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INVESTIGATING THE STRENGTH OF THE PARTS PRODUCED BY FRICTION WELDING PROCESS

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Abstract- *Amongst all the rising new fastening technologies, friction stir fastening (FSW), is fictional and established by The fastening Institute (TWI) in 1991, it is used frequently for the welding of high strength of the aluminium alloys such as the AA6061 and Copper which are difficult for welding by conventional fusion welding techniques. Friction fastening (FW) is nothing however the gathering of a series of the friction-based solid state that joins the processes of which might manufacture the high-quality welds of various elements with either similar or dissimilar materials and it's been attracting increasing within the attention. The aim of the project is to weld two plates of AA 6061 and Copper using the different tool profiles and to optimize the parameters like tool rotational speed, tool profile, depth of cut and feed etc. affecting the properties of welded joints. This paper reviews based on friction stir welding process analysis, Mechanical properties, Micro structural properties, Post weld heat treatment of the joints, Corrosion of the joints in Aluminum and its alloys.*

***Key Words*: solid type welding, tool, welding properties, FSW analysis, post weld treatment.**

1. INTRODUCTION

Welding is that the method of the metal connexion with the assistance of the heat, and with or while not the pressure. welding is that the issue that it's the sculptural or the fabrication method which will be wont to joined materials, typically the metals or the thermoplastics is inflicting the fusion, that is simply the distinct from the lower temperature and also the metal connection techniques like the brazing and also the fastening, that cannot soften the bottom metal. Additionally to the melting of the bottom metal, a filler material is usually additional to the joint to create a pool of liquid material that cools simply to make the joint which will be as robust as same because the base material. It then the automatically mixed with 2 other items of the metal at the place of the joint, then the softened metal (due to the elevated temperature) is joined exploitation mechanical pressure (which is additionally applied by the tool), very similar to connection the clay, or dough. it's in the main used on the atomic number 13, and also the most frequently on extruded atomic number 13 (non-heat treatable alloys), and on the structures that id required superior weld strength while not the post weld heat treatment. it absolutely was simply fictitious and by experimentation well-tried at The welding Institute United Kingdom in Dec 1991.The work piece was placed on a backup plate and clamped by exploitation fixtures to prevent lateral motion. The tool moves within the interface between two faces. As tool moves, weld cools and joins. A hole is left among the work piece when withdrawal of tool. There's a superb challenge in fastening aluminum and its alloy exploitation standard fastening ways like fusion fastening thanks to they type the compound layer, high thermal conduction of thermal growth and hardening shrinkage. the most downside behind Fusion fastening is that when fastening, there is a complete alteration in small structure and loss of mechanical properties. This downside is fully avoided in friction stir fastening since it's solid state fastening. Further, once FSW is compared with standard fastening ways a number of the benefits are

- FSW is done without any filler material.
- FSW does not require any shielding gas.
- Arc and fume are not formed.
- FSW produces less residual stress and distortion on the base material.
- Skilled labors are not required.
- Porosity and cracking aren't formed thanks to solid type welding.

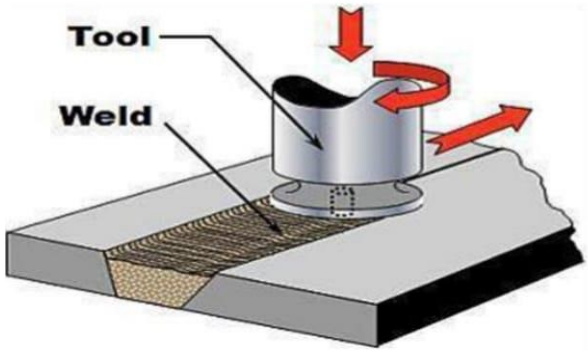

Figure 1: FSW process

2. LITERATURE SURVEY

From the last two decades, friction stir-welding has been considered as a successful welding technique for joining all hard materials and metal matrix composites in addition to aluminium. This is possible because, joining is established by means grain refinement which can also cause increase in mechanical properties. During joining, the amount of parameters required to regulate is restricted and which may be easily controlled to supply the sound weld. Machine controllable parameters are having direct relation with mechanical properties except speed of welding. FSP and FSSW are the 2 variants in friction stir welding. It will become a eminent technique to supply surface composites, super plastic forming, later may be a decent alternate technique to resistance spot welding. Friction stir welding joints are susceptible to differing types of defects which we will eliminate by choosing the right tool design and process parameters. This process of welding is less preferred to weld hard materials due to the lack of tool material and tool design. Tool wear are going to be the main problem while welding the metal matrix composites thanks to the presence of hard ceramic particles.

