Influences of post weld heat treatment on Impact Test of Friction Stir Welded butt joints of Industrial Aluminum

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Abstract: Friction stir Welding is the type of welding used as a solid state joining process for materials because it deflects the common problems obtained in conventional welding processes. The reality that joining of alloys could be usually faced problems in many sectors that includes automotive, aerospace, ship building industries, electronics etc. where fusion welding is not possible due to large difference in physical and chemical properties of the components to be joined. This article presents a survey for the main work done concerning welding and heat treatment carried out to this aluminum and Izod Test on Aluminum .

Keywords: Friction Stir Welding, Rotational Speed, Impact Test, Industrial Aluminum, Heat Treatment

I .INTRODUCTION

Aluminum and its alloys are extensively utilized in many industries such as automotive, shipbuilding, aircraft, structural applications, appliances, food packaging and transportation industry due to their high strength to weight ratio and corrosion resistance and for their attractive mechanical properties achieved by thermal treatments. The increasing demand of lightweight and durability makes advanced high strength industrial Aluminum (0.4%Cu, 0.5%Mg, 0.5%Mn, 0.3%Si,and 0.2 Fe with the remainder being aluminum) attractive for future aerospace and Marine Industry application. In this study 6mm thick Al sheet welded by FSW and the effect of welding speed on weld hardness properties was investigated. FSW is relatively new solid-state technique developed by the welding institute for joining of Aluminum alloys. In this welding Process, a rotating tool is inserted into the joint line of two adjoin material and translated along the interface. This study focuses on the effects of rotational and welding speeds on the hardness of joints in friction stir welded. Welds were achieved under low heat input conditions at rotational and welding speeds of 1200, 1000 and 500 rpm and 300 mm/min.

II. Experimental work

The industrial aluminum used in this investigation was a 6 mm thick plate. It was prepared into the required dimensions of 300 mm× 150 mm by bend saw and filling files. Butt joint configuration was prepared to fabricate FSW joints. Its chemical composition is presented in Table 1. The cylindrical pin was used for friction stir welding. The welding tool was rotated in the clockwise direction, and the specimens, which were tightly attached to the

backing plate, were traveled. In this work, the constant welding speeds 300 mm/min. The tool rotation speed was 1200, 1000, 500 r/min and the tilt angle was 3˚.

Material	**% of Material**
Fe	0.2%
Si	0.3%
Mg	0.5%
Mn	0.5%
Cu	0.4%
Al	98.1%

Table-1

These specimens were clamped tightly to a thick backing plate of low carbon steel on NC FSW machine shown in fig 3.

Fig.3

An experiment was conducted to illustrate the effect of heat treatment on work piece. The work piece was carried to fitting shop where it was figured to proper dimension and then cut into four equal parts of same dimension.[1]

For Heat Treatment Apparatus used:

Muffle furnace (sometimes, retort furnace) in historical usage is a furnace in which the subject material is isolated from the fuel and all of the products of combustion including gases and flying ash. After the development of high-temperature electric heating elements and widespread electrification in developed countries, new muffle furnaces quickly moved to electric designs. Today, a muffle furnace is (usually) a frontloading box-type oven or kiln for high-temperature applications such as fusing glass, creating enamel coatings, ceramics and soldering and brazing articles. . They are also used in many research facilities, for example by chemists in order to determine what proportion of a sample is non-combustible and non-volatile (i.e., ash). The muffle furnace used had following specifications: Maximum temperature – 1200 degree Celsius• Maximum voltage-220 volts• Maximum Load- 3.5 kilo watt

In the muffle furnace Post weld heat treatment temperatures were set at 400 ^{0}C and Post weld heat treatment times were controlled at 20 and 24 hours10. The muffle furnace which was set at a temperature of 400 Celsius and the test pieces were left for 1 hour at the elevated temperature for carrying out annealing.[1]

Impact test

Impact test is used to determine the amount of energy that the material can absorb before rupture. The two tests commonly used to conduct impact test are the Charpy test and the Izod test. In this investigation, Izod test was employed to conduct the impact test. The impact test machine shows in figure IMPACT . This method is commonly employed to measure the impact strength of newly developed alloys. The impact test was performed in accordance with ASTM E23 standards. Specimen of size 10 mm x10 mm x 55 mm was used with a notch of dimension 2 mm x 2 mm x 45^0 . The specimen is loaded as a simple beam and is placed horizontally between the anvils so that knife strikes at a point opposite the notch at the mid-span.

