Effect of Temperature on Corrosion Behavior of VM110SS Casing Steel in the CO₂/H₂S Coexistent Environment

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The effect of temperature on the corrosion behavior of VM110SS casing steel in a H₂S/CO₂ co-existing environment was investigated by high temperature and high pressure (HTHP) autoclave and the electrochemical corrosion method. In addition, scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS) were used to characterize the morphologies and structure of the corrosion scales. The results show that the corrosion rates of VM110SS steel in the gas-liquid two phase acidic environment exponentially increase in the initial stage and then decrease with the rise in temperature, and the corrosion rate reaches the peak at 90°C. The principal components of the product may be Fe_xS_y, indicating that the corrosion process is mainly dominated by H₂S. The corrosion scales with a porous flocculent structure can be detected in the gas phase; however, the corrosion scale with a brittle characteristic can be easily exfoliated in the liquid phase. Electrochemical tests show that the corrosion current density of VM110SS steel increases with the increase of temperature, and the total impedance decreases. The cathode process is greatly affected by temperature, and the corrosion reaction is mainly controlled by diffusion and activation. The investigation provides a theoretical basis for corrosion failure analysis of casing and technical guidance for material selection.

Keywords: H₂S/CO₂; VM110SS steel; temperature; corrosion scales; electrochemistry

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