Experimental Investigation and Static Analysis of Aluminium Alloys by Using Friction Stir Welding

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Abstract – *The Friction Stir Welding (FSW) is a latest process of Advanced Welding Technology and was invented in 1991 by The Welding Institute (TWI) at Cambridge, in United Kingdom. In 1995, Friction Stir Welding has been used frequently for welding of high strength aluminium alloys such as AA6061, AA6063. etc. which are difficult to weld by conventional fusion welding techniques. Friction welding (FW) is a collection of a series of friction-based solid state joining processes which can produce high quality welds of different components with either similar or dissimilar materials and has been attracting increasing attention. The overall aim of this study is to weld two plates of AA 6063 using different tool profiles and to optimize the parameters Ince tool rotational speed. tool profile., depth of cut, feed etc. affecting the properties of welded joints& also study is to get the optimum parameters for the materials under considerations, to investigate the Heated Affected Zone, Mechanical Affected Zone and Weld Nugget (WN) besides to study the defects occurring during welding process by applying different parameters chosen. The welding process was done by using conventional milling machine. Three experiments being used are the Tensile Testing, Optical Microscopy (OM) and Hardening test to get the strength of the joint and the metallographic studies. The findings also found out that suitable parameters being choose give less defect. Therefore, at higher speed and lower tool plunge length, the joint strength decreased due to lack of bonding between aluminium and steel.*

***Key Words*: Stir welding, V joint, Friction welding, Tool plunge length, Tensile strength, Rotational speed.**

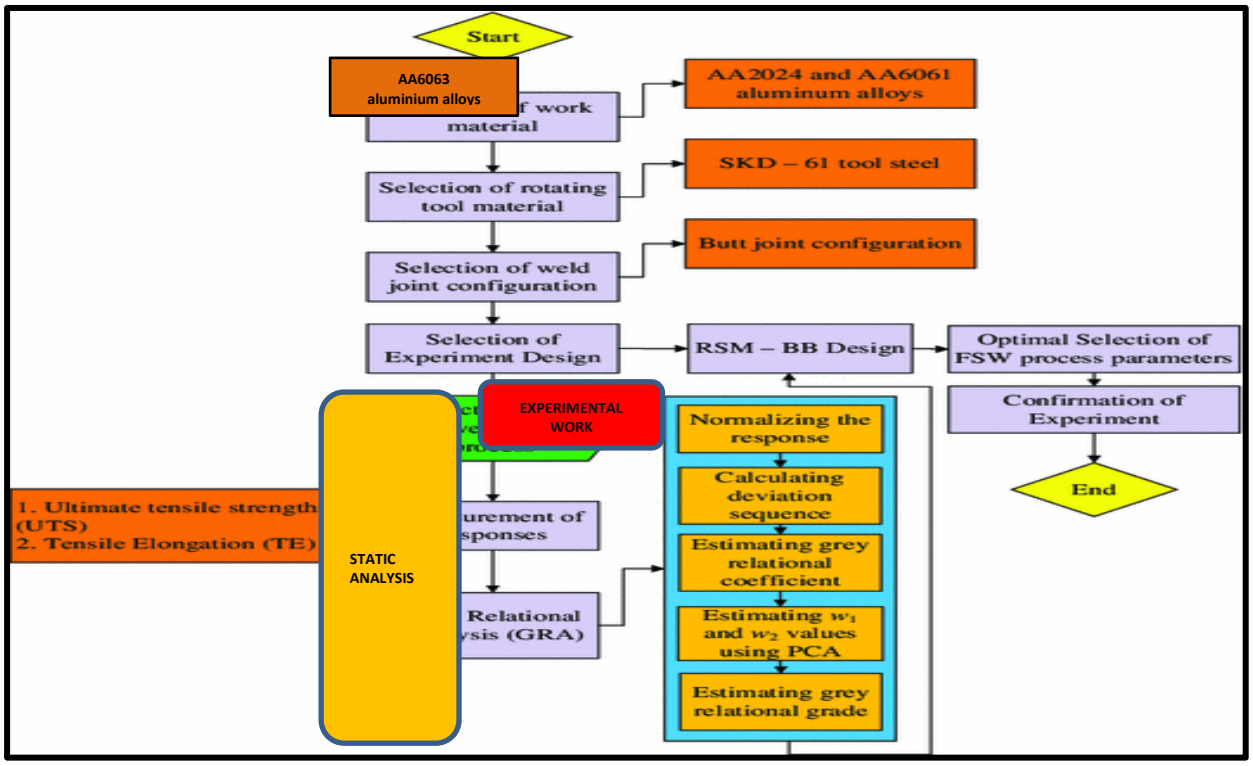
1. INTRODUCTION

Aluminum and its alloys are widely used in the automotive industry because of their low density, high specific strength, good corrosion resistance, good workability, high thermal and electrical conductivity, attractive appearance, and intrinsic recyclability. As an extremely light metal, magnesium and its alloys have excellent specific strength, excellent sound damping capabilities, good cast ability, hot formability, good electromagnetic interference shielding, and recyclability.

