IJARESM
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING, SCIENCE & MANAGEMENT

EXPERIMENTAL ANALYSIS ON THE EFFECT OF TOOL ROTATIONAL SPEED ON WELDING STRENGTH IN FRICTION STIR WELDING ON AL ALLOY 6061 AND 8011.

Marathe Shalin P[1], Patel Ripalkumar C[2], Shah Jainam N[3], Patel Jaykumar N[4]
Assistant Professor, Mech. Eng. Dept., SNPIT & RC, / GTU, Umrakh / Bardoli, India[1].
Assistant Professor, Mech. Eng. Dept., SNPIT & RC, / GTU, Umrakh / Bardoli, India[2].
Research scholar, Mech. Eng. Dept., SNPIT & RC, / GTU, Umrakh / Bardoli, India[3]
Research scholar, Mech. Eng. Dept., SNPIT & RC, / GTU, Umrakh / Bardoli, India[4]

Abstract: ***This research deals with the experimental study of the tool rotational speed on the welding strength. For the welding purpose cylindrical pin tool has been selected and the two base plates has been selected namely as Al alloy 6061 and 8011. During the experiment the tool transverse speed is kept constant. For the welding vertical milling machine is used in which vertical downward force is kept constant. In order to determine the effect of tool rotation speed three different tool speed are taken as 1750, 2220 and 2720 rpm. As a result it has been found that s the tool rotational speed increases the welding strength increases and also it can be concluded that friction stir welding can successfully used to produce mechanically sound welds and defect free welds on aluminum alloys.***

Keywords: **Al alloy, friction stir welding, tool rotational speed, welding strength.**

INTRODUCTION

Friction stir welding (FSW) is a solid state joining process (the metal is not melted) that uses a third body tool to join two facing surfaces. Heat is generated between the tool and material which leads to a very soft region near the FSW tool.

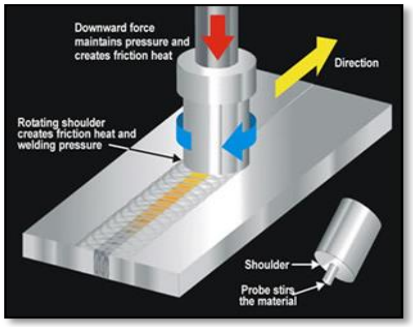

Figure 1 principle of operation

It then mechanically intermixes the two pieces of metal at the place of the joint, then the softened metal (due to the elevated temperature) can be joined using mechanical pressure (which is applied by the tool), much like joining clay, or dough. It is primarily used on aluminum, and most often on extruded aluminum (non-heat treatable alloys), and on structures which need superior weld strength without a post weld heat treatment.

It is invented at The Welding Institute (TWI) of the United Kingdom in 1991 as a solid-state joining technique. The conventional rotary friction welding process requires at least one of the parts being joined to be rotated and has the practical limitation of joining regular shaped components, preferably circular in cross-section and limited in their length. Short tubes or round bars of the same diameter are a good example. A constantly rotated non consumable cylindrical shouldered tool with a profiled probe is transversely fed at a constant rate into a butt joint between two clamped pieces of butted material. The probe is slightly shorter than the weld depth required, with the tool shoulder riding a top the work surface. Frictional heat is generated between the wear resistant welding components and the work pieces.

This heat, along with that generated by the mechanical mixing process and the adiabatic heat within the material, cause the stirred materials to soften without melting. As the pin is moved forward, a special profile on its leading face forces plasticized material to the rear where clamping force assists in a forged consolidation of the weld. This process of the tool traversing along the weld line in a plasticized tubular shaft of metal results in severe solid state deformation involving dynamic recrystallization of the base material.

LITERATURE SURVEY

Biswajit Parida *et al* .[1] have done development of friction stir welding (FSW) of commercial grade Al-alloy to study the mechanical and microstructural properties. **P. Cavaliere et *al*.**[2] studied the effect of welding parameters on mechanical and microstructural properties of AA6056 joints produced by Friction Stir Welding. **Ahmed khalidhussain *et al*.**[3] have done evaluation of parameters of Friction stir welding for Aluminium AA6351 alloy. **Indira Rani M. *et al.***[4] did study of process parameters of friction stir welded AA 6061 aluminium alloy in annealed and T6 conditions. **H.J. Liu *et al.***[5] studied tensile properties and fracture locations of friction-stir-welded joints of 2017-T351 aluminium alloy.**J. Kwon *et al.***[6] have done FSW of Aluminium to Magnesium-Dissimilar metal weld was performed. A maximum tensile strength of 132 MPa was obtained for a tool rotational speed of 100 RPM.**. Guo *et al.* [7] (2001)** Studied that the Dissimilar AA6061 and AA7075 alloy have been friction stir welded with a variety of different process parameters. In particular, the effects of materials position and welding speed on the material flow, microstructure, micro hardness distribution and tensile property of the joints were investigated. It was revealed that the material mixing is much more effective when AA6061 alloy was located on the advancing side and multiple vortexes centres formed vertically in the nugget. **Thomas (1997) *et al* .**[8] focuses on this study the relatively new joining technology, friction stir welding (FSW). Friction stir welding can be used to join most aluminum alloys and surface oxide presents no difficulty to the process. On the basis of this study it was recommend that number of lightweight materials suitable for the automotive, rail, marine and aerospace transportation industries can be fabricated by FSW. **M. Kimura *et al* [9].** used AA 7075 -T6 alloys that have been friction welded under different welding conditions. Appearances of welded surfaces have been researched upon and the mechanism of friction stir welding has been discussed. **Steurs *et al.***[10] have studied the effect of process parameters on residual stress during the friction stir processing of 5083 to 6082 Aluminium alloys.

