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The Effect of Metal Transfer Modes on Mechanical Properties of 3CR12 Stainless Steel

Authors : Abdullah Kaymakci, Daniel M. Madyira, Ntokozo Nkwanyana

Abstract : The effect of metal transfer modes on mechanical properties of welded 3CR12 stainless steel were investigated. This was achieved by butt welding 10 mm thick plates of 3CR12 in different positions while varying the welding positions for different metal transfer modes. The ASME IX: 2010 (Welding and Brazing Qualifications) code was used as a basis for welding variables. The material and the thickness of the base metal were kept constant together with the filler metal, shielding gas and joint types. The effect of the metal transfer modes on the microstructure and the mechanical properties of the 3CR12 steel was then investigated as it was hypothesized that the change in welding positions will affect the transfer modes partly due to the effect of gravity. The microscopic examination revealed that the substrate was characterized by dual phase microstructure, that is, alpha phase and beta phase grain structures. Using the spectroscopic examination results and the ferritic factor calculation had shown that the microstructure was expected to be ferritic-martensitic during air cooling process. The tested tensile strength and Charpy impact energy were measured to be 498 MPa and 102 J which were in line with mechanical properties given in the material certificate. The heat input in the material was observed to be greater than 1 kJ/mm which is the limiting factor for grain growth during the welding process. Grain growths were observed in the heat affected zone of the welded materials. Ferritic-martensitic microstructure was observed in the microstructure during the microscopic examination. The grain growth altered the mechanical properties of the test material. Globular down hand had higher mechanical properties than spray down hand. Globular vertical up had better mechanical properties than globular vertical down.

Keywords : welding, metal transfer modes, stainless steel, microstructure, hardness, tensile strength
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