Friction stir welding is a refreshing approach to the joining of metals. Although originally intended for aluminum alloys, reach of FSW has now extended to a variety of materials including steels and Polymers. This review deals with the fundamental understanding of the process and it's metallurgical Consequences. The focus is on heat generation, heat transfer and plastic flow during welding, Elements of tool design, understanding defect formation and the structure and properties of the welded materials. Friction welding is the welding process in which the heat required for welding is obtained by friction between the ends of the two parts to be joined .One of the parts to be joined is rotated at a high speed near about 2000 rpm and the other part is axially aligned with the second one and pressed tightly against it. The friction between the two parts raises the temperature of both the ends. Then the rotation of the part is stopped abruptly and the pressure on the fixed part is increased so that the joining takes place.

2. EXPERIMENTAL METHODOLOGIES

From the critical discussion on literature survey and gaps identified from the literature, the problem statement for the current paper is Investigation of Strength of V Joint By TIG Welding & it's Analysis by using the experimental method and validate with finite element method In experimental methodology detail discussion is carried out, about material used, specimen preparation and welding geometry used.



3. STATIC ANALYSIS OF WELD JOINT

Finite element analysis (FEA) involves the solution of engineering problems using computers. Engineering structures that have complex geometry and loads, are either very difficult to analyze or have no theoretical solution. However, in FEA, a structure of this type can be easily analyzed. Commercial FEA programs, written so that a user can solve a complex engineering problems without knowing the governing equations or the mathematics; the user is required only to know the geometry of the structure and its boundary conditions. FEA software provides a complete solution including deflections, stresses, reactions, etc. In this technique the structure is divided into very small but finite size elements (hence the name finite element analysis). Individual behavior of these elements is known and, based on this knowledge; behavior of the entire structure is to be determined. FEA solution of engineering problems, such as finding deflections and stresses in a structure, requires three steps:

A. Pre-process or modeling the structure

B. Analysis

C. Post processing

1.Procedure to perform the FEA tool to determine the stresses in tensile specimen ANSYS is a sophisticated and comprehensive finite element program that has capabilities in many different physics fields such as static structural, nonlinear, thermal, implicit and explicit dynamics, fluid flow, electro-magnetic, and electric field analysis. The following

procedure was conducted in ANSYS to measure the stresses inside the single V&U groove butt weld joint.

2. Importing geometry ANSYS comes with IGES support by default but there are Geometry Interfaces available for Pro/E, CATIA, UG, Solid work, Parasolid, etc. IGES is the oldest of these formats and does not work very well for solids, but is ok for wireframe geometry.

3. Creating material properties While selecting the material properties it is assume that the material is to be isotropic in nature.

4. DETAILS OF IMPLEMENTATION

Step 1:- I started the work of this project with literature survey. I gathered many research papers which are relevant to this topic. After going through these papers I learnt about Friction Stir Welding.

Step2:- After that the Material are required for my project are decided.

Step 3:- After deciding the Material, the 3 D Model will be done with the help of UNIGRAPHICS software.

Step 4:-The Static Analysis of the components will be done with the help of ANSYS using FEA.

Step 5:- After that Experimentally done on vertical milling machine .

Step 6:- Comparative analysis of Reaction forces will be made between static simulation and experimental results and then Results and conclusions will be drawn

5. RESULTS AND DISCUSSION

From the above experimental and computational data, we are going to compare experimental results with computational results.

Characteristics	Rotation rate(rpm)	Traverse speed (mm/min)	UTS (MPa)
FSW 6063 PLATE -4MM THICK	**1400**	**40**	**87**
FSW 6063 PLATE -4MM THICK	**2000**	**20**	**83**
FSW 6063 PLATE -4MM THICK	**2000**	**28**	**78**
FSW 6063 PLATE -4MM THICK	**2000**	**40**	**52**

5. CONCLUSIONS

From the results of this present investigation and the discussion presented in the earlier chapters, the following conclusions are drawn.

1.Thus by this project, we verify the different input parameters for friction stir welding and tool geometry to get optimum welded joint property for maximum tensile strength.

2. At the tool rpm of 1400 and tool feed of 40mm/min we got the maximum strengths for all three different speed & feed.

3. Comparing the joint strength at different speed & feed we found that maximum weld strength 87.00 MPa with round tool profile.

4. The speed of the tool should be more as possible higher speed can be achieved on the machine. As the higher speed of the tool causes good weld quality and also increase the strength due good mixing of material of both the plates.

5. From the above FEA & Exp Result it is conclude that UTS of FEA & EXP. is near about same at Weld Joint.

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