

Joining of Aluminium 6082-T6 to aluminium 6082- T6 by Friction stir welding

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Abstract

In this research paper, microstructures and mechanical properties of friction stir welded joint of 6082 aluminium alloy to 6082 aluminium plates in 3 mm thickness with using filler materials. With this aim, welds were produced using High molybdenum high speed steel, with a cylindrical pin tool having 3 mm and 14 mm diameter of pin and shoulder respectively. The microstructure and vicker's microhardness performed on TMAZ, HAZ and NZ. Transverse tensile test were performed to evaluate the weakest portion of weld joints.

Keywords: Friction stir welding, Aluminium 6082-T6, Hardness, Tensile testing

Introduction:

Friction Stir Welding (FSW) is a revolutionary solid state welding technique invented at The Welding Institute (TWI) in 1991 [1]. The FSW process operates below the solidus temperature of the metals being joined. This process is a derivative of the conventional friction welding and is being used to produce continuous welded seams for plate fabrication [2].

FSW is considered to be the most significant development in metal joining in a decade. It is also a "green" technology due to its energy efficiency, environment friendliness, and versatility [3]. As compared to the conventional welding methods, FSW consumes considerably less energy. No shielding gas or flux is used, thereby making the process environmentally friendly. The joining does not involve any use of filler metal. During initial phase of development, the process was very widely used for joining similar Al alloys Friction stir welding can be applied to various types of joints like butt joints, lap joints, T butt joints and fillets [4].

EXPERIMENTAL PROCESS

RESULT ANALYSIS

SR NO	SAMP LES	WELDED JOINT
1	Al/Al	
2	Al/Al Zinc	
3	Al/Al Tin	
4	Al/Al R.E.	

Fig.1 FSW welded samples

The welding was carried out at constant rotation speed of 1000 rpm and constant feed rate of 28 mm/min and carried out with filler metal powders and without filler metal powders with in various amounts likes 0.5%, 1% and 1.5%. Defects free weld obtained during welding. For welding vertical milling machine used. Different welded joints were shown above fig.1

MICROSTRUCTURE

The micrographs of the weld specimen were taken at 400X magnification. The Base metal, HAZ, TMAZ and NZ were studied. The characterization was done on the cross section of the specimen.



Fig.2 Microstructure at 400X magnification

In all microstructures TMAZ RZ shown with 400X magnification. In this fine grain structure and porosity shown in microstructure.

TENSILE TESTING

Tensile testing was carried out on High temperature testing machine. Al/Al Zinc has higher ultimate tensile strength 218.90 MPa while rare earth has low ultimate tensile strength 100 MPa

MICROHARDNESS

The microhardness values of Al/Al are plotted in Fig. The Graphs of microhardness indicates a trend of increase of microhardness ($HV_{0.2}$) from the HAZ side to the weld nugget region in general for similar joints. Micro-hardness values of Al/Al 1.5% Rare earth was observed low compared to others. It is important to note here again that UTS values of Al/Al 1.5 % Zinc & Al/Al 1.5 % R.E. were observed 218.90 MPa & 100 MPa respectively.

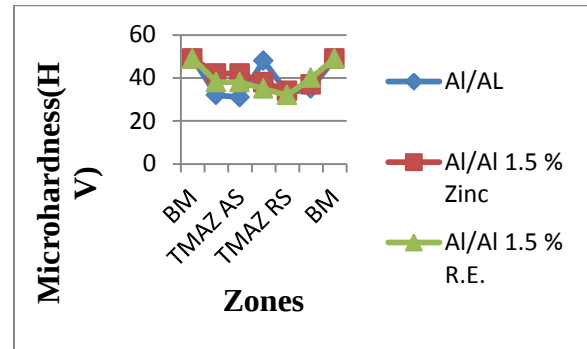


Fig.3 Microhardness for Al/Al

Microhardness values of Nugget Zone (NZ) of both these samples were observed low in comparison to that of Al/Al joint without filler. These may be attributed to formation of new intermetallics or composite structure at the nugget zone. The same can be verified by XRD analysis of weld interface. There is also observed fluctuations in $HV_{0.2}$ values with respect to change in zone on either side of the similar weld without filler (Al/Al). However, the variation of microhardness ($HV_{0.2}$) is not so abrupt for similar welds with filler addition.

CONCLUSION

Mostly all welds are defect free but in some welded plates cracks observed. Micro hardness low because of low amount of precipitates. Tensile testing shown that the joint strength of Al/Al with Zinc Filler metal powder was higher than other filler metal powder.

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