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Effect of the Welding Parameters on the Structural and Mechanical Properties of Aluminium and Copper Sheet Joints by Electromagnetic Pulse Welding

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Abstract

Aluminium-copper hybrid parts, as a substitution to copper parts, result in weight and cost reduction, and are relevant in applications related to the electronic, heating and cooling sector. However, aluminium to copper joined by thermal welding processes presents challenges in terms of achieving good joint quality. This is attributed to their dissimilar mechanical and thermal properties which result in large stress gradients during heating. This study investigated joining of aluminium to copper sheets by electromagnetic pulse welding, which is a solid-state process that uses electromagnetic forces for joining of dissimilar materials. Hybrid sheet welds were obtained for all parameters conditions, selected according to a Taguchi L18 design. The structural and mechanical characteristics were examined and related to the welding parameters by means of a Pareto analysis and response graphs. The welded zone started with a wavy interface with interfacial layers and defects and evolved to a flat interface without interfacial layers. The maximum transferable force depended on the minimum specimen thickness and the strength of the hybrid sheet weld. In case of aluminium sheet thickness reduction, the maximum transferable force was linearly correlated with the aluminium sheet thickness. High quality joints were obtained for no aluminium sheet thickness reduction and for a sheet weld strength which was at least as high as that of the base material. The most effective way to increase the transferable force was to lower the initial gap and to increase the free length, which resulted in no aluminium sheet thickness reduction. Alternatively, the use of a rounded spacer decreased the effect of the aluminium sheet thickness on the transferable force. An increase in weld width was achieved for an increase in capacitor charging energy and gap, whereas an increase in weld length was obtained for a de-

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