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Study of Modelling, Analysis and Testing of Friction Stir Welding of AL Alloys 6061 & 6082

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***Abstract* – Aluminum alloy 6061 & 6082 has gathered wide acceptance in the fabrication of light weight structures required a high strength to weight ratio. Compared to fusion welding processes that are routinely used for joining structural aluminum alloys, friction stir welding process is an emerging solid state joining process in which the material that is being welded does not melt and recast. This process uses non-consumable tool to generate frictional heat in the butting surfaces. The welding parameters tool pin profile plays a major role in deciding welding quality. In this project an attempt is made to understand the effect of welding speed and tool pin profile on FSP zone formation in Aluminum alloy 6061 & 6082.Three different tool pin profiles are used to analysis the welding joints. Those profiles are 1.Straight cylindrical, 2.Tapered cylindrical, 3.Square. In this project we are also doing coupled field analysis for both cutting tools and welding plates.**

We are also doing experimental work by using milling machine. In that we are preparing fixture, cutting tools and plates. Main parameters taken for this project are Cut feed, spindle RPM.

Machine used for the experimental work are FN2 semiautomatic machine. For modeling we are using Pro/Engineer software, for analysis ANSYS.

***Keywords* – Stock prediction, KNN, Forecast.**

I. INTRODUCTION

1.1 Introduction about Friction Stir Welding

Friction stir welding (FSW) is a solid-state welding process that gained much attention in research areas as well as manufacturing industry since its introduction in 1991 (TWI) For almost 22years, FSW has been used in high technology applications such as aerospace to automotive till high precision application such as micro welding. The main feature of a solidstate welding process is the non-melting of the work material which allows a lower temperature and a lower heat input welding process relative to the melting point of materials being joined. This is advantageous over the conventional fusion welding where excessive high heat input is required to melt the work material.

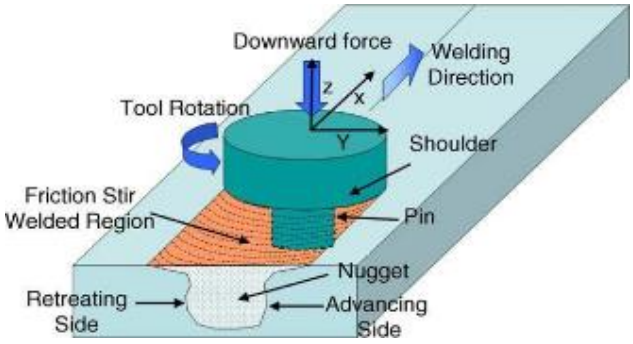

Figure 1.1: Schematic Drawing of FSW from [Mishra and Ma, 2005].

II. LITERATURE REVIEW

As was discussed in the introduction, FSW is a solid-state welding process in which the material is joined via mechanical stirring.

2.1 Friction Stir Welding (FSW)

Friction stir welding was invented by TWI, Cambridge in 1991.friction stir welding involves the joining of metals without fusion or filler materials it produced a plasticized region of materials. A non-consumable rotating tool is pushed into the materials to be welded and then central pin, followed by the shoulder, is brought into contact with the two parts to be joined as shown in figure. The rotation of the tool heats up and plasticizes the materials it is in contact with and as the tool moves along the joint line, the material from the front of the tool swept around these plasticized annulus to the rear, eliminating the interfece.so the welds are created by the combined action of frictional heating and mechanical deformation due to a rotating tool. The maximum temperature reached of the order of 0.8 of the melting temperature. The tool has a circular section except at the end where there is a threaded probe or more complicated flute the junction between the cylindrical portion and the probe is known as the shoulder. The pin penetrates the workpiece whereas the shoulder rubs with the top surface. The heat is generated primarily by friction between a rotatingtranslating tool and the workpiece, the shoulder of which rubs against the

workpiece. There is a volumetric contribution to heat generation from the adiabatic heating due to deformation near the pin. The welding parameters have to be adjusted so that the ratio of frictional to volumetric deformation induced heating decreases as the workpiece becomes thicker.

2.2 Friction Stir Welding Process Parameters

Welding depends on the following three process parameters. They are

- Spindle speed
- Feed rate
- Depth of penetration

III. EXPERIMENTAL PROCEDURE

3.1.1 SELECTION OF MATERIAL

Aluminum Alloy AA6061& 6082: Aluminium alloy AA6061 & 6082 is a medium strength alloy with excellent corrosion resistance. It has the highest strength of the 6-series alloys. Alloy AA6061 & 6082 is known as a structural alloy. In plate form, AA6061 is the alloy most commonly used for machining. The addition of a large amount of manganese controls the Grain structure which in turn results in a stronger alloy. Alloy AA6061&6082 machines well and produce tight coil of swarf when chip breaker are used.

Tool material: High speed steel

3.1.2 Sample Preparation

Rolled plates of 3mm in thickness were cut into the required size (100mm x 50 mm x 3 mm) by power hacksaw cutting and milling. The experiments were conducted on the Aluminium alloy IS 6061 & 6082. Before the friction welding, the weld surface of the base material was cleaned. Plate edges to be weld were also prepared so that they are fully parallel to each other. This is to ensure that there is no uneven gap between the plates which may not result in sound welding. Secondly surface preparation was also done so that the surfaces of both the plates are of equal level and footing plates are of equal level and footing.

3.1.3 experiment

A semi automation milling machine was used for friction stir processing (FSW) of aluminum alloy. The machine was a maximum speed 6000 rpm and 10-horse power. Test piece was clamped in the fixture tightly. Initially the rotating pin was inserted into a predrilled hole, which will facilitate the startup of welding .Tool tilt angle was 2 degree processing began at spindle speed of 1000 rpm and travel rate of 75mm/min. since tool plunge was to the extent of 3mm and plate thickness the same step was repeated for tool . The result was two side welded plates. The process was repeated for tool travel rate of 90 mm/min for the tool speeds of 1200rpm. The plates where then subjected to mechanical testing.

IV. CONCLUSION

FSW process benefits solid state joining method that has great advantage on light weight material such as aluminium alloy due to its thermal properties which make it difficult to be joined using conventional methods. Similarly to the other welding method, heat generation and heat transfer play major role in determining the success of the joining process as well as predominantly establish the joint characteristics and properties. Though the detail of the process mechanism and the effect on the welding has been widely studied in lab scale, good understanding of the process mechanism provides a better view on choosing the best parameter for the process and finally to achieve the best result in practice.

In our project we are comparing two Al 6061&6082 material which is good for welding and designed 3 types of cutting tools cylindrical tool,tapered cylindrical tool and Square tool for doing Friction Stir Welding.

In this project by observing Above analysis and experimental result for cylindrical tool is having more thermal flux and thermal gradient, then we will get good weld property while doing welding process. In material point of you 6061 is having good tensile streangth properties compare to 6082.In structural analysis Triangle tool is having less displacement and yield stress. Also remaining tools is also with in the limit. We are concluding that cylindrical tool is best suited tool for FSW.

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