JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Tribological Behaviour of Aluminium 6063/SiC Metal Matrix Composites (MMC) Under Different Load and Time.

Om Prakash Sondhiya[1] and Sourabh Chourey[2 *]

[1]Assistant Professor, [2]P.G. Scholar

[1,2]Department of Mechanical Engineering IET-DAVV, Indore, