IIId12-005

Effect of shielding gas on thermal properties of thin plates of duplex stainless steel welded by pulsed GTAW process

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In this work, UNS32304 duplex stainless steel welds were evaluated by observing the influence of the pulsed GTAW welding process on thermal properties of this material. 1.8 mm duplex stainless steel sheets were welded by the GTAW process varying the shielding gases between pure Ar and Ar + 2%N2 without filler metal. The thermal welding cycles were studied by a type K and S thermocouple system fixed close to the welding line. The temperature distribution along the welding line was determined by reaching values within the phase transformation range of this material. Through a quantitative and semiquantitative evaluation of elements the Creq/Nieq ratio was calculated for the ferrite, austenite and secondary austenite grains of the solidified zone, ZAC and base metal. The addition of 2% N2 in the shielding gas caused an increase of the austenite formation in the solidified zone if compared to welding without N2 addition, being the most suitable atmosphere for welding in duplex stainless steels. The thermophysical properties were studied by laser flash method (MFL) used to determine the thermal diffusivity of the material in the thickness direction. The specific heat and Curie temperature of the solidified zone of welds was obtained by the thermal analysis by differential exploratory calorimetry (DSC). Measurements of porosities and specific mass of the solidified zone were obtained and compared with the base metal and metal as received. With this information it was possible to evaluate the thermal conductivity of the material after welding process. Increased thermal conductivity was found for both welded samples and suggest correlation with increased ferritic phase and decreased porosity also observed for solidified zone.