

Fatigue-Induced Effects of Prolonged Holding Time on Corrosion in AISI 4130 Steels Welded with a Nickel-based Electrode via the Pulsed TIG Process

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Abstract : The maintenance of blowout preventers (BOPs) used in the hydrocarbon field requires the use of a material with good mechanical and corrosion resistance properties. In the present study, the impact of fatigue-inducing holding times ranging from 1 to 3 hours during post-weld heat treatment (PWHT) at 640°C on the electrochemical behavior and mechanical properties of AISI 4130 steel substrate overlaid with a nickel-based alloy is investigated. The overlay was achieved using the pulsed Tungsten inert gas (TIG-Pulsed) process. The results indicated that, as the fatigue-inducing holding time increased beyond 3 hours, the hardness of the substrate/surface interface decreased. This phenomenon can be attributed to the release of thermal stress resulting from the weld overlay operation. Additionally, electrochemical impedance spectroscopy (EIS) measurements were conducted in a 2.5% NaCl solution, revealing a capacitive effect in the low-frequency region due to the precipitation of a new film that modified the surface properties. In contrast, potentiodynamic tests indicated that the open circuit potential (E_{corr}) became more stable or positive with an increased fatigue-inducing holding time.

Keywords : AISI4130, holding time, TIG-Pulsed, corrosion, hard facing operation