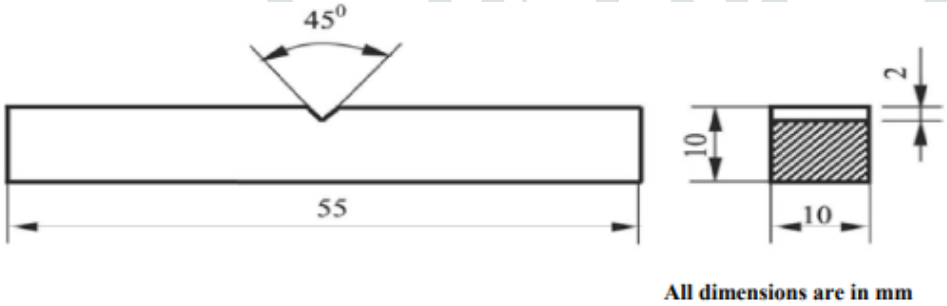
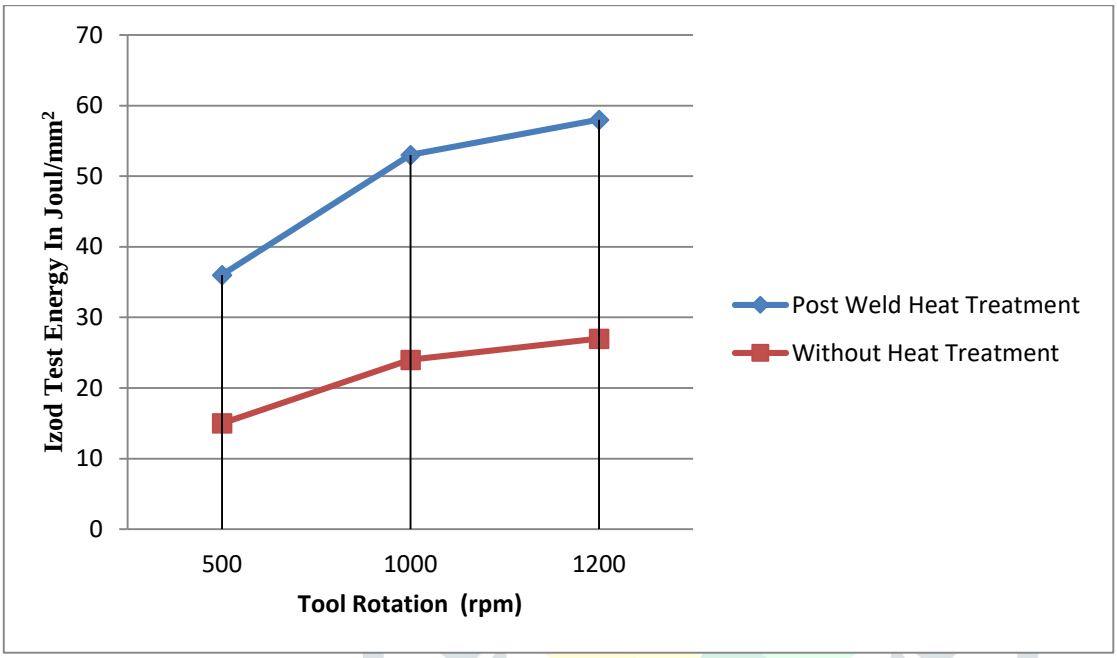


figure IMPACT

The procedure adopted to conduct the test is as follows. The pendulum of the machine is raised to its top most position and held by catch adjusted to give a constant height of fall to rupture the specimen. It is then released and allowed to fall and rupture the specimen. The energy required to rupture the specimen is a function of angle of rise, which is indicated on a semicircular scale indicator graduated in degrees or in Joules. Energy absorbed by the specimen during fracture is equal to the energy recorded on the dial indicator with the specimen in position minus the energy recorded on the dial indicator after breaking the specimen thus energy absorbed by the alloy in both as-cast and heat-treated specimens were evaluated. Three specimens were tested and average values of impact energy in Joules are reported. It was found that in all the cases there was just a little scatter in the results and each value did not deviate more than 3% from the average value. The test was carried out at room temperature. Impact testing machine FIT /300/008 EN serves for testing Izod impact energy/ strength.

III.Result

The result of impact toughness of as welded and after PWHT at 400^{0c}, in as welded condition, weld region exhibit a low toughness value as compared to PWHT specimens. In this izod impact test in energy/ strength of without Heat treatment work piece increase with the effect of tool rotation increase with high rpm tool rotation but after post weld heat treatment hardness increase with high rpm tool rotation compare than without heat treatment work piece .



VI.REFERENCES

1. "Effect of Post-weld Heat Treatment on Microstructure and Hardness Properties of Friction Stir Welded Industrial Aluminum", International Journal of Emerging Technologies and Innovative Research ISSN:2349-5162, Vol.6, Issue 5, page no.430-433, May-2019

2. A.P Reynolds, W.J. Arbegast et al., "Material Flow And Average Strain Rates In Friction Stir Welds", presented at the 11th Annual Advanced Aerospace Materials and Processes Conference and Symposium, ASM International, Seattle WA, March 14-15, 2000

3. W. J. Arbegast, Z. Li and P. J. Hartley, "Abnormal Grain Growth of Autogenous and Hybrid 2195 Friction Stir Welds", presented at 13th Annual Advanced Aerospace Materials and Processes Conference and Symposium, ASM International, Orlando, Florida, June 9-12, 2002

4. Asadi, P., Akbari, M., Besharati Givi, M.K., and Shariat Panahi, M., (2016), Optimization of AZ91 friction stir welding parameters using Taguchi method, *Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications*, Vol.230(1), pp.291–302.

5. Sanket V Bhosale, Vijay J Dhembare, Jaydeep M Khade" Effect of Post Weld Heat Treatment on Aluminium Alloys" International Journal of Innovative Research in Science,Engineering and Technology (Vol. 7, Issue 12, December 2018)