

Effect of temperature on the corrosion behavior of BG140V steel in CO₂ environment

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Abstract The integrity of well casings is crucial for safe oil extraction, especially in CO₂-rich environments. BG140V steel, a low-alloy steel commonly used in oil fields, faces significant corrosion challenges, particularly in regions like Xinjiang. Understanding how temperature affects the corrosion behavior of BG140V steel in these conditions is essential for optimizing its performance and ensuring the longevity and reliability of oil extraction operations. The effect of temperature on the corrosion rate of BG140V steel in CO₂-containing environment was studied by using the high-temperature and high-pressure reactor by weight-loss method, and the corrosion morphology and corresponding corrosion products of BG140V steel at different temperatures were analyzed by scanning electron microscopy, energy spectroscopy and X-ray photo-electron spectroscopy. The results show that with the increase of temperature, the corrosion rate of BG140V steel in CO₂-containing environment shows a trend of first decreasing and then increasing, and the corrosion rate is greater than 0.076mm/a. The corrosion rate is 0.7501mm/a at 30 °C, 0.087mm/a at 90 °C, and 0.2086mm/a at 110 °C. As the temperature rises from 30 °C to 90 °C, the corrosion products on the surface of BG140V steel gradually become denser, and the regular hexahedral crystals gradually become rounded, and the porosity between the grains becomes smaller, which effectively prevents the corrosion medium from reaching the matrix through the corrosion product film, and the corrosion rate decreases. When the temperature reaches 110 °C, the local corrosion products fall off, the film density of the corrosion products decreases, and the corrosion rate increases. When the temperature rises from 30 °C to 90 °C, the corrosion products of BG140V steel are basically the same, which are mainly composed of FeCO₃ and (Fe,Ca)CO₃ double salts and amorphous Cr(OH)₃ and Cr₂O₃.

Keywords Temperature; BG140V; CO₂-containing environment; Corrosion

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