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Study on mechanical behaviour of friction stir welded 6082-T6 aluminium alloys

S. Sivabalan, R. Sridhar, G. Sathishkumar

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Abstract

The Mechanical Behaviour of Aluminium 6082-T6 alloy are investigated using friction stir welding (FSW) Process, aluminium 6082-T6 alloy is a light medium strength alloy with good corrosion resistance, mostly used in wide variety of high stress applications like fuel liners, radiators and marine fittings.the scope of process parameters considered in this work are tool rotational speed chosen 800–1200rpm, the traverse speed was chosen 100–200mm/min and axial force was chosen 8 KN. Pin profile was chosen as straight Cylindrical Tool. The thermal model is designed and analysed in the ANSYS using transient thermal analysis. The strength and micro-structural aspects of processed joints are studied.weldment made at 1000rpm, 2.5mm/*sec* and 8 KN which gave the best ultimate tensile strength.measured hardness values are in the range of (84–88) in nugget zone, (70–75) in HAZ region and (62–66) in parent material. The Heat value of 880W was calculated for the welding speed 1000rpm, 2.5mm/*sec* and 8 KN by using mathematical expression.

Introduction

Friction stir welding (FSW) helps to joining aluminium alloys, magnesium, copper, titanium and stainless steels without preheating the material. The welding method will carried out by rotating a FSW non consumable tool in to parent metal. The Mechanical energy is converting in to thermal energy plastic atomic diffusion will takes place [1], [2], [3]. The tool works around the zones, heat affected zone (HAZ) followed by parent material Solid state joining process (FSW), is initiate at the Welding Institute (TWI) the metals are bonded lesser the melting point temperatures of the parent metal. While coalescence takes place mechanical behavior of the parent materials improve their strength, lesser distortions, fine finish in their surface, and automation potential are high [4], [5], [6]. Now a days FSW has been and still in an emerging trends in a manufacturing sector mainly its suits on high-robustness alloys, the optimization takes place with various approach and techniques of process parameters [7], [8], [9], [10]. Its comparatively with other conventional welding techniques heat generation from the tool to the workpiece by FSW process is able to protect the mechanical behaviour of the parent metal will reduce the shrinkage decrement and residual stresses in the weldments. No filler materials is needed in FSW process is eco-friendly [11], [12], [13], [14]. In this proceess tool is stirred in to the parent metal with a rotated with the downward thrust along the surfaces of the base metal is holded in proper position by fixing to a base plate. Tool profile is manufactured with identical dimensions with bigger diameter portion known as shoulder, enlarged to a smaller diameter portion is named as pin. pin profile has different shapes like cylindrical,

conical, triangular, threaded, square and hexagonal shapes friction takes place between the tool pin profile and shoulder of the tool will generate the heat and it will plasticizes the parent metal and it will cause the weld [15], [16], [17], [18]. A schematic representation of FSW process and equipment set up is shown as Fig. 1. major portion of the material is pushed from the advancing side to the retreating side Main feasibility of friction stir welding (FSW) in aluminum alloys is compared to conventional fusion welding process, flaws are reduced, cracks are avoided [19], [20], [21], [22]. This is due to the solid state joining process, in this work 70mm×75mm & 6mm thickness of similar aluminium alloys AA6082 are welded using FSW. The Tensile properties and hardness were investigated (Fig. 2 and Table 1).

Section snippets

. Friction stir welding condition & process parameters

Tool Rotational speed range between the 800–1200rpm and the Traverse speed is 1.66mm/*sec* & 2.5mm/*sec*, Axial force of 8×103 N both sides welding was carried. Aluminium AA 6082-T6 alloys are joined soundly by solid state joining techniques using various Tool rotation speed. Improvements in the mechanical behaviour to be identified. Ultimate expansion evaluation/tensile strength of the weldments and hardenability of welments evaluated in harness testing will biased by the tool rotation…

Tool material: High carbon high chromium steel

Toughness ranges is increased from base working strength 40–55 HRC baswd upon the carbon content and the lesser alloying element. Presence of is well suitable for hot working dies specially in extrusion process of Magnesium and aluminium, as well as die-casting dies, forging dies, mandrels and hot shears [28]. The main advantage of the chosen tool material over traditional Up to 550°C high-strength steels is ability to resist softening and up to 2100MPa will provide moderate toughness.…

. Tool design & nomenclature

The straight cylindrical pin profile of tool can plunge in to the plates with high rotational speed and stir the material to form plastic atomic diffusion the flat cylindrical shoulder diameter is three times the pin diameter which acts as forging medium during the welding process (Table 3, Fig. 3).…

. Material selection

Aluminum alloy AA 6082-T6 identified as Base material due to its broad availability & high stress applications widely used in engineering industries. Chemical mixture of the Aluminum alloy AA 6082- T6 are given below (Table 4, Table 5).…

Experimental work for AA6082-T6

Proportions of the Aluminum plate is chosen based upon by analyzing process of the ASTM Standards of Metals. The specifications are 70×75mm and the density of the metal plate was 6mm. Now 6mm density was chosen because in most of the industrial applications 6mm plates are used widely (Fig. 4, Fig. 5).…

Tensile strength test

Tensile strength for similar aluminum alloy 6082-T6 weldments. The results were represented against the tool rotational speeds are (800rpm, 1000rpm and 1200rpm and traverse feed of 1.66mm/*sec* and 2.5mm/*sec*. It is noticed that better tensile strength is attained at the Tool Rotational Speed of 1000rpm traverse feed of 2.5mm/*sec* and axial force at 8KN (Table 6, Fig. 6, Fig. 7).…

Hardness Test

Vickers Hardness Test (VHN) for Ssimilar aluminum alloys 6082 welded specimen. Attempt is made based on the better …

Conclusion

Welding was Carried out on the AA 6082-T6 weldments are studied based upon chosen parameters and subsequent conclusions are described. Aluminium alloy 6082-T6 was successfully Joined by using the Friction Stir Welding (FSW) process. The weldment made at 1000 rpm, 2.5 mm/*sec* and 8 KN which gave the best result in tensile test than other weldments. The microstructure of AA6082 base metal shows elongated particles of Al-Si and Mg-Si in a matrix of aluminium solid solution. The base metal has…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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