Study of the Influence of Heat Treatments on the Mechanical Behavior of FSW-Welded Plates

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Abstract:

This study investigates the effect of heat treatments on the mechanical properties of friction stir welded (FSW) aluminum alloy plates. The research focuses on AA5082 H22 aluminum alloy, processed into 200x100x6 mm plates for welding. A custom-designed and machined tool was used to execute FSW on a modified universal milling machine equipped with a clamping system for precise alignment and stability during welding. The welding process parameters, including tool geometry, penetration, and translation, were carefully controlled to ensure high-quality joints.Post-welding, heat treatments were applied at two distinct temperatures (250 °C and 300 °C) to relieve residual stresses induced by welding. Using an electric furnace, the plates underwent controlled heating and cooling cycles. The effects of these treatments were assessed through metallographic characterization, including microscopy and chemical etching, to evaluate microstructural changes in the weld zones. Mechanical testing revealed the influence of thermal relaxation on stress distribution and joint integrity. The results showed improved mechanical performance and reduced residual stress in the treated samples, highlighting the significance of optimized post-weld heat treatments in enhancing the durability of FSW joints. This work contributes to the broader understanding of welding aluminum alloys and provides guidelines for optimizing heat treatment parameters for FSW applications.

Keywords:

FSW, aluminum alloy, heat treatment, mechanical behavior, residual stress, AA5082 H22.