



Discussion on Tensile Test of Friction Welded Specimen of Aluminum Alloy (AA6063T6) and Stainless Steel (SS304)

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Abstract: Friction welding is a fairly recent technique in which frictional heat is generated to carryout plastic deformation at the welding location, there by affecting the formation of a joint while the material is in solid state. The principle advantage of friction welding, being a solid state process, low distortion and high joint strength, even in those alloys that are considered non weldable by conventional welding technique. A lathe machine is used to join aluminium(AA6063t6) and stainless steel(SS304).A digital vernier calliper to measure the burn off length. In this experiment two parameters were fixed and three parameters were varied. Fixed parameters were: length and diameter of specimen i.e 80mm and 12.5mm respectively. Varied parameters were: weld time. RPM and burn off length. Total no. of experiments were 8 . Total tests conducted on the job were: tensile strength. In this paper we have studied the mechanical behavior of friction welding of aluminium and stainless steel alloy.

I. INTRODUCTION

Friction welding is a high speed process suited to production welding. However initial trials are required to standardize the process parameters for a given job. Typical applications of the process include welding of drill bits to shanks, i.e engine valves head to stems, and automobile rear axle hub end to axle casing. Friction Welding (FRW) is a solid state welding process which produces welds due to the compressive force contact of work pieces which are either rotating or moving relative to one another. Heat is produced due to the friction which displaces material plastically from the faying surfaces. In friction welding the heat required to produce the joint is generated by friction heating at the interface. The components to be joined are first prepared to have smooth, circular surfaces. One piece is held stationary while the other is mounted in a motor driven chuck or collet and rotated against it at high speed. A low contact pressure may be applied initially to permit cleaning of the surfaces by a burnishing action. This pressure is then increased and contacting friction quickly generates enough heat to raise the abutting surfaces to the welding temperature.

As soon as this temperature is reached, rotation is stopped and the pressure is maintained or increased to complete the weld. The softened material is squeezed out to form a flash. A forged structure is formed in the joint. If desired, the flash can be removed by subsequent machining action.

II. EXPERIMENTAL SETUP

For doing friction welding vertical milling machine and lathe machine both can be used. The joining of Al6063t6 and SS304 is obtained by using lathe machine at different r.p.m.

1. **Lathe machine:** This machine is used to weld aluminium and stainless steel with help of friction generated in between these alloys.
2. **Stop watch-** Stop watch was also used to note down the weld time during friction welding.
3. **Vernier calliper:** This was used to note down the burn off length during welding.

III. SPECIMEN SPECIFICATIONS

The following are the specifications which will be used:

- Length of specimen : 80mm (each)
- Diameter of specimen : 12.5mm

Two cylindrical specimens of same size 80 mm lengths & 12.5mm diameter were used

For friction welding we put facing operation both on the aluminium & stainless steel specimen. Chamfering on aluminium is done and drilling in the stainless steel specimen.



Fig. – Specimen

Chemical Composition:

The following tables show the composition of base materials.

Sr. no	Elements	Observation (% Weight)
1	Copper	0.1
2	Magnesium	0.75
3	Silicon	0.9
4	Iron	0.35
5	Manganese	0.1
6	Zinc	0.1
7	Titanium	0.1
8	Chromium	0.1
9	Aluminium	97.5

Table 1: Chemical composition of Aluminium (AA6063T6)

Sr. no.	Elements	Observation (%)
1	Nickel	10
2	Silicon	0.38
3	Manganese	1.67
4	Phosphorus	0.045
5	Chromium	18.2
6	Sulphur	0.03
7	Carbon	0.054

Table 2: Chemical composition of Stainless Steel (SS304)

IV. RESULTS

Tensile strength test was carried out at CITCO-IDFC TESTING LABORATORY situated in industrial phase-1 Chandigarh (India).

Sample No.	Various parameters			UTM results	
	R.P.M.	Area (mm ²)	Weld Time	Tensile Strength	Diameter at Interface
1	900	96.459	45	0.155	11.08
2	1500	109.774	30	0.174	11.82
3	1400	106.456	29	0.203	11.64
4	700	113.898	49	0.125	12.05
5	1800	106.091	25	0.183	11.62

V. CONCLUSIONS

- 1) Friction welding has been successfully employed to weld dissimilar metals.
- 2) During tensile testing, high UTS was observed in sample no. 3 manufactured at 1400 rpm having burn off length 8mm, welded in 29 seconds.
- 3) It is concluded from the experiment that more tensile strength is obtained at 1400 rpm. Beyond this value the tensile strength decreases. Also the samples prepared at rpm of less than 1000 rpm has poor tensile strength.

REFERENCES

- [1]. Ching-yu Yang, Inverse determination of heat input during the friction stir welding process; International Journal of Heat and Mass Transfer 76 (2014) 411–418
- [2]. W.Y. Li, T. Fu, L. Hütsch, J. Hilgert, F.F. Wang, Effects of tool rotational and welding speed on microstructure and mechanical properties of bobbin-tool friction-stir welded Mg AZ31; Materials and Design 64 (2014) 714–720
- [3]. S. Papaefthymiou, C. Goulas, E. Gavalas; Micro-friction stir welding of titan zinc sheets; Journal of Materials Processing Technology 216 (2015) 133–139

- [4]. Hazman Seli, Ahmad Izani Md. Ismail, Endri Rachman, Zainal Arifin Ahmad, Mechanical evaluation and thermal modeling of friction welding of mild steel and aluminum, *Journal of Materials Processing Technology*, Volume 210, Pg 1209-1216, March 2010.
- [5]. Hyung-Seop Shin, Jung-Soo Park, Yoon-Chul Jung, Jung-Ho Ahn, Yoshihiko Yokoyama, Akihisa Inoue, Similar and dissimilar friction welding of Zr-Cu-Al bulk glassy alloys, *Journal of Alloys and Compounds*, Volume 483, Pg 182-185, July 2008.
- [6]. Hyung-Seop Shin, Young-Jin Jeong, Ho- Yeon Choi, Hidemi, Kato, Akihisa Inoue, Joining of Zr-based bulk metallic glasses using the friction welding method, *Journal of Alloys and Compounds*, Volume 434-435, Pg 102-105, October 2006.
- [7]. I. Mitelea, C.M. Craciunescu, Parameter influence on friction welding of dissimilar surface-carburized/volume-hardened alloyed steels, *Materials and Design*, Volume 31, Pg 2181-2186, October 2009.
- [8]. Jolanta Zimmerman, Wladyslaw Wlosinski and Zdzislaw R. Lindemann, Thermo-mechanical and thermal modelling in the process of ceramic-metal friction welding, *Journal of Materials Processing Technology*, Volume 209, Issue 4, Pg 1644-1653, February 2009.