11/21 (30)

Materials Today: Proceedings 60 (2022) 1421–1423

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Investigation of mechanical properties of friction stir welding aluminium alloy AA7475-T651 and AA2219-O

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ARTICLE INFO

Article history:
Available online 26 November 2021

Keywords:
Aluminium alloys
Friction stir welding
Hardness test
FSW parameters

ABSTRACT

In this study, two dissimilar aluminium alloys are joined together through friction stir welding, and their microstructure and mechanical properties like hardness and fracture analysis. In this paper, Al alloy AA7475-T651 and AA2219-O is chosen for Friction stir Welding due to the different hardness level. The welding process is executed with the optimized input parameters and the welding joints quality was inspected. Hardness properties were tested in Thermomechanically affected zone, heat-affected zone, and Welding Zone. The fracture analysis method is used to identify the defects in the welding zone. Finally, the quality of the welding is justified by the hardness and fracture analysis, based on the results the welding process can be applied for different harness Al alloys.

1. Introduction

Friction Stir Welding is derived as the solid-state connecting technique that combines two facing surfaces with a third body tool. The heat between the tool and the material is produced, leading to an extremely soft area near the FSW tool. It is employed largely on non-heat-treatable alloys, aluminum, and constructions that require a better welding strength without the use of post-solder thermal therapy [1,2].

Two separate pieces of metal are supported, and the tool is supported (through probe). The progress of the instrument via the joint also indicates the welding area and the tool shaft area. A non-consuming cylindrical shouldering tool is rotated constantly, and fluid in a button joint between the two clamped parts of butted matter at a constant pace with a profiled sonde. The sample is somewhat lower than the weld depth required by the tool shoulder drive at the top of the working area [3,4]. AA2219-T87 and Al-Mg alloy AA5083-H321 were welded with optimum input parameters such as tool rotational and transverse speed and pin diameter. Microstructural studies for identifying the quality through investigating the welding zone. Between wear-resistant solving elements and working parts, frictional heat is produced [6]. This thermal energy, together with the adiabatic heat inside the material created by the mechanical mixing process, makes the mixed materials softer without stirring. As the pin travels forward, the material is pushed to the rear by a distinctive contour on the lead face, which helps to solidify the produced joint. This procedure through the tool in a plasticized tubular metal shaft leads to a severe solid deformation, with the consequence that the base material becomes dynamically recrystallized [6] (see Fig. 1).

FSW offers potential benefits over traditional fusion soldering techniques. Good mechanical characteristics, safety, Easily mechanized for basic milling machinery, typically good weld appearance and minimal thickness, reduced tool consumption, minimum welding area, low environmental effect, overall fusion-to-friction performance, and cost [7]. Some of the downsides include the exit hole on the left when the tool is withdrawn, which demands large down pressures, with a solid clamping to hold the plates together.

The objective of this work is to investigate the mechanical properties such as Hardness and fracture characteristics in the different welding zone. Based on the literature survey, the investigation of the following materials AA7475-T651 and AA2219-O is very rare because of the hardness and melting characteristics. So in this paper, the AA7475-T651 and AA2219-O welded by FSW and its hardness and fraction analysis are evaluated.

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https://doi.org/10.1016/j.matpr.2021.10.439
2214-7853/