Investigation on hydrogen-induced stress corrosion cracking (SCC) behavior of seamless-track joints from flash-butt welding for high-speed railways

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Abstract To reduce the service risk of U75V welded joints, the hydrogen induced stress corrosion cracking (SCC) behaviour and mechanism of U75V welded joints immersed in a 3.5 wt% NaCl/ hygrogenated solution were investigated using the slow strain rate test (SSRT) method and electrochemical measurements. The weld joint (WJ) shows a more negative potential (−0.56 mV) and higher corrosion current density (9.62 × 10^{-5} A/cm^2) than the base metal (BM) due to concentrated residual stress and more boundaries for hydrogen adsorption. Furthermore, the WJ had a considerably high SCC susceptibility (ISSRT = 0.9237) in the hydrogen solution, with an accompanying mechanism of anodic dissolution and hydrogen erosion. Because of weld hardening, the WJ has a slightly higher strength value (1000.67 MPa) than that of the BM (996.7 MPa) in the air, and the strength and elongation of both the WM and BM significantly decreased after exposure to the NaCl/ hydrogen solution, particularly for the WJ. These results were mainly attributed to the synergetic effect of stress concentration and micro-galvanic corrosion. We believe that this finding will facilitate the further application of U75V welded joints in steel rails.