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Aluminium alloys joined by Friction stir welding of AA2xxx and AA7xxx sheet alloys & their Studies on Microstructural and Mechanical Properties

S. Sai prakash , V. Sagar, K. Tarun, K. Venkata Kishore, V.V. Ravi kumar

Department of Mechanical Engineering, Nadimpalli Satyanarayana Raju Institute of Technology, Andhra Pradesh, India – 531173

*Corresponding author Email: ravivv_1982@yahoo.com

Abstract

The aim of the present work is to investigate on the mechanical and microstructural properties of AA 2xxx and AA 7xxx aluminium alloys and (T6-temper condition) joined by friction stir welding (FSW). The two sheets, aligned with perpendicular rolling directions, have been successfully welded. Some aluminium alloys are difficult to join using traditional fusion (melting and solidification) welding techniques. Friction Stir Welding (FSW) is a solid-state welding technique that can join two plates of material without melting the work piece material. This process uses a rotating tool to create the joint and it can be applied to aluminium alloys in particular. Microstructure (Optical and SEM) and mechanical properties of friction stir welded joints were studied. Vickers micro hardness tests and grain size measurements were taken from the transverse plane of welded samples. Distinct zones in the macrostructure were evident. The zones were identified by transitions in the microstructure and hardness of weld samples. The zones identified across the sample were the unaffected parent metal, the Heat Affected Zone (HAZ), the Thermo-Mechanically Affected Zone (TMAZ), and the Nugget Zone (NZ). Measured hardness values varied through each FSW zone. Friction stir welding of this alloy resulted in fine recrystallized grains in weld nugget which has been attributed to frictional heating and plastic flow. AA 2xxx and AA 7xxx aluminium alloys friction stir welding process also produced a softened region in the weld nugget, which may be due to the dissolution and growth of possible precipitates, identified as Al_2Cu and $MgZn_2$. AA 2xxx and AA 7xxx aluminium alloys were friction stir welded under tool rotational speed of 1000–1600 rpm and traversing speed of 60–220 mm/min, keeping other parameters same. The variable process window is responsible for the change in total heat input and cooling rate during welding. Therefore, the joint fabricated using lowest tool traversing and rotational speed, exhibits substantial improvement in bond strength.

Keywords: AA-2xxx alloys, AA-7xxx alloy, Precipitation hardening, Friction-stir welding, mechanical Properties.