In friction stir welding Cost effective and long-life tools are available for the FSW of aluminium and other soft alloys. Reactivity of tool material with oxygen from the atmosphere and with the work piece is additionally a crucial consideration. Additional developments in FSW tool materials are needed to traumatize the matter of high tool value with low tool life throughout fastening of more durable alloys. Heat generation rate and plastic flow within the work piece are suffering from the shape and size of the tool shoulder and pin. Though the tool style affects weld properties, defects and also the forces on the tool, they're presently designed through empirical observation by trial and error. Work on the systematic design of tools using scientific principles is simply beginning. Examples of recent studies include calculation of flow fields for different tool geometries and the calculation of tool shoulder dimensions based on the tool's grip of the plasticized material. The pin cross-sectional geometry and surface features like threads influence the warmth generation rates, axial forces on the tool and material flow. Tool wear, deformation and failure also are far more prominent within the tool pin compared with the tool shoulder. Calculations of the axial, longitudinal and lateral forces on the tool can be done as functions of process parameters, or evaluated from the measure data. Estimation of the load bearing ability of the tool pin is required considering the utmost stresses within the tool pin thanks to combined effects of bending and torsion. There is a requirement for concerted research efforts towards development of cost-effective durable tools for commercial application of FSW to hard engineering alloys.

3. OBJECTIVES

- Welding to dissimilar metal alloys using Circular friction welding process.
- Experimentation to be done by varying welding parameters.
- Conduction of Mechanical testing (Tensile, Impact test) to record the response/output.
- DOE techniques can be used to analyze the process performance and conclude the results.
- Microstructure analysis to study microstructure changes.
- Joint Strength: The resistance of a material to break under tension, we can increase
- Tensile strength of weld joint using suitable tool profiles and choosing ideal input parameters.
- Optimum Parameters: We choose ideal input parameters like speed, feed and depth of cut for better result.
- Tool Profiles: We choose suitable tool profiles like as circular, hexagonal and triangle for better result.

4. METHODOLOGY

I. HARDWARE SPECIFICATIONS

The hardware requirements are

- Aluminium Alloy
- Copper Alloy
- Vertical Milling Machine

II. MATERIAL SELECTION

Aluminum Alloy:

Aluminum and it's alloys happiness to the sunshine metals, given to their approximate density of two, 70 kg/dm^3. For comparison: steel has the density of the generally 7,85 kg/dm^3. metal has the most important field of the applying of the sunshine metals. In 2005, the

worldwide annual production of the metal was thirty one Mt

- Aluminium is ductile and it will be hot rolled or cold rolled right down to all the way down to} thicknesses of 6-7 μm (foil) and it will be extruded down to wall thicknesses of zero.5 mm. It may be ironed, then drawn, and forged, and sealed or solid by ancient strategies.
- Aluminium is corrosion resistant, and its surface will be protected against corrosion by anodizing, painting or lacquering.

Copper Alloy:

Copper-Alloys are nothing but the metal zero which are having the copper as the foundation or base of device that they have a high resistant against corrosion, the best known as traditional types of Bronze where in tin is a significant addition and Density 8.96g/cm3

- Excellent heat conductivity
- Excellent electrical conductivity
- Good corrosion resistance
- Good machinability

Figure 2: Aluminum alloy and Copper alloy

Vertical Milling Machine:

The vertical head clamps the vertical sliding surface of the vertical milling machine motor is fixed to the shoulder of the head and drives the vertical spindle through a Poly-V belt and drive system.

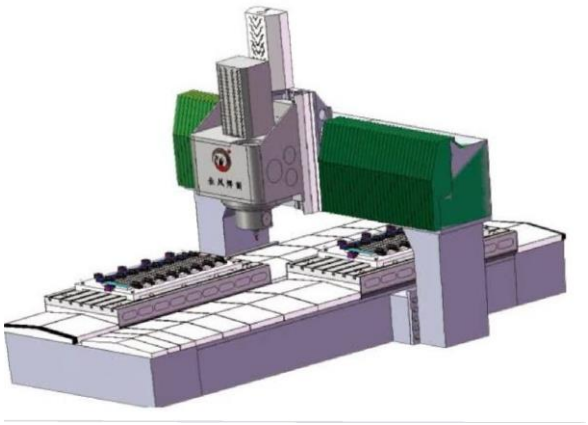

Figure 3: Vertical milling machine

III. ROTATING TOOL PIN

The tool employed in vertical miller is non-consumable tool encompasses a circular section except at the top wherever there's a rib probe and a lot of difficult flute, the junction between the cylindrical portion and therefore the probe is understood because the shoulder. The probe penetrates the work piece whereas the shoulder rubs with the highest surface. The tool has associate degree finish faucet of five to six millimetre diameter and a height of five to six millimetre however it should vary with the metal thickness. The tool is ready during a positive angle of some extent within the fastening direction. the look of the pin and shoulder assembly plays a crucial role on however the fabric moves throughout the method.

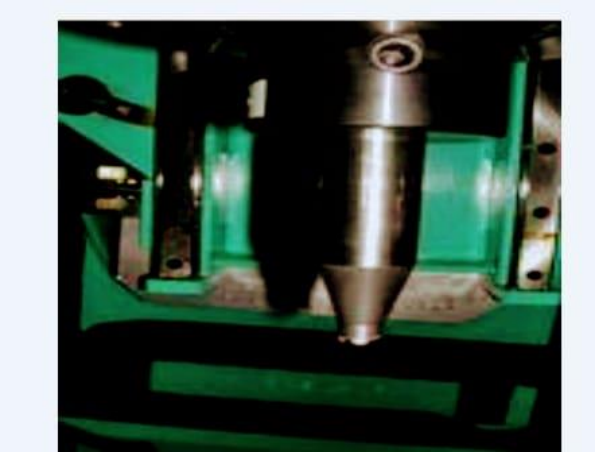

Figure 4: Tool pin

IV. INPUT PARAMETERS FOR TOOL

The main input parameters in friction stir welding are as follow:

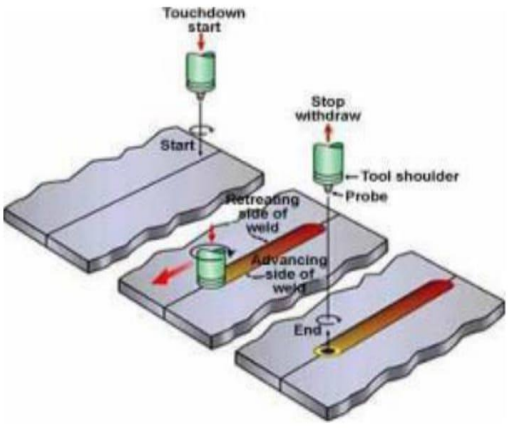

Figure 5: Friction stir-welding process

Rotational Speed of Tool:

The rotational speed of the device is also known as the machine spindle rpm affects the quality is the just of the point joint. When increase in the device rotational speed, the device generates heat by friction also increases which directly affects temperature at welding position. Proper temperature is required to desire the welding there for rotational speed of the tool must be selected properly.

Welding Feed Speed:

The welding feed speed also affects the quality of welded joints. With decrease in the tool of the rotational in the speed of that in the tool, the time in which the tool is just in the contact within the material will just increases, so the heat generated by friction also increases which directly affects temperature at welding position. Proper temperature is required for the desired welding there for the welding feed speed should be selected properly.

Depth of the Cut (Axial Force):

The depth in the cut in FSW also termed as axial force applied affects the quality of the welding output. When we increase the thickness of the material plates the required depth of cut to properly join the material increases, so the required axial force will also increase. There is certain limit of the axial force that can be applied based on the machine specification. So, we have that limited range of thickness that can be the welded by machine based on its capacity to apply axial force.

V. WORKING PRINCIPLE

A perpetually revolved non expendable cylindrical-shouldered tool with a profiled probe is transversally fed at a relentless rate into the joint between 2 clamped items of butted material. Resistance heat is generated between the wear-resistant attachment parts and also the work items. This heat is created by the mechanical combination method and also the adiabatic heat within the fabric tent the stirred materials to melt while not melting. As per the pin is simply enraptured forward, as a special profile on its leading face forces plasticized material to the backend wherever clamping force assists in a very cast consolidation of the weld. This method of the tool traversing through the weld line in a very plasticized hollow shaft of metal effects in severe solid-state deformation involving dynamic re- crystallization of the bottom material.

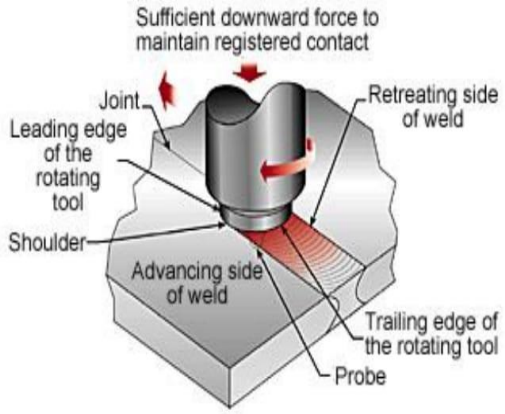

Figure 6: FSW working principle

In friction stir attachment the special cylindrical body part tool with a profiled probe is revolved and slowly plunged towards the joint line between 2 items butted along. The components ought to be clamped onto a backing bar throughout a fashion that forestalls the contiguous joint faces from being forced apart. This heat forms the latter to melt while not reaching the temperature and permits traversing of the tool on the weld line. The utmost temperature reached is of the order of zero.8 of the melting temperatures of the fabric.

VI. APPLICATION OF FRICTION STIR WELDING

- **Shipbuilding and Marine Industries:**

  The shipbuilding and marine industries are two industries to adopt FSW process for the first time for commercial application

- **Aerospace Industry:**

  At present the aerospace industry is using FSW process for welding prototype parts that is Wings, fuselages, empennages etc.

- **Railway Industry:**

  The high-speed trains for commercial production made up of aluminum extrusions which will be joined by friction stir welding.

VII. ADVANTAGES

- The process is environment friendly because no fumes or spatter is produced and no shielding gas is required.
- Since the temperature involved in the process therefore shrinkage is quiet low during solidification
- One tool can be almost used for up to 1000 meters of weld length that is 6000 series aluminum alloy
- Dissimilar metals can be welded.
- The weld produced is of superior quality with excellent mechanical properties and fine micro structure

VIII. LIMITATIONS

- High investment.
- slower traverse rate than other fusion welding techniques, although this may be offset if fewer welding passes are required
- Less flexible than manual and arc processes because the difficulties with thickness variations and non-linear welds.

5. CONCLUSION

It is evident that friction stir welding has more potential in the fabrication of similar and dissimilar aluminium alloys when compared with other conventional welding methods. The friction stir welded Aluminium alloys have been introduced and the simulation techniques are also validated with its process parameters. It is observed that similar and dissimilar FSW welded aluminium alloys have been used in industrial applications for its mechanical properties. For the past decades, researchers are inspected dissimilar aluminium alloys and analyzed mechanical and metallurgical properties. The grain structure of FSW joints, cavities, formation of onion rings in weld nugget zone of aluminium alloys are tested and SEM analysis reveals the deformities in aluminium alloys. In future, dissimilar aluminium alloys are recommended to increase the quality of weld in industries and commercial applications.

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9. BIOGRAPHIES

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