cr, 3Cr and 5Cr steel in CO₂ environment was investigated in situ by means of electrochemical measurements. The characteristics of corrosion scale were characterized by surface analysis techniques. The results showed that 3Cr steel could reduce the corrosion rate by 51% compared with 1Cr steel, and the reduction in the corrosion rate slowed when the Cr content in X65 steel was higher than 3%. The Cr-rich corrosion scale on 1Cr, 3Cr and 5Cr steels possessed a prepassivation characteristic. When the Cr content was 3% or higher, an adequate amount of Cr compounds could form in the prepassivation film, which effectively inhibited the localized corrosion, while the pitting sources on 1Cr steel were developed to form the corrosion pits. The increase of Cr(OH)₃ content in the prepassivation film was conducive to improve the stability and compactness of the corrosion scale, and thus providing a favorable protection for the substrate, which was the reason why the CO₂ corrosion resistance of low Cr steel improved with the increase of Cr content.

Keywords: Low-chromium steel, CO₂ corrosion, Polarization curve, Electrochemical impedance spectroscopy, Corrosion scale

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