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PRACA DOKTORSKA

Mechanizm tworzenia złącza w procesie łukowego przypawania kołków

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- Gliwice 2010 -

Abstract

Research presented in this dissertation is focused on physical phenomena's influencing the welded joint formulation during drawn arc welding process. The welding arc observations were done in the first cognitive part of this research and allowed to distinguish V specific phases of this welding process: pilot arc initiation, welding current increase, welding current stabilization, high light radiation from the welding arc, stud plunge and liquid metal solidification. The influence of the welding gas type and welding polarity on the arc shape and radiation ware recorded and analyzed.

Observations made during this research showed some evidence of welding process destabilizations which root causes were established in the second part of this research by applying Red X methodology. It appeared that increased level of oxygen and sulfur in the stud material was causing welding process instability. The welding arc had tendency to "climb" along the welded stud when its ionization potential has been reduced by the oxygen released from the stud material in the high arc temperature. Additionally conducted analysis of the forces acting on the liquid droplet proved that the resultant force decreases when the arc starts to climb.

In order to satisfy visual aspects and process stability the upgrade to big diameter stud arc welding technology was proposed based on conclusions driven from the presented study. Additional welding trials showed two kinds of repeatable defects in welded joints: cold weld in the flash area and shrinkage cavity inside the weld. The relative stress level in the notch area (end of cold weld) was established by FEA calculations. This analysis showed that horizontal distance between the end of cold weld and the stud surface (not the cold weld length itself) is the critical parameter defining maximum stress level in the welded joint. These calculations allowed opening the windows of available welding process parameters. The influence of different welding process parameters on the tendency to formulate shrinkage cavity was tested by applying 6 Sigma methodology. The conducted experiment proved that the tendency to formulate the cavity in the weldment can be eliminated by applying correct process parameters.

This research was planned based on the current knowledge of drawn arc welding process described in the available literature which was presented in the theoretical part of this dissertation.