FRICTION STIR WELDING OF ALUMINIUM 5086 ALLOYS

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Abstract

Friction Stir welding (FSW) is a solid state attachment method used for welding of metals of same and different metals. This process of friction stir welding (FSW) is widely using for the reason it can produces sound welds and doesn't have common issues like solidification and liquefaction cracking connected to the fusion techniques. The Friction stir welding of Al 5086 alloys had been commercialized and up to date interest is targeted on change of integrity with different metals. Thus on commercialize this method, analysis studies are required to characterize. particularly, FSW has impressed researchers to aim modification of integrity different metals like aluminum 5086 that differ in properties and sound welds with none or restricted inter metallic bonding of components has been done. In this paper we have to make a research on the current analysis state of FSW between aluminum 5086 with attention on the resulting welding and tensile strength, microstructure, elongation and the tools are used to produce the welds and also an insight into future analysis during this process of study the project of friction welding. By this process in our project we got an idea of going to maintain the rotational speed (rpm) 450 to 1400 and also by changing welding rpm (speed). This friction stir welding is used in nasa for joining of two totally different or same types of materials.

Keywords: *Friction stir welding, Tool, Welding parameters, and Mechanical properties etc…*

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1. INTRODUCTION

Welding is the most economical and efficient way to join metals permanently. it is the only method of joining two or additional pieces of metal to make them act as one piece. Welding is significant to our economy. It is usually a fore said that fifty make the most the gross national product is related to welding in a way or the other. Welding ranks high among industrial {process} and involves additional sciences and variables than those involved in the other industrial process.

2. EXPERIMENTAL PROCEDURE

The experimental study includes the butt joining of three of 3 pure aluminum plates. The welding method is carried out on a vertical shaping machine (Make HMT FM-2, 10hp, 3000rpm) as shown in Fig 2.1. Tool is hold in tool arbor as shown in Fig 2.2. Welding jigs and fixtures are designed to carry two plates of two hundred millimeter X mm millimeter X three millimeter thickness as shown in fig vi.5.1. Table 5.1 shows the combinations of the tool rotational speed (RPM), welding speed (mm/min) and tool geometry and diameter of the tool shoulder to the diameter of the tool pin (Ds/Dp). These combinations are chosen based on the literature survey and therefore the capability of the milling machine used for the experimental study. The schematic diagrams of tools utilized in this method.

In the present work, totally different FSW butt welds were obtained by variable varying the process parameters among the varying the R.P.M and therefore the best values are drawn supported the trend of the values. The weld joints are tested for enduringness and therefore the specimens are cross sectioned from the joints perpendicular to the fastening direction and are as per ASTM tips. The parameters tool movement speed, pin length and fastening speeds are varied by keeping the axial force constant.

Table1: Chemical Composition of H13 Tool Steels

Element	Min.(%by Weight)	Max.(% by Weight)
Carbon	0.37	0.42
Phosphorus	0	0.025
Sulphur	0	0.005
Silicon	0.80	1.20
Chromium	5.00	5.50
Vanadium	0.80	1.20
Molybdenum	1.20	1.75

Fig 2.1

Fig 2.2: Welded plate at 450 rpm

Table 2: showing the wildings at different rpm's in general explanation resulting good, better, best.

WELDING NUMB	R.P.M	FEED	RESULT
1	450	35	GOOD
2	710	50	GOOD
3	900	63	BETTER
4	1400	100	BEST

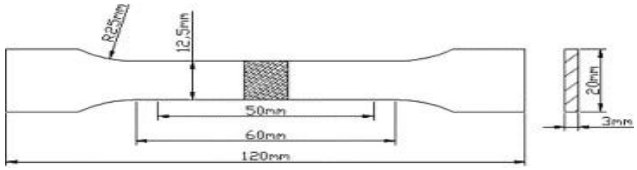


Fig 2.3: schematic sketch of Tensile Specimen

Impact specimens were machined as per ASTM E8M within the traverse direction from the welded joints and shown. Impact check was applied by exploitation Charpy impact machine as shown in Fig.6.21. To review microstructure, the specimens were mounted by exploitation mounting machine as shown.

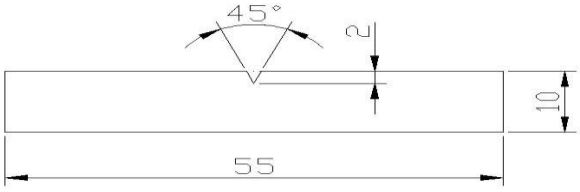


Fig 2.4: Schematic sketch of Impact Specimen

Table 3: showing R.PM, FEED, IMPACT STRENGTH

Conditions	R.P.M	FEED	IMPACT STRENGTH (J)
1	450	35	14
2	710	50	21
3	900	63	13
4	1400	100	12

3. RESULTS AND DISCUSSION

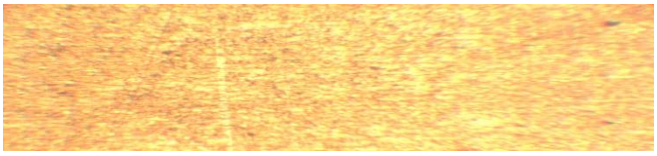
During FSW, the material flow round the tool pin is because of the heat generated by the friction and stirring action. In fusion fastening of chemical element, defects like porosity, scum inclusions solidification cracking etc, deteriorates the weld quality and joint properties. Usually, fiction stir welded joints are free from these defects since there's no melting takes place throughout fastening and thus the metals are joined at intervals the solid state itself because of heat generated by friction and flow of the metal by the stirring action.

3.1 Microstructure study

The figure below shows the optical photos of the stir zone of friction stir processed samples and additionally the bottom metal. it's discovered that the grain size has become finer inside the samples compared to the bottom metal in fig. friction stir welded samples showed recrystalized fine grains inside the stir zone and additionally the elongated grains in TMAZ.

4. MICRO STRUCTURE TEST

Test Name: Microstructure
Type of Specimen: parent specimen
Metal for Testing: Aluminum



Test Name: Microstructure
Type of Specimen: Welded specimen
Metal for Testing: Aluminum

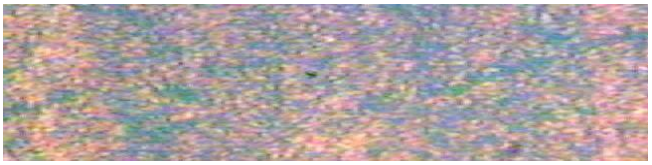


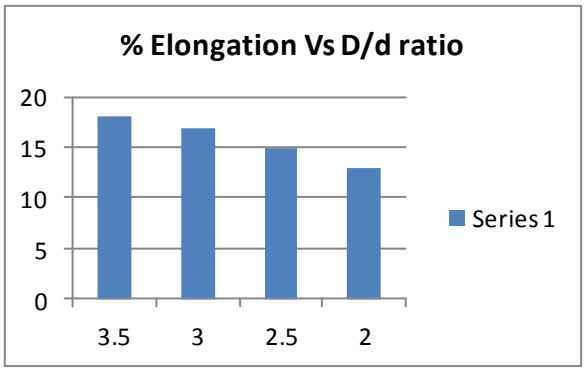
Table 4: showing constant axial force

Condition	Rotation speed (rpm)	D/d ratio	Welding speed (mm/min)	Axial force (kN) 5
4	1400	3.5	45	Constant

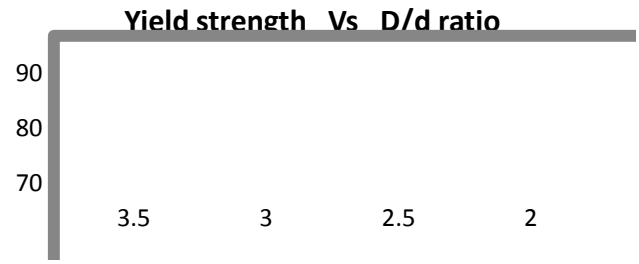
Table 5: showing the values obtained at different R.P.M, feed, Rockwell hardness, brines hardness, impact strength.

FSW (R.P.M/MM)	ROCKWELL HARDNESS (HRB)	BRINEL'S HARDNESS VALLUE	IMPACT STRENGTH (J)
450/40	74.5	26	14
710/80	78.4	74.5	21
900/125	78	31	13
1400/160	75	78.3	12

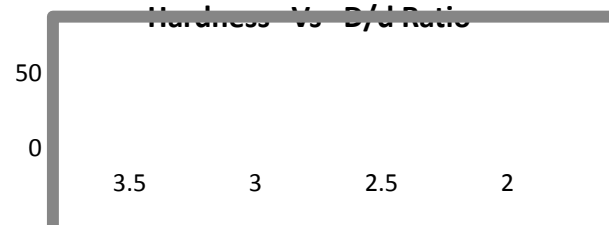
5. GRAPHS



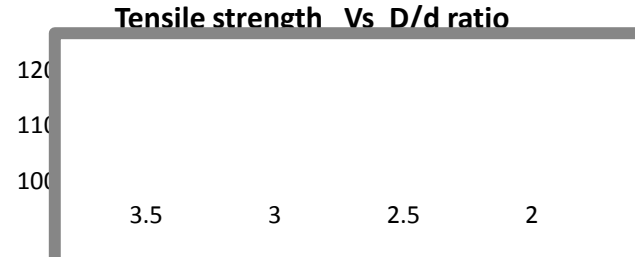
Graph 1: Representing the values obtained elongation of the specimen vs diameter of the tool



Graph 2: Representing the values obtained yield strength vs diameter of the tool



Graph 3: Representing the values obtained hardness of the specimen vs diameter of the tool



Graph 4: Representing the values obtained tensile strength of the specimen vs diameter of the tool

6. CONCLUSION

1. aluminium is that the best metal for friction stir welding method it offers higher results compared with completely different rpm and feed and as we tend to increase the rpm the welding output is getting better.
2. Tool profile used here is square of 5X5mm
3. Strength of tool made is 50 and Materials used for making tool is H13
4. At 1400 rpm tool rotates speed and 40/40mm/min traverse speed with square profile resulted in good mechanical properties. Joint potency is good
5. All fsw joints were unsuccessful at the retiring side this might result to improper heat distribution at splitting aspect.
7. within the welding of aluminium is also done at 900 rpm tool rotates with a speed of 40mm/min of welding lack of heat generation.
8. Hardness variation is observing along cross-sectional of the welds it was determined that lowest hardness at retreating and bent when fusion zone and thermo mechanical affected zone.
9. By observing all speeds we are able to say that aluminium is giving higher output

By conducting above experiment we are able to conclude that aluminium has the foremost effective properties for the method of friction stir welding. throughout this project we have a tendency to had undergone completely totally different rpm and feed for the aluminium and conducted several tests like micro structure test, tensile test, etc by observing all welding metals and process aluminium offers the higher output. aluminium during this method offers the higher output of withstanding fully totally different conditions. welding of aluminium in friction stir welding process successfully obtained for numerous welding speeds, rotation speeds**.**

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