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INFLUENCE OF THE HEAT INPUT ON THE MICROSTRUCTURE AND RESIDUAL STRESS OF AISI 304L STEEL WELDED BY AUTOGENOUS GTAW PROCESS

De Souza, L.H.(1); Moreira, L.P.(1); Xavier, C.R.(2); Marcelo, C.J.(1);
Universidade Federal Fluminense(1); Universidade Federal Fluminense(2); UniFOA(3); Universidade Federal Fluminense(4);

In this work, the effects of welding heat input on the resulting microstructure and residual stress of AISI 304L steel is investigated. For this purpose, an autogenous GTAW process was adopted by varying the heat input over a range of 0.7-1.5 kJ/mm. The welding specimens consisted of rectangular sheets with nominal thickness equal to 6 mm, 150 mm length and 40 mm width. In all cases, the sheet surface is directly exposed to effects of the electrical arc welding, that is to say, neither chamfers nor joining of separated parts of this material was employed. Thermocouples were inserted beneath the sheets in order to register the thermal cycles during the welding experiments. The residual stresses were measured in the welded samples using the hole drilling technique according to the non-uniform stress method. After that, the samples were firstly ground, polished and etched in order to reveal the microstructures and to evaluate the characteristics of the fusion zone (FZ) and heat affected zone (HAZ). From the microstructural analysis, it is observed that the HAZ is formed by rough austenite grains with the presence of ????-ferrite. Conversely, the observed microstructure of the FZ is formed by ????-ferrite dendrites dispersed in the austenitic matrix. In general, the ????-ferrite exhibited a vermicular morphology (skeletal network) wherein a lamellar ferrite morphology can also be observed. For all considered heat inputs, a decrease of the hardness was verified from the Vickers microhardness measurements performed in both fusion and heat affected zones in comparison to the AISI 304L as-received conditions. From all evaluated heat inputs, the residual stresses in the regions closest to the FZ are predominantly tensile whereas apart from this zone are under a compressive stress state.