EXPERIMENTAL WORK

The base plate of Al 6061 is taken as shown in figure 1 and tool made from H13- hot tool work steel is shown in figure 2.

Figure 2 Al alloy 6061 base plate

Figure 3 cylindrical pinned tool

Figure 4 vertical milling machine

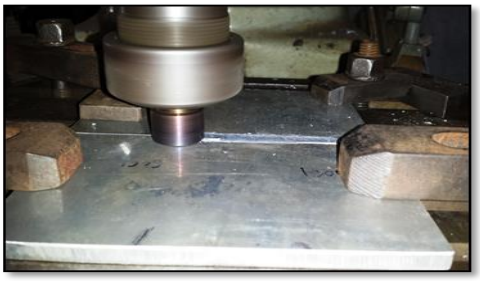

Figure 5 close up view of the welding

For the welding purpose vertical milling machine is used as shown in figure 3. During the welding the tool rotational aped is changed and the downward vertical force and the transverse speed of the tool is kept constant. The tool rotational speed is taken as 1750, 2220 and 2720 rpm.

Testing

After the welding has been completed, tensile test specimens are developed by machining process. Testing specimens are generated according to the ASME-IX. Figure 6 shows the welding plates and figure 7 shows the specimen to be tested.

Figure 6 welded plates

Figure 7 tensile test specimens

RESULTS

The tensile test results are shown in table 1. From the table it is clear that as we increases the tool rotational speed the tensile welding strength increases and that is true for both the base plate of aluminium alloy. The possible reason behind this results is that due the high tool rotational speed more friction is generated at the welding location. That leads to better joining of the two base plate increasing the welding strength. Furthermore study can be carried out to find out the tool tilt angle effect on the welding strength and also some other toll pin profiles can be experimentally studied.

Table 1 Tensile welding strength		
Aluminum Alloy	**Tool rotational speed (RPM)**	**Tensile welding Strength (MPa)**
6061	**1750**	**38.3**
6061	**2220**	**40.5**
6061	**2720**	**75.2**
8011	**1750**	**72**
8011	**2220**	**79**
8011	**2720**	**80.4**

References

[01] Biswajit Parida, Sukhomay Pal ,Pankaj Biswas, M. M. Mohapatra ,Sujoy Tikader," Mechanical And Micro-Structural Study Of Friction Stir Welding Of Al-Alloy" International Journal Of Applied Research In Mechanical Engineering (Ijarme), Issn: 2231 –5950 Volume-1, Issue-2, 2011

[02] P. Cavaliere , G. Campanile , F. Panella , A. Squillace ," Effect Of Welding Parameters On Mechanical And Micro structural Properties Of Aa6056 Joints Produced By Friction Stir Welding", Journal Of Materials Processing Technology 180 (2006) 263–270

[03] Ahmed Khalid Hussain, Syed Azam Pasha Quadri" Evaluation Of Parameters Of Friction Stir Welding For Aluminium AA6351 Alloy ",International Journal Of Engineering Science And Technology, Vol. 2(10), 2010, 5977-5984

[04] Indira Rani M. *et al.*did study of process parameters of friction stir welded AA 6061 aluminium alloy in annealed and T6 conditions

[05] H. J. Liu, H. Fujii, K. Nogi, Friction stir welding characteristics of 2017-T351 aluminium alloy sheet, JOURNAL OF MATERIALS SCIENCE 40 (2005) 3297 – 3299

[06] J. Kwon *et al* have done FSW of Aluminium to Magnesium-Dissimilar metal weld was performed.A maximum tensile strength of 132 MPa was obtained for a tool rotational speed of 100 RPM.

[07] R.L. Goetz, K.V. Jata, in: K.V. Jata, M.W. Mahoney, R.S. Mishra, S.L. Semiatin, D.P. Filed (Eds.), "Friction Stir Welding and Processing", TMS, Warrendale, PA, USA, 2001,pp.35.

[08] W.M.THOMAS, NICHOLAS, E.D., WATTS, E.R., STAINES,D.G., Friction Based Welding Technology for Aluminium. In Materials Science ForumVols. 396-402, Trans. Tech. Publ.,Switzerland, s., 2002, pp. 1543-1548.

[09] A. Heinz a, A. Haszler," Recent development in aluminium alloys for aerospace applications", Materials Science and Engineering A280 (2000), pp.106.

[10] T4 S.T. Amancio-Filho, S. Sheikhi,J.F. dos Santos, C. Bolfarini. Preliminary study on the microstructure and mechanical properties of dissimilar friction stir welds in aircraft aluminium alloys 2024-T351 and 6056- journal of materials processing technology 206(2008),pg. 132–142.

