Corrosion Behaviors of SMSS 13Cr and DSS 22Cr in H₂S/CO₂-Oil-Water Environment

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A series of corrosion tests were performed in field and laboratory to investigate corrosion behaviors of Supermartensitic Stainless Steel 13Cr (SMSS 13Cr) and Duplex Stainless Steel 22Cr (DSS 22Cr) in H₂S/CO₂ containing environment. Carbon steel of P110S was chosen as comparison specimens in this study. A new field corrosion testing apparatus was designed and manufactured in order to perform this study. The corrosion species of the pipe flow include CO₂, H₂S and saline formation water; the water cut of the production flow was 16%. The flow temperature near the wellhead was 50°C, the corrosion test was 90 days. Analysis techniques, such as Weight loss, X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM), Energy Dispersive Spectrum (EDS), double-loop electrochemical potentiokinetic reactivation (DL-EPR) and Scanning Kelvin Probe Force Microscopy (SKPFM) methods were used in this study. The results showed that pitting attack happened on DSS 22Cr and P110S specimens, however, SMSS13Cr steel was survival. In high H₂S containing environment, the reactivation ratio of SMSS 13Cr was lower than DSS 22Cr and the intergranular corrosion and the degree of sensitization (DOS) of DSS 22Cr was higher, and the risk of localized corrosion in DSS 22Cr steel was higher. Corrosion mechanism models in H₂S/CO₂-oil-water system for the three types of steel were proposed.

Keywords: Corrosion; H₂S/CO₂-oil-water system; pitting attack; SMSS 13Cr; DSS 22Cr

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