

Investigation on Friction Welding of Al 2025 Tube with Aluminium Plate

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ABSTRACT

In the past couple of many years, the field of erosion welding advancement has been seeing significant updates. Welding method is a significant metal creation measure that has shifted a few modern areas, for example, Aviation, Vehicle and Boilers and so on. These materials were utilized in aviation radiator motor. Friction welding is generally utilized as a small scale manufacturing strategy in different industries. A test set-up was planned to accomplish friction welding of plastically twisted AL 2025 prepares. In this investigation, composite steel (AL 2025) was welded under various welding boundaries. Later the mechanical properties, such as hardness test and compressive test were conducted. Based on the outcomes got from the experimentation, the most influential factor has been determined.

KEYWORDS

Friction Welding, AL2025, Mechanical Properties.

Introduction

Joining of metals is maybe the most key necessities of ventures. There are extreme necessities of the current creation industry premium, the usage of canny materials and philosophy isolated from quality and prosperity standards. Rubbing welding is one of the versatile and grounded welding estimates that are good for giving extraordinary quality welds; it gives solid state joining of the materials through the controlled scouring of the interfaces [1]. As a result of in this manner made warmth smooth the material and conveyed the limited faces into the plasticized structure which achieves incredible quality welds [2]. In this cycle heat energy is made by the bury conversion of mechanical energy into atomic force at the interfaces of the scouring parts [3]. Hardness assessments address maybe the most beneficial methodologies for quality affirmation in the field of mechanical depiction of materials. Due to its ease and its smartness of execution, Rockwell hardness test is the most extensively used [4]. The principle property in aluminium combination is the strength of the last section, which is dependent on the mechanical properties [5]. In the current assessment, composite steel (AL 2025) was welded under different welding limits and from that point the mechanical properties like hardness test and compressive test were directed. In view of the outcomes obtained from the experimentation, the graph was plotted.

Materials and Methodology

The examination was directed to using AL 2025 cylinder plate and business aluminium tube. The compound amalgamation of the AL 2025. The AL 2025 was cut into the important size (50mm x 50mm) using shear shaper machine. The chamber outside estimation 18.8 mm and inward width 14.8 mm were cut into various lengths such as 29 mm, 30 mm and 31 mm tube and each 3 pieces in without opening [WoH] independently. The 2 mm expansiveness openings were entered on the chamber outer surface. By then, sensible openings as shown by the chamber expansiveness were exhausted in the point of convergence of the plate. The using of moving square in the FWTPET cycle to leads as a disfigurement free welding joint, higher strength and less mutilation. The gathered work piece was fixed on the machine table with the help block establishments, and the device was fixed in the shaft. Mechanical assembly made of equipment steel were used to produce FWTPET joints in this assessment, and the engineered construction of equipment material.



Fig. 1.Without Hole Tube



Fig. 2.Tube Plate



Fig.3. After Welding Process

Experimental Details

A.Friction Welding Process

An in-house made FWTPET course of action used in the current assessment and the FWTPET machine contains equipment holder, shaft, table and supporting plan. The gadget is brought down during upheaval, and warmth is created considering contact when the shoulder contacts the parent material and warmth made on the top surface of the chamber plate separately. The surge of metal occurs towards the point of convergence of the instrument center.

The metal courses through the openings in the chamber and includes the opening between instrument pin and inner estimation of the chambers. The get-together of the work piece was welded in different blends and different limits using L9 even bunch.

Table 1.Chemical Composition for Al 2025

	Mg	Cu	Si	Mn	Fe	Al
Wt%	0.898	0.152	0.432	0.039	0.210	98.13
Ca	Ti	Zn	Cr	Ni	Sn	Pb
0.013	0.065	0.000	0.057	0.002	0.002	0.001

Table 2.Chemical Composition for tool material

	Mn	Cr	Mo	V	C	Si	Ni	W
Wt%	0.36	3.71	4.31	2.05	0.87	0.30	0.31	0.95

B.Compression Test

The test is all things considered situated in two plates that scatter the applied weight across the entire surface zone of two backwards faces of the test and a while later the plates are moved together by a far and wide test machine making the model level. A pressed model is normally abridged toward the applied powers and develops toward the way inverse to the force. A pressing factor test is fundamentally something in spite of the more typical strain test. To play out a pressing factor test, a model is stacked into a pressing factor analyser with a pressing factor mechanical assembly and a load is applied and is essentially crushed until disillusionment.

