Mechanical Behaviour of Composite Weld Of LM 25/ Sic$_{P}$ by Friction Welding

R J Golden Renjith Nimal, Vivekanand Kumar, Abdul Majid, V Manikanta Raju, Zameerul Haque

ABSTRACT

In this competitive world, the customers perceive the most reliable high quality. Friction welding famously abbreviated FW is one of the most important metals welding process in manufacturing industries. The various process parameters that influence the weld quality are speed, forging pressure, friction pressure, forging time, friction time. Here in our project we have conducted the experiment with the composite material of LM25/SiC by varying different parameters. The friction Welding process is a kind of solid-state welding process. The solid-state welding process is the way toward joining two metals in temperature beneath the liquefying point without the expansion of filler material. Aluminum compound (LM25) and SiC have been picked as a matrix and reinforcement material individually. Stir casting is made by adding 20% of SiC with LM25 respectively. After casting, the composite is made as rod based on ASTM standards and microstructure analysis is done to identify distribution of particles. Frictions welding on composite rods (20mm diameter and 95mm length) with various speeds are done the micro structure and mechanical behaviours are studied at the weld zone. The result show that the tensile strength and hardness at the weld spot is high at the rod welded at 2000 rpm speed.

Keywords: LM25/SiC; FW- Friction Welding; tensile strength

I. INTRODUCTION

A technique for working on a workpiece contains offering a test of material harder than the workpiece material to a nonstop surface of the workpiece causing relative cyclic development between the test and the workpiece while encouraging the test and workpiece together whereby frictional welding is produced.

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The test enters the workpiece in order to make a plasticized locale in the workpiece material around the test, ceasing the relative cyclic development, and enabling the plasticized material to cement around the test.

This strategy, which we allude to as "friction welding" gives an exceptionally straightforward technique for joining a test to a work piece. The strategy can be utilized for fixing splits and so forth inside a work piece or for joining individuals, for example, studs or brambles, to a work piece. Another part of the innovation contains causing a test of a material harder than the workpiece material to enter the joint district and restricted segments of the workpieces on either side of the joint. Contact welding is a sort of fashion welding, for example, welding is finished by the utilization of weight. Grating produces heat, if two surfaces are scoured together, enough warmth can be created and the temperature can be raised to the dimension where the parts exposed to the friction might be intertwined.

In conventional friction welding, relative rotation between a pair of work pieces is caused while the work pieces are urged together. Typically thereafter once sufficient heat is built at the interface between the work pieces, relative rotation is stopped and the work pieces are urged together under forging force which may be same as or greater than the original urging force."Friction Welding" (FW) is a group of solid-state [welding] processes using heat generated through mechanical friction between a moving work piece, with the addition of an upsetting force to plastically displace material. Many dissimilar metal combinations can be joined and there are a number of process parameters including: speed, friction time, forging time, friction pressure, forging pressure, etc.

II. LITERATURE REVIEW

M N Ahmad Fauzii his investigation says that the fortified alumina-6061 aluminum tests are produced by shifting the rotational speed however keeping consistent the grating weight and contact time.it is established that the welded locales have three unique districts unaffected zone, deformed zone, and completely distorted zone.

EmelTaban in his investigation says that Inertia weld has been utilized to join two different materials they are a 6061-T6 aluminum amalgam and AISI 1081 steel. The joints are assessed utilizing mechanical testing and metallurgical investigation. The outcomes uncover that joint qualities on the request of 250 Mpa could be accomplished. Bond lines were portrayed by a slight layer of Al-Fe intermetallic. This intermetallic layer found the middle value of approximately 250 nm thick.

Wei Guo is his study prepared a sample with two dissimilar materials 7A04 aluminium alloy and AZ31 magnesium alloy and investigated the microstructure and mechanical properties of joints. He found that large amount of micro cracks were generated in the formed interlayer. He found the inter metallic layer decreased significantly with increasing friction pressure. The tensile strength of the joints increases remarkably with increasing friction pressure.

Kimura M carries a study on friction welding of two dissimilar metals AA 6063 and AISI 304. This study says about the effect of fiction welding condition on joining phenomenon, tensile strength and bend ductility of friction welded joints.

Osman Torun caries an investigation on the impact of welding parameters on microstructure and mechanical properties of cast Fe-40Al composite. The examination is done for fixed speed of 1000 rpm for different grinding times, rubbing weights and fashioning weights. Micrographs exhibited that brilliant welding shaped ceaselessly along the interface aside from tests welded for 3s. Test outcomes demonstrated that the most extreme shear quality was 469.5 MPa.

III. EXPERIMENTAL ANALYSIS

A. Aluminium Alloy Lm25

Table 3.1 Chemical composition of LM25

Element	% Present
Copper	0.1max.
Magnesium	0.20-0.60
Silicon	6.5-7.5
Iron	0.5 max.
Manganese	0.3 max
Nickel	0.1 max.
Zinc	0.1 max.
Lead	0.1 max.
Tin	0.05 max.
Titanium	0.2 max.
Aluminum	Remaining

The basic elemental properties and its mechanical properties are very important consideration in the case of welding a material using friction welding technique as it is a solid state welding.

Table 3.2 shows the properties of LM 25.

Property	Value
Density	2670 kg/m^3
Melting Point	615^{o}c
Elastic Modulus	71GPa
Tensile Strength	280MPa
Percentage Of Elongation	5%
Hardness	120 BHN

B. WELDING PARAMETERS OF FRICTION WELDING

The principal factors in direct drive contact welding are the rotational speed, the pivotal powers and the welding time. These factors decide the measure of vitality presented in the weld zone and the rate of warmth age at the interface. It is to be noticed that the warmth age rate isn't steady over the weld interface and that it likewise shifts amid the distinctive phases of the welding cycle. The welding parameters are

- Rotation speed
- Forging pressure (MPa)
- Friction time

Rotation Speed

Friction welding is a technique in which rotating speed as a result of warmth for welding is conveyed by the direct transformation of mechanical energy to thermal energy at the interface of the workpieces.

Forging Pressure

American Welding Society (AWS) as a solid-state welding process that makes a weld under compressive power (forging pressure) contact of workpieces rotating or moving concerning each other to convey heat and plastically indicates material from the faying surfaces. The joint quality expanded and afterward diminished in the wake of achieving most extreme esteem, with expanding upset pressure and upset time.

Friction Time

A longer upset time caused the surplus piercing into a smooth metal material forming the associate intermetallic layer. However, a number of the welds showed poor strength counting on some accumulation of alloying components at the interface, that area unit the results of temperature rise and also the existence of intermetallic layers like FeAl.

Table 3.4 Friction Welding Parameters

Parameters	Specimen Samples		
	S1	S2	S3

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Rotational Speed (rpm)	1600	1800	2000
Forging Pressure (Mpa)	60	90	120
Friction Time(seconds)	26	35	15

IV. RESULTS AND DISCUSSION

A. Microstructural Analysis

The microstructural property such as SEM image at the cross section of the weld zone is evaluated. EDX graph was studied to conform, the nearness of SiC particles in LM25/SiC composite.

4.1.1 Evaluation of EDX Test

The optical photomicrograph of the made LM25/SiC has shown up in fig.4.1 It is seen from the supposition that SiC particles are dispersed reliably in the aluminum structure at all weight rate which may be a result of the proportional estimation of the thickness of system and bolster material causing the atom neither float nor not all that awful in the mix. The degree of the SiC particles emits an impression of being uniform all through the aluminum system. This can be credited to ground-breaking blending action. Homogeneous allocation of particles is fundamental to overhaul the mechanical properties of the cross-section composite.

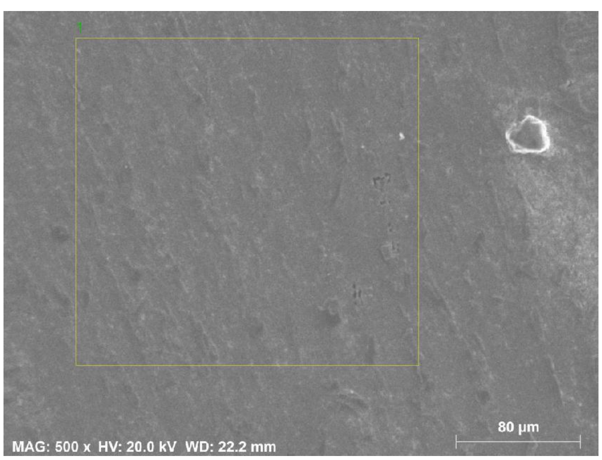

Fig. 4.1 Microscopic view of LM25/SiC

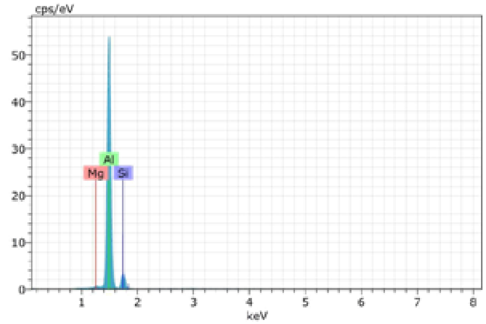

Fig. 4.2 Result of EDX

Table 4.1 Weight % of element

Element	Wt. %
Mg	0.64
Al	87.12
Si	12.24

B. Evaluation of SEM

The SEM image of the composite bar at the weld cross region was considered and the SEM picture reveals that the homogeneous dispersing of SiC particles in the grid. In any case, in some zone, avoid a course of action happened due to the closeness of visitor inside the cast. In the midst of the solidifying of composite the aluminum dendrites bond first and the particles expelled by the solid-liquid interface.While comparing the above specimen results shows that the presence of SiC is greater in the specimen S3 than the other specimens. Hence the welded specimen S3 is stronger than the other specimens.

Table 4.2 Observed values of tensile test

SI. No.	**Specimen**	**Ultimate Tensile Strength (UTS) MPa**
1	S1	46
2	S2	65
3	S3	74

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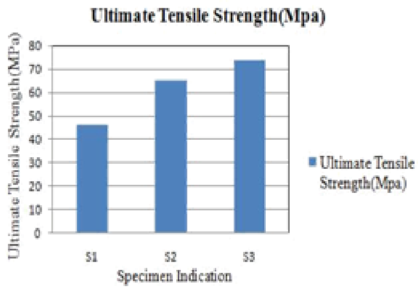

It is observed from the graph that the friction welded joint at 2000rpm produce maximum tensile strength at the weld zone.

V. CONCLUSIONS

The LM25/SiC composite was produced by stir casting method. 20% of SiC is added to LM25 to form composite. The friction welding was carried out on the composite rod in the friction welding machine. The mechanical properties like hardness and rigidity were assessed and furthermore, microstructural examinations were completed. From this examination, the accompanying ends are inferred.

- ✓ Production of LM25/SiC composites was effectively done by the blend throwing technique.
- ✓ Particles are consistently disseminated in the framework.
- ✓ Welding of LM25/SiC composite rods was successfully done by friction welding.
- ✓ Tensile test was carried out successfully.
- ✓ Tensile strength at the weld zone increases as the rotational speed increases.
- ✓ Vickers hardness test at the weld zone and casted rod was carried out successfully.
- ✓ Hardness at the weld zone and they gave pole builds a role as the rotational speed increments.

REFERENCES

1. R. Hariharan and R.J. Golden Renjith Nimal'Friction Stir Welding Oof Dissimilar Aluminum Alloys (6061&7075) By Using Computerized Numerical Control Machine'Middle-East Journal of Scientific Research 20 (5): 601-605, 2014.

2. R.J. Golden Renjith Nimal and R. Hariharan 'A STUDY OF Aluminum and MAGNESIUM ALLOY WITH INTERLAYER USING DIFFUSION BONDING'International Journal of Pure and Applied Mathematics, Volume 116 No. 14 2017, 525-531.

3. S Rajakumar S., Muralidharan C., Balasubramanian V. (2011). 'Influence of friction stir welding process and tool parameters on strength properties of AA7075-T6 aluminium alloy joints' Materials and Design 32: 535– 549.

4. Thomas J., Ragavi B.S., Raneesha P.K., Ahmed N.A., Cynthia S., Manoharan D., Manoharan R., "Hallermann-Streiff syndrome", Indian Journal of Dermatology, ISSN : 0019-5154, 58(5) (2013) pp.383-384.

5. Subhashini V., Ponnusamy S., Muthamizhchelvan C., "Growth and characterization of novel organic optical crystal: Anilinium d-tartrate (ADT)", Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy, ISSN : 1386-1425, 87() (2012) pp.265-272.

6. Cavalierea P., Squillace A. (2005). 'High temperature deformation of friction stir processed 7075 aluminium alloy.' Materials Characterization 55: 136– 142.

7. Lorenzo H.Mancini , Nanocomposite – preparation,properties and performance-Nova publishers Inc., (2008), 1-282 .

8. Houyem Abderrazak - Silicon Carbide: Synthesis and Properties in techopen (2008).

9. Saad Ahmed Khodir and Toshiya Shibayanagi, "Dissimilar Friction Stir Welded Joints Between 2024-T3 Aluminum Alloy And Az31 Magnesium Alloy", Materials Transactions, Vol. 48, No. 9, pp. 2501-2505, 2007.

10. Hariharan V.S., Nandlal B., Srilatha K.T., "Efficacy of various root canal irrigants on removal of smear layer in the primary root canals after hand instrumentation: A scanning electron microscopy study", Journal of Indian Society of Pedodontics and Preventive Dentistry, ISSN : 09704388, 28(4) (2010) pp.271-277.

11. J. Babu Rao - Production of nano structured silicon carbide by high energy ball milling - International Journal of Engineering, Science and Technology – (2011) - 82-88.

12. Katarzyna Szot - Electrodes modified with carbon nanoparticles and enzymes - institute of physical chemistry polish academy of sciences – 2012M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989