Study of the Corrosion Behaviour of the Steel Q315NS Heat-affected Zone in H₂SO₄ Solution by Electrochemical Noise

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To provide insight into the influence of the welding thermal cycle on the corrosion behaviour of Q315NS steel, the corrosion behaviours of the base metal (BM) and heat-affected zone (HAZ) in 50 wt.% H₂SO₄ solution at 25 °C were investigated with surface observations, electrochemical noise (EN) measurements, polarization measurements and electrochemical impedance spectroscopy (EIS). The transient characteristics, power spectral density (PSD) and wavelet transform were employed to analyse the EN data. The microstructure of the BM, fine-grained region (FGHAZ) and inter-critical region (ICHAZ) mainly consisted of pearlite and ferrite, while granular bainite was the main phase in the microstructure of the coarse-grained region (CGHAZ). The corrosion processes of the BM, FGHAZ and ICHAZ were similar due to the similar microstructures, while the corrosion process of the CGHAZ was different from the others. A dense corrosion product film was formed on the BM, FGHAZ and ICHAZ, while a uniform, loose and rough corrosion product film was formed on the CGHAZ. The corrosion products of the BM and CGHAZ were both mainly composed of FeSO₄·H₂O, CuO and Sb₂O₃. According to the characteristics of EN, the corrosion process of the BM, FGHAZ and ICHAZ could be divided into the initial passivation process and the following localized corrosion process. Passivation occurred on the surface of the CGHAZ initially and then turned into general corrosion. The corrosion strength of the BM, FGHAZ and ICHAZ decreased constantly with increasing corrosion time, while the corrosion strength of the CGHAZ decreased in the initial corrosion stage and then remained steady.

Keywords: Q315NS steel; heat-affected zone; H₂SO₄ solution; corrosion behaviour; electrochemical noise

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