Table 3.Levels and factors

Factors	Levels				
	1	2	3	4	5
Projection in mm	0	0.5	1	1.5	2
Depth of Cut in mm	0.25	0.5	0.75	1	1.25
Pin Length in mm	4	6	8	10	12
Tool Shoulder Diameter in mm	12	14	16	18	20
Speed in rpm	600,800				

C.Hardness Test

A hardness test is ordinarily performed by crushing an expressly dimensioned and stacked article (indenter) into the outside of the material you are attempting. The hardness is directed by assessing the significance of indenter penetration or by assessing the size of the impact had by an indenter.

Hardness is estimated for the various zones, for example, base metal tube, Heat influenced zone close to tube, weld interface, base metal cylinder plate, Warmth influenced zone close to tube plate.

Results and Discussions

A. Compression Test

The speed versus pressure strength plots at 600,800 rpm are appeared in figure 4.It demonstrates which one have the high pressure strength and high hardness are appeared in table 4.

Table 4.Input and output process

Speed rpm	Projection mm	Depth of Cut mm	Pin Length mm	Tool Shoulder Diameter mm	Compression Strength MPa	Hardness Hv
600	0	0.25	4	12	2731.22	249.18
600	0.5	0.5	6	14	2744.32	250.94
600	1	0.75	8	16	2757.42	252.71
600	1.5	1	10	18	2770.52	254.47
600	2	1.25	12	20	2783.62	256.24
800	0	0.5	8	18	2713.1	231.77
800	0.5	0.75	10	20	2726.2	233.54
800	1	1	12	12	2745.4	237.58

800	1.5	1.25	4	14	2723.4	237.13
800	2	0.25	6	16	2734	237.41
Larger is Better					2783.62	256.24

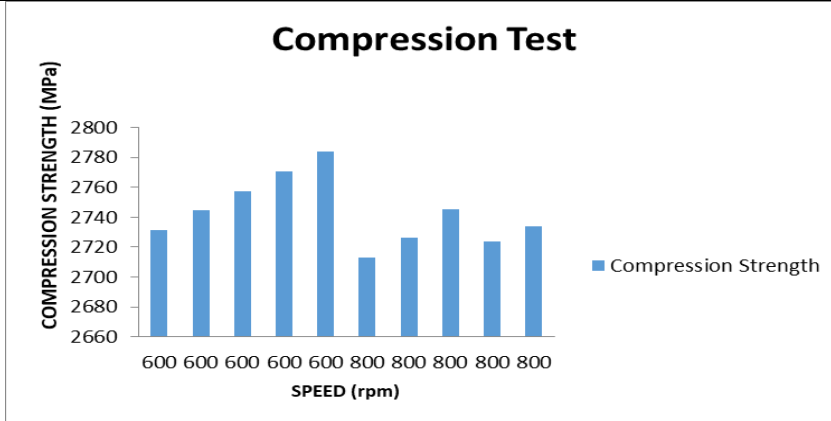


Fig. 4. Speed vs compression strength

B. Hardness Test

The assortment of Rockwell hardness on C scale (HRC) at the weld interface and away from the point of convergence of weld interface of models, grinding welds orchestrated. Figure 5 shows, which one has the high hardness metal tube and metal tube plate.

