MECHANICAL AND WEAR PROPERTIES OF FRICTION STIR WELDING OF ALUMINIUM ALLOYS

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Abstract : The welding is the process of joining similar metals and dissimilar metals by melting the material with or without the use of filler material. Aluminum alloys are the major applications in welding process like aerospace industries, ship building industries. Friction stir welding is a novel technique for production of joints in solid state. The various process parameters are spindle speed, feed, load and geometry of the tool. The joining of similar Aluminum Alloys was carried out using friction stir welding (FSW) techniques are rotational speed, transverse speed, tool geometry. In this process aluminum alloy butt joint are prepared using Friction stir welding with varying process parameters are rotation speed, transverse speed by keeping constant load and tool geometry. The mechanical properties such as tensile strength, hardness and impact strength were evaluated. The microstructures of joints were analyzed using optical microscope and scanning electron microscope. The wear properties were also analyzed using pin and disk apparatus.

Index Terms **- Component, formatting, style, styling, insert.**

KEYWORDS: *Conical Plane Tapered Tool, Tensile Strength, Impact Strength, Hardness, Microstructure, Wear Strength, Friction Stir Welding.*

1. INTRODUCTION

Friction stir welding (FSW) is a relatively new joining process that has been used for high production since 1996. Because melting does not occur and joining takes place below the melting temperature of the material, a high-quality weld is created. This characteristic greatly reduces the ill effects of high heat input, including distortion, and eliminates solidification defects. Friction stir welding also is highly efficient, produces no fumes, and uses no filler material, which make this process environmentally friendly.

The joining of similar Aluminium Alloys was carried out using friction stir welding (FSW) technique and the process parameters were optimized using Taguchi orthogonal design of experiments. The rotational speed, transverse speed, tool geometry and ratio between tool shoulder diameter and pin diameter were the parameters taken into consideration.

The optimum process parameters were determined with reference to tensile strength of the joint. The predicted optimal value of tensile strength was confirmed by conducting the confirmation run using optimum parameters. This study shows that defect free, high efficiency welded joints can be produced using a wide range of process parameters and recommends parameters for producing best joint tensile properties. The other properties like hardness, impact strength, wear and corrosion of the welded joint will be estimated. The joining of similar Aluminium Alloys was carried out using friction stir welding (FSW) technique and the process parameters were optimized using Taguchi orthogonal design of experiments. The rotational speed, transverse speed, tool geometry and ratio between tool shoulder diameter and pin diameter were the parameters taken into consideration. The optimum process parameters were determined with reference to tensile strength of the joint. The predicted optimal value of tensile strength was confirmed by conducting the confirmation run using optimum parameters. This study shows that defect free, high efficiency welded joints can be produced using a wide range of process parameters and recommends parameters for producing best joint tensile properties. The other properties like hardness, impact strength and wear of the welded joint will be estimated.

2. IDENTATIONS

The base materials selected for this investigation were AA5083 aluminium alloys plate of 6 mm thickness having chemical composition and mechanical properties shown in the Table I In the present study, sheets of size 140mm x 70mm of AA5083 were cut for welding by FSW.

Aluminium - balance

Chromium - 0.05-0.25% max
Copper - 0.1% max
Iron - 0.4% max
Magnesium - 4.0 to 4.9%
Manganese - 0.4 to 1.0%
Silicon - 0.4% max
Titanium - 0.15% max
Zinc - 0.25% max

3. FIGURES AND TABLES

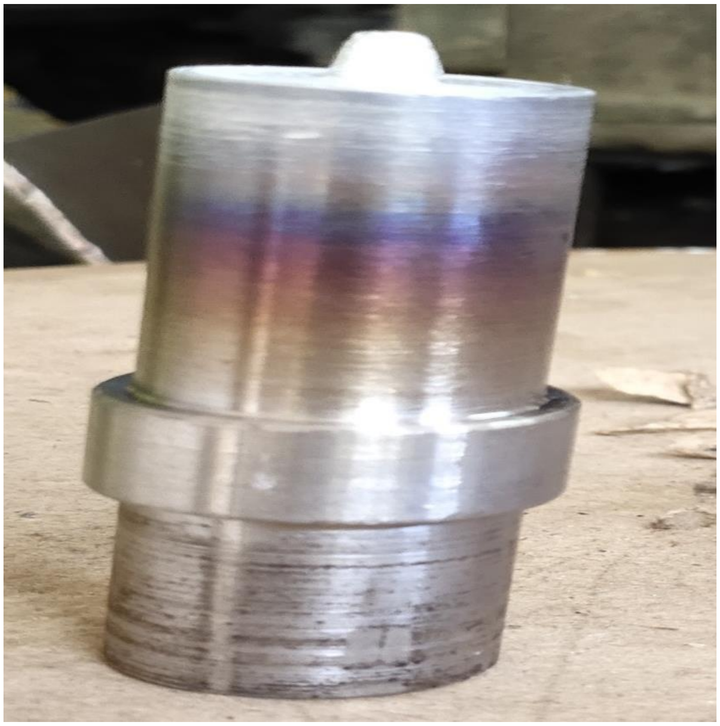

Fig 3.1: conical plane tapered too

Table 3.2: process parameters of the tool

TOOL SPEED [rpm]	FEED PER DEPTH[mm]	TILT ANGLE[deg]
560	20	1
710	30	1
900	40	1
1120	50	1
1400	60	1

Fig 3.3: welding method

In FSW process heat generated by friction between the surface of the plates and the contact surface of a special tool, composed of two main parts are shoulder and pin. Shoulder is responsible for the generation of heat and for containing the plasticized material in the weld zone, while pin mixes the material of the components to be welded, thus creating a joint. This allows for producing defect-free welds characterized by good mechanical and corrosion properties.

Fig 3.4: welding specimens

These specimens are cut by requirement tests by manual vertical CNC machine with ASTM standards of FSW process. The alloys are fine structure it can be performed by the process which can be processed some other properties with the help of process parameters.

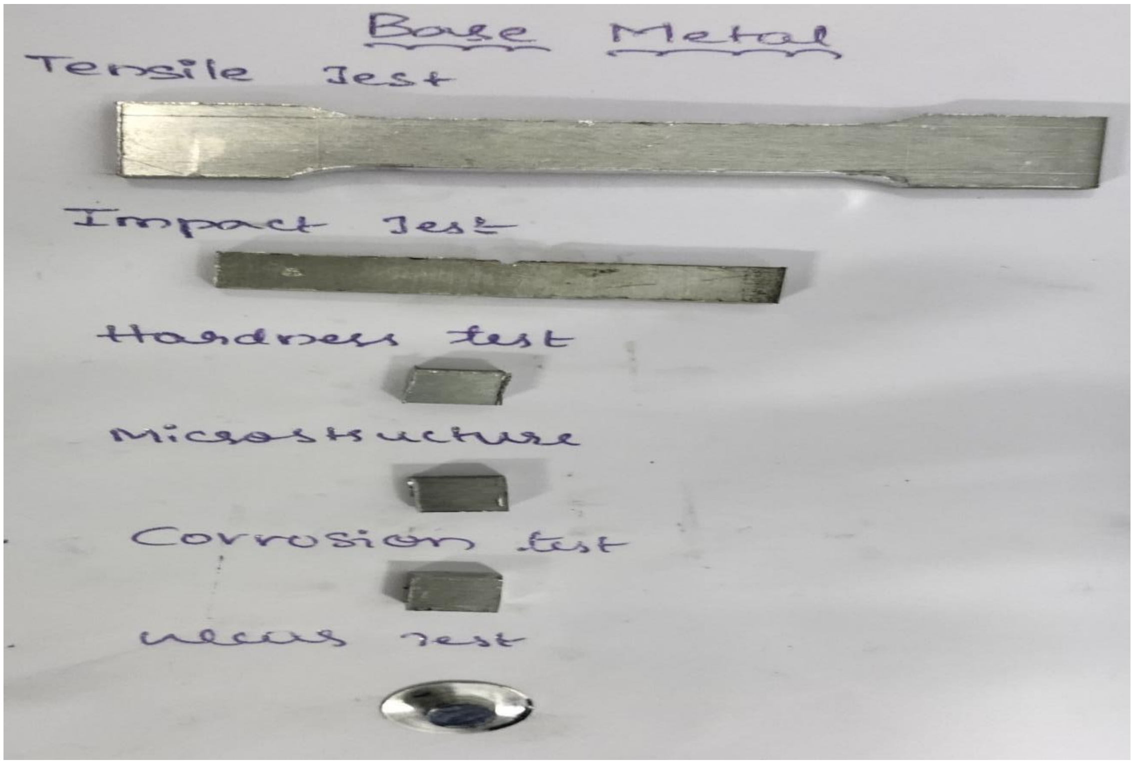

Fig 3.5: cutting specimens for testing

The mechanical properties of a material are those which affect the mechanical strength and ability of a material to be molded in suitable shape. Some of the typical mechanical properties of a material include

1. Tensile strength
2. Impact strength
3. Hardness test
4. Microstructure
5. Wear test

4. CONCLUSIONS

1. The Analysis of Variance for the ultimate tensile strength result concludes that the designis the most significant parameter with a percentage of 67.91%.

2. The Analysis of Variance for the yield strength result concludes that the tool design is the most significant parameter with a percentage of 21.03%.

3. The Analysis of Variance for the % of elongation result concludes that the tool design is the most significant parameter with a percentage of 23.76%.

4. The Analysis of Variance for the Impact Strength result concludes that the tool desion is the most significant parameter with a percentage of 30%.

5. The optimum combination of parameters obtained from the main effect plot for mean is process parameters of tool design of taper cylindrical, Different welding speeds (mm/min).

The aluminum plates were welded using rounded profile tool at a speed of 560 rpm to 1400 rpm with different feeds. The welded plates were first sectioned according to the specific test specimen dimensions are noticed, the following tests which were performed on the welded plates are as given below: Destructive Testing is conducted as below UTM (Universal Testing Machine) , Hardness Testing , Impact Testing, Hardness testing, microstructure testing, Wear testing were noticed in the alloy on FSW in the second joint. Since the second phase particles were not discernible by optical microscopy. Density of precipitates has decreased as a result of coarsening; Grain boundary precipitates have also coarsened. The effects of process and tool parameters on macrostructure of the friction stir welded joints.

Table 5: Mechanical properties of FSW specimens

S.NO	MATERIAL	HARDNESS[ppm]	ELONGATION[%]	TENSILE STRENGTH[Pa]	IMPACT STRENGTH[joules]
1	BASE MATAL	96.5	23.36	287.765	30
2	SAMPLE-1	83.5	2.88	142.883	8
3	SAMPLE-2	84.8	6.80	232.373	8
4	SAMPLE-3	85.9	4.80	138.745	10
5	SAMPLE-4	85.8	2.60	139.983	16
6	SAMPLE-5	87.9	6.76	224.023	12

The wear test should be done on highest tensile and lowest tensile strength it will gives no loss occurs in the specimens. Wear of metals occurs by plastic displacement of surface and near-surface material and by detachment of particles that form wear derbis.

Table 6: Mechanical properties of wear strength

S NO	MATERIAL	ROTATION SPEED[rpm]	WEAR STRENGTH[volume loss]
1	BASE METAL	650	VOLUME LOSS
2	SAMPLE 2	710	VOLUME LOSS
3	SAMPLE 3	900	VOLUME LOSS

5. REFERENCES

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