

Study on the Electrochemical and Hot Corrosion of Cr-Mo Alloy Steel Multilayer Weldments

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ABSTRACT

SAE 4130 is a kind of heat treatable high strength low alloy steel which has been widely used in defense industry, aerospace industry, nuclear power plants and the petrochemical industry. In this study two kinds of welding processes of SAE 4130 have been simulated: " Annealing + Welding + Solution + Tempering " (AWST) and " Annealing + Solution + Tempering + Welding + Stress Relief " (ASTWR). The weldment is placed in 3 wt% NaCl(aq) for analysis and assessment of electrochemical reaction and thermal corrosion resistance, and the result can be used as the reference for planning equipment maintenance and service cycles. The results of this study indicate that in the environment of 3 wt% NaCl(aq), the corrosion resistance of AWST follows the order of: base material > heat affected zone > weld pass, and the corrosion resistance of ASTWR follows the order of: heat affected zone > base material > weld pass. The high temperature thermal cycle of welding applied to the corrosion resistance passive film (Cr₂O₃) of AWST weldment will lead to segregation reaction of chromium-depleted sensitization reaction at grain boundaries, and the tendency of intergranular corrosion in weld pass and heat affected zone. The appearance of some bainite in the heat affected zone of ASTWR weldment has led to superior corrosion resistance. However, the stress relieving temperature of ASTWR is only 550 thus leading to rather uneven distribution of chromium element and the chromium-depleted sensitization reaction. Therefore, the corrosion potentials of ASTWR are all higher than those of AWST, and the corrosion resistance of weldment is: AWST > ASTWR.

Keywords : SAE 4130、NaCl、electrochemical corrosion、sensitization reaction、high temperature corrosion

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