Table 5. Reading can be taken from hardness test

Sample No	Base Metal – Tube	HAZ	Weld Interface	HAZ	Base Metal – Tube Plate
1	221.37	231.98	249.18	233.58	228.98
2	223.13	233.74	250.94	235.34	230.74
3	224.9	235.51	252.71	237.11	232.51
4	226.66	237.27	254.47	238.87	234.27
5	228.43	239.04	256.24	240.64	236.04
6	220.96	214.57	231.77	216.17	211.57
7	215.73	216.34	233.54	217.94	213.34
8	209.77	220.38	237.58	221.98	217.38
9	209.32	219.93	237.13	221.53	216.93
10	209.6	220.21	237.41	221.81	217.21

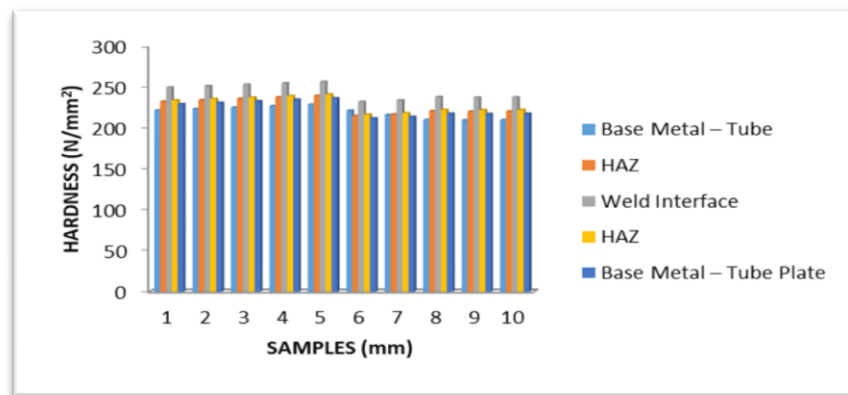


Fig. 5. Hardness test

Conclusion

In this study investigation has been conducted with several samples have a various parameters of Friction Welding. The results shows clearly among all the samples the larger pin and shoulder dimension sample having significant compression strength and hardness. This investigation concluded the larger sample is the better. In further investigation a significant change in the dimension and tool material preparation may provide better improvements and the structure analysis will be included.

References

- [1] Meshram SD, Mohandas T and Reddy GM 2007 Friction welding of dissimilar pure metals. *Journal of Materials Processing Technology* 184: 330–337.
- [2] Sahin M 2009 Characterization of properties in plastically deformed austenitic-stainless steels joined by friction welding. *Materials and Design* 30: 135–144.
- [3] Sahin M, Akata HE and Gulmez T 2007 Characterization of mechanical properties in AISI 1040 parts welded by friction welding. *Materials Characterization* 58: 1033–1038.
- [4] Giulio Barbato, Maurizio Galetto, Alessandro Germak and Fabrizio Mazzoleni in influence of the indenter shape in Rockwell hardness test.
- [5] P. Jonsén, H.-Å. Häggblad, K. Sommer in Tensile strength and fracture energy of pressed metal powder by diametral compression test.
- [6] Arivazhagan N, Singh S, Prakash S and Reddy GM 2008 An assessment of hardness, impact strength and hot corrosion behavior of friction-welded dissimilar weldments between AISI 4140 and AISI 304. *Inc. Adv. Manuf. Technol.*, 39: 679–689.
- [7] C.V.Kumar, S.Muthukumar, A.Pradeep, S.S.Kumaran.Optimization study of friction welding of steel tube to aluminium tube plate using an external tool process. *International Journal of Mechanical and Materials Engineering [IJMME]*, vol.6 (2011), No.2, 300-306.
- [8] Ates H, Turker M and Kurt A 2007 Effect of friction pressure on the properties of friction welded MA956 iron-based super alloy. *Materials and Design* 28: 948–953.
- [9] Meshram SD, Mohandas T and Reddy GM 2007 Friction welding of dissimilar pure metals. *Journal of materials Processing Technology* 184: 330–337.
- [10] S.Senthilkumaran, S.Muthukumar, and Chandrasekhar Reddy. Effect of tube preparations on joint strength friction welding of tube to tube plate using external tool.*Experimental Techniques*,DOI:10.1111/j.1747-1567.2010.00700.x
- [11] Sahin M, Akata HE and Gulmez T 2007 Characterization of mechanical properties in AISI 1040 parts welded by friction welding. *Materials Characterization* 58: 1033–1038.
- [12] M.K. Fahad, Stresses and failure in the diametral compression test, *Journal of Materials Science* 31 (1996) 3723–3729.