Experimental Investigation and Machine Learning-Based Prediction of Mechanical Properties of TiC-Reinforced Al 6113 Joints Produced by TIG Welding

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Abstract

The present study investigates the effect of titanium carbide (TiC) powder reinforcement and welding parameters on the mechanical and geometrical characteristics of aluminium alloy joints fabricated using the Tungsten Inert Gas (TIG) welding process. Experiments were conducted under different current and scan speed conditions with and without TiC powder addition in a grooved configuration. The welded joints were evaluated for hardness, strength and bead geometry to assess the influence of process conditions and reinforcement. Results revealed that the incorporation of TiC particles considerably improved joint strength and hardness due to the uniform distribution of hard ceramic particles within the weld metal matrix. Further, developed a machine learning model to predict the heat input during TIG welding and hardness of the produced weld joint under varying process conditions. Overall, the study demonstrates that appropriate control of TIG welding parameters combined with TiC reinforcement significantly enhances the mechanical performance of aluminium alloy joints.

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