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INOVATIVE HYBRID JOINT TECHNIQUE THROUGH FRICTION STIR WELDING AND ADHESIVE BONDING

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ABSTRACT

Lightweighting is a current trend in mechanical design, especially in the transportation industry, as the pressure to improve vehicle dynamic performance, safety and fuel efficiency is ever higher. One way of achieving this goal is through the implementation of aluminium alloys in the design of several components. Although the use of these alloys has previously been restrained by production difficulties associated with their poor welding properties, friction stir welding and adhesive bonding allowed for a larger flexibility in lightweight structural design. In this preliminary work an innovative joining process combining these two technologies was studied.

Keywords: friction stir welding, adhesive bonding, hybrid joints.

INTRODUCTION

The path to improved energy efficiency and reduced harmful emissions in transportation vehicles will have to involve advanced lightweight materials (Das & Yin, 2007). Manufacturing difficulties, more specifically in the creation of joints between aluminum alloys components, has restrained the application of these materials in many structural designs. The advent of friction stir welding (FSW) has allowed of an increased flexibility in structural design, taking advantage of these lightweight alloys.

Friction stir welding (Thomas, *et. al.*, 1992), a solid-state joining process developed and patented by the The Welding Institute (TWI), emerged as a welding technique to be used in high strength alloys that were difficult to join with conventional techniques. Conventional fusion welding of aluminum alloys often produces a weld which suffers from defects, such as porosity developed as a consequence of entrapped gas not being able to escape from the weld pool during solidification. In contrast, with FSW the interaction of a non-consumable tool rotating and traversing along the joint line creates a welded joint through visco-plastic deformation and consequent heat dissipation resulting in temperatures below the melting temperature of the materials being joined. FSW compared to fusion processes creates low distortion, excellent mechanical properties in the weld zone, and allows for execution without a shielding gas, and is suitability to weld all aluminum alloys (Mishra & Mahoney, 2005).

RESULTS AND CONCLUSIONS

In an attempt to produce sound joints, a brief optimization study on the welding parameters involved in FSW lap joining was performed through the Taguchi method. Aluminum 6082-T6 lap joints were made out of 230 mm x110 mm x2 mm, with overlaps of 60 mm.

A L8 orthogonal array with two levels was employed to study, rotational speed, welding speed, probe depth and distance between passes, as well as the interactions between all but the latter. Figure 1 presents a pie chart with the influence of every parameter in the ultimate tensile stress (UTS).

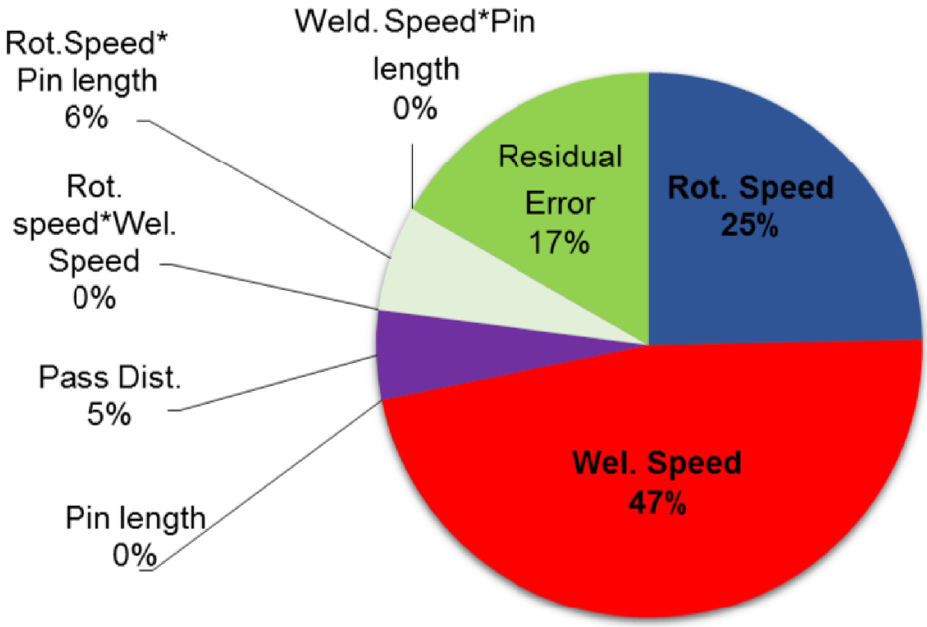

Fig. 1 - Influence of every parameter in the ultimate tensile stress

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