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Friction Stir Welding of Aluminium Alloys

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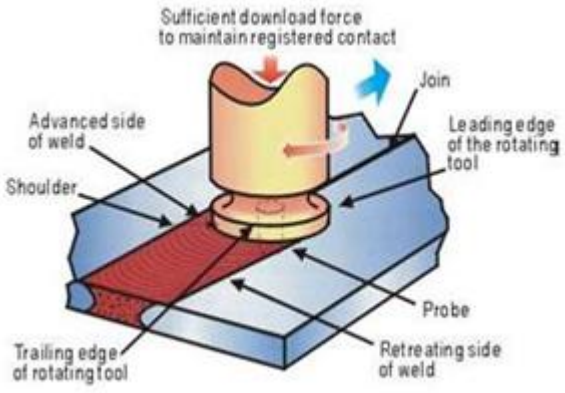
Abstract - *Friction stir welding (FSW) is a profoundly essential and as of late created joining innovation that delivers a strong stage bond. It utilizing a pivoting apparatus to create frictional heat that makes materials of the segment be welded to mellow without achieving the dissolved point and enable the device to move along the weld line. Plasticized materials are exchanged from the trailing edge of the instrument test to main edge, leaving a strong stage bond between the two sections. Friction stir welding from nut and bolts to applications surveys the essentials of the procedure and how it is utilized as a part of modern applications.*

Key Words: **Friction, Alloy, Tensile**

1. INTRODUCTION

Friction stir welding (FSW) is a process of joining work piece without softening the metal and it uses non consumable tool. Heat is delivered by the erosion between the non consumable tool and work piece material, which stir up a locale close to the friction stir welding tool. While the devise is crossed along the joint line, it mechanically intermixes the two bits of metal, and produces the hot and mellowed metal by mechanical weight, which is connected by the tool, much like joining dirt, or better. It is basically utilized on created and expelled aluminium and especially for structure which required high weld quality.



2. Experimental Setup

2.1 Material Selection

The material and their specification selected for friction stir welding processes are shown in table number 1

Table -1:

Sl. No	Material Name	Specifications
1	Aluminium AA-6061	150mm(length) x 75mm(width) x 5mm(thick)
2	Aluminium AA-6082	150mm(length) x 75mm(width) x 5mm(thick)
3	Aluminium AA-19500	150mm(length) x 75mm(width) x 5mm(thick)

2.2 Specification of Friction Stir Welding Machine

Table No 2:

Machine Name	HMT – FM2
Bed Side	800 mm x-movement 400 mm y-movement 400 mm z-movement
Motor Speed	10 HP
Maximum Speed	1800 RPM
Minimum Speed	250 RPM
Tool Used	H-13

2.3 Steps of Welding Process

1. Cut the required size of the work piece to be weld.
2. Place the work piece on the machine work bench.
3. The selected friction stir welding tool has to be fit in the machine spindle.
4. In friction stir welding machines setting the rotation speed (w), axial force (F) and welding speed (v)
5. Welding process is started from one end to another end of the work piece.
6. Repeat the same procedure for other work pieces.
7. Cut the specimen according to the standard size for testing.

Fig 2. Work piece before friction stir welding

Fig 3. Work piece fixed on the fixture

Fig 4. Welding process

Fig 5. End of welding process

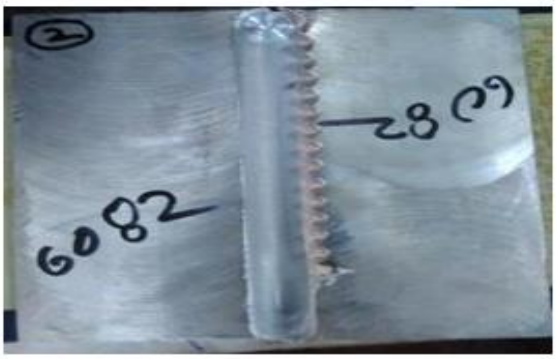


Fig 6. Welded Work Piece

3. Results and Discussion

3.1 HARDNESS TEST

3.1.1 Hardness Test of Parent Metals (Aluminium)

Sl. No	Specimen Sample	Hardness in HBR			
		R 1	R 2	R 3	AVERAGE
1	AA 6061	44	48	48	46.67
2	AA 6082	57	57	58	57.33
3	AA 19500	50	48	48	48.67

3.1.2 Hardness Test of Similar Aluminium Alloys After Welding

Sl. No	Specimen Sample	Hardness in HBR			
		R 1	R 2	R 3	AVERAGE
1	AA 6061	42	42	45	43
2	AA 6082	42	41	42	41.67
3	AA 19500	35	34	33	34

3.1.3 Hardness Test of Dissimilar Aluminium Alloys After Welding

Sl. No	Specimen Sample	Hardness in HBR			
		R 1	R 2	R 3	AVERAG
1	AA 6061 & AA 6082	45	41	43	43
2	AA 19500 & AA 6082	42	42	42	42
3	AA 19500 & AA 6061	46	46	48	46.67

3.2 TENSILE TEST

3.2.1Tensile Strength of Parent Metals (Aluminium)

Sl. No	Test Specimens	Ultimate Load (N)	Area (mm^2)	Ultimate Tensile Strength (N/mm^2)
1	AA6061	13840	46	300.85
2	AA6082	18280	46	397.39
3	AA19500	10520	46	228.69

3.2.2 Tensile Strength of Similar Aluminium Alloys After Welding

Sl. No	Test Specimens	Ultimate Load (N)	Area (mm^2)	Ultimate Tensile Strength (N/mm^2)
1	AA-6061	7520	46	163.47
2	AA-6082	7960	46	173.043
3	AA-19500	3920	46	85.217

3.2.3 Tensile Strength of Dissimilar Aluminium Alloys After Welding

Sl. No	Test Specimens	Ultimate Load (N)	Area (mm2)	Ultimate Tensile Strength (N/mm2)
1	AA-6061 to AA-6082	7480	46	162.608
2	AA-6061 to AA-19500	4760	46	103.478
3	AA-6082 to AA-19500	6120	46	133.043

3.3 IMPACT TEST

3.3.1Impact Test of Parent Metals (Aluminium)

Sl. No	Specimen Samples	Impact Strength (Joules)
1	AA 6061	8
2	AA6082	4
3	AA19500	6

3.3.2 Impact Test of Similar Aluminium Alloys After Welding

Sl. No	Specimen Samples	Impact Strength (Joules)
1	AA 19500	2
2	AA 6082	4
3	AA 6061	4

3.3.3 Impact Test of Dissimilar Aluminium Alloys After Welding

Sl. No	Specimen Samples	Impact Strength (Joules)
1	AA 19500 & AA 6061	4
2	AA 19500 & AA 6082	6
3	AA 6061 & AA 6082	8

4. CONCLUSIONS

By using FSW we can join materials which are difficult to join by other type of welding process. Excellent mechanical properties in tensile and other type of tests. joints are leak proof and strong. no arc or fumes, no porosity. Energy efficient, no filler material is required, no required of gas shielding. no slag formation. Can be used to weld non ferrous materials Cu, Al etc .

• The aluminium AA 6082 has stronger alloy as compare to other two metals in the parent metals.

• Tensile strength of similar metals are more than dissimilar metals.

•Dissimilar metals have a more hardness and impact strength than similar metals.

•The welded aluminium AA 6082 alloy has more strength than AA 6061 & AA 19500 alloys.

•As compared to other welding FSW is a green and environmentally friendly welding technology because of its low energy usage, no need of consumable material such as shield gases, electrode, filler metals and no emission of gases.

•Friction stir welding has higher joint efficiency using less heat input as compared to other welding.

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