Corrosion Behavior of 316L Stainless Steel in Oilfield Produced Water in Presence of CO₂ and Acetic Acid

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doi: 10.20964/2020.05.23

Received: 19 August 2019 / Accepted: 16 October 2019 / Published: 10 April 2020

316L stainless steel has good corrosion resistance and is widely used in oilfield produced water. The environment of oilfield produced water is complicated by corrosion factors such as acetic acid, CO₂, high temperature and high pressure, which easily lead to pitting corrosion. Corrosion behavior of 316L stainless steel in oilfield produced water was studied by weight loss, anode polarization curve, electrochemical impedance spectroscopy and scanning electron microscope methods. The pitting corrosion was the main behavior to 316L stainless steel in the simulated oilfield produced water. The corrosion rate increased first and then decreased with the increase of temperature and the corrosion rate was the highest at 60 °C. The passivation current density of 316L stainless steel was the largest at 60 °C, indicating that the pitting sensitivity was the strongest at 60 °C. When the acetic acid concentration was 1000 ppm, the corrosion rate was the largest. The pore resistance and charge transfer resistance of 316L stainless steel was the smallest when 1000 ppm acetic acid was added. The low concentration of acetic acid was more likely to destroy the passivation film. When the CO₂ partial pressure was 0.1 MPa, the passivation film appeared “glitches” phenomenon, and the corrosion rate reached the maximum. The maximum pitting depth of the oilfield produced water after adding 1000 ppm acetic acid and 0.1 MPa CO₂ for 72 h at 60 °C was 0.145 mm.

Keywords: 316L stainless steel; temperature; acetic acid concentration; CO₂ partial pressure; pitting corrosion

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