International Journal of Mechanical Engineering and Robotics Research

ISSN 2278 – 0149 www.ijmerr.com
Vol. 3, No. 4, October, 2014

Research Paper

COMPARATIVE EXPERIMENTAL STUDY OF FRICTION STIR WELDING AND GAS WELDING PROCESS ON AA6061

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An experimental investigation has been carried out on Hardness distribution, tensile properties and microstructure of weld butt joints of 6061 aluminium alloy. Two different welding processes have been considered: an innovative solid state welding process known as friction stir welding (FSW) process and Gas welding. Hardness distribution results showed a general decay of mechanical properties of Gas joints, mainly due to high temperature experienced by the material. Instead, in FSW joint, lower temperatures are involved in the process due to severe plastic deformation induced by the tool motion and lower decay of mechanical properties. In the nugget zone a slight recovery of hardness is observed due to recrystallization of very fine grain structure. Hence from industrial perspectives, FSW process is very competitive as it saves energy, has higher tensile strength and prevents the joints from fusion related defects.

Keywords: Friction stir welding, Gas welding, Hardness, Aluminum 6061

INTRODUCTION

A method of solid phase welding, which permits a wide range of parts and geometries to be welded and called Friction Stir Welding (FSW), was invented by W. Thomas and his colleagues at The Welding Institute (TWI), UK, in 1991. Heat is generated by rubbing one metal against the other by the application of pressure. The frictional heat, thus generated, makes the metals plastic, and at this stage, forging pressure is given to cause upset and completion of welding.

Aluminium alloy 6061 In this study, Aluminium alloy 6061 and has been selected. Alloy 6061, a cold finished aluminium wrought product, has the highest strength of all aluminium alloys. Aluminium alloy 6061 is a medium to high strength heat- treatable alloy with a strength. It has very good corrosion resistance and very good weld ability although reduced strength in the weld zone. It has medium fatigue strength.

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CHEMICAL COMPOSITION

Table 1: Base Material Composition

Material	AL	Mg	Si	Fe	Cu	Zi
Amount (wt.%)	Bal	0.8-1.2	0.4-0.8	Max 0.7	0.15-0.40	Max 0.25

MECHANICAL PROPERTIES

Table 2: Base Material Mechanical Properties

PROPERTY	VALUE
Proof Stress	270 MPa
Tensile Strength	310 MPa
Elongation A5	12%
Shear Strength	190 MPa
Hardness Vickers	100 HV

FRICTION STIR WELDING JOINTS

Figure 1: Taper Threaded Tool

Figure 2: Half Grooved Threaded Joint

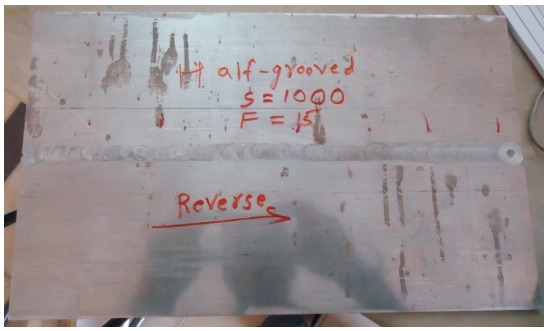


Figure 3: Gas Weldin

RESULTS

Microstructures

The microstructures of the FSW joints with taper threaded tool, half grooved tool and gas welded joint respectively are as shown below.

Figure 4: Microstructure of Half Grooved Tool Joint

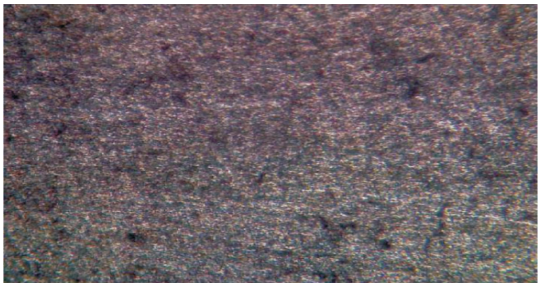


Figure 5: Microstructure of Taper Threaded Tool Joint

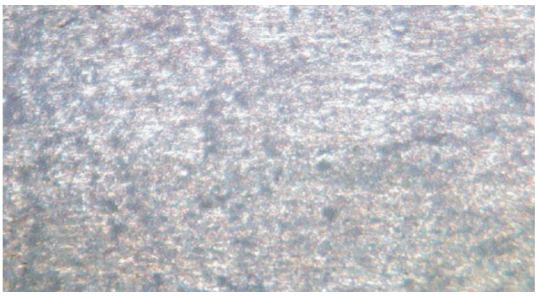
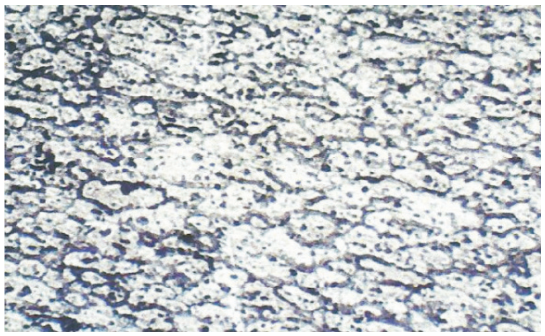


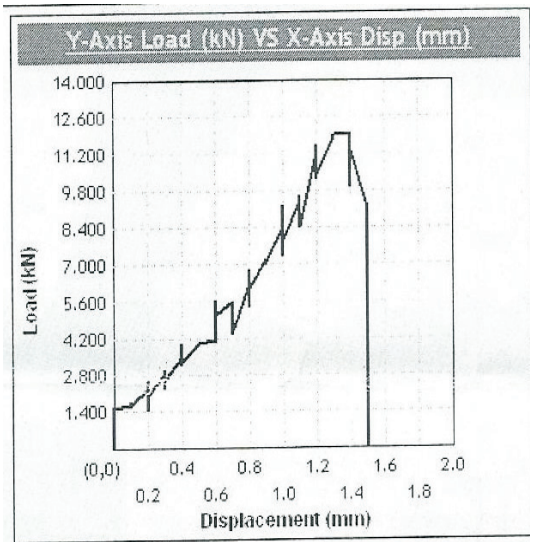
Figure 6: Microstructure of Gas Welding Joint



Tensile Test Report: From the tests conducted it is clearly obtained that the hardness is more for gas welding when compared to FSW but the tensile strength is much better for FSW than the gas welding.

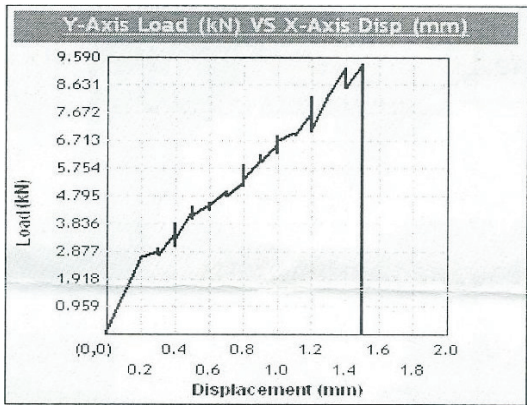
- The tensile strength of FSW joint for half grooved tool is 115.13MP.

Figure 7: Tensile Strength Graph of Half Grooved Threaded Joint of FSW



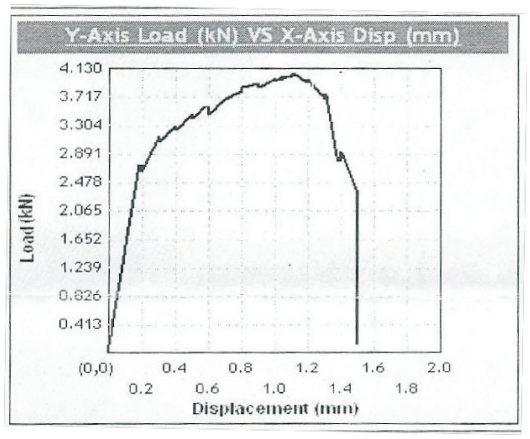
The tensile strength of FSW joint for taper threaded tool is 91.863MPa.

Figure 8: Tensile Strength Graph of Taper Threaded Joint of FSW



The tensile strength of gas welded joint is 39.980MPa.

Figure 9: Tensile Strength Graph of Gas Welding Joint



ULTIMATE LOAD

The Ultimate load of FSW joint for half grooved tool is 11.88KN

The Ultimate load of FSW joint for taper threaded tool is 9.54KN

The Ultimate load of gas welded joint is 4.080KN

ELONGATION

The Elongation of FSW joint for half grooved tool is 1.760%.

The Elongation of FSW joint for taper threaded tool is 1.160%.

The Elongation of gas welded joint is 1.600%.

VICKER HARDNESS TEST RORT

The hardness of FSW joint for taper threaded tool is 52.97HV.

The hardness of FSW joint for half grooved tool is 51.33HV.

The hardness of gas welded joint is 54.67HV.

CONCLUSION

From all the test's the FRICTION STIR WELDING is best Mechanical properties.

Compare to FSW joint for half grooved tool is good properties then FSW joint for taper threaded tool.

So we concluded FSW joint for half grooved tool is good mechanical properties of AA6061

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