CONTRIBUTIONS OF SAW MULTI PASSES WELDING IN THERMAL AND MICROSTRUCTURAL CONTROL

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ABSTRACT

The manufacture of thick equipment and structures represents one of the most challenging applications of welding processes for joining. Arc welding processes, characterized by their limited depth of penetration, make it necessary to carry out a prior chamfering action in order to allow metallurgical joining in the entire thickness of the joint. As a result, the greater the thickness of the chamfered joint, the greater the amount of material to be used to fill the formed chamfer. Industrially, a smaller number of passes leads to a faster joining process, which reduces the cost of the procedure. However, from a metallurgical point of view, an increase in the number of passes acts by normalizing the weld microstructure. Among the processes with a high material feeding rate, the SAW (Submerged Arc Welding) process stands out, whose characteristics allow the joint to be filled in a smaller number of welding passes, thus reducing the cost and time of operation. Among the main characteristics of the welding processes, the heat input significantly influences the dilution, the fusion, the penetration, the microstructural transformations generated and the mechanical characteristics of the welded part, and must be treated as a key parameter in the structuring of the process. This work proposes, through metallographic analysis, microhardness and bending test according to the ASME IX standard, an empirical evaluation of the use of SAW processes in the joining of ASTM A516 GR70 sheets of 12.7 mm thickness in two scenarios, with one and with two filling passes. The first welding test carried out for filling, in a single welding pass, reached values of 3.58 kJ/mm, given the need to use higher current and lower welding speed. From the metallographic analysis, the formation of microconstituents of high hardness and fragility, such as martensite and upper

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bainite, was observed. The bending test was performed proving the failure of the welding test, causing cracks in the face and root of the weld. In contrast, the second test was carried out on two welding passes, reaching 2.12 kJ/mm and 2.46 kJ/mm of heat input for the two passes, respectively. The metallographic analysis allowed the observation of the formation of more ductile microstructures than the first scenario analyzed, such as perlite and ferrite. The welding test with two passes was evaluated and approved through the bending test, besides to a reduction of 90 HV in the fusion zone compared to the welding procedure in a single welding pass. Thus, the action of the second welding pass on the thermal control of the heated metal in cooling the first welding pass is clear. This corroborates in a decisive way the importance of microstructural analysis in the formulation of specifications of welding procedures.

Keyworkds: Heat Input; Productivity; Submerged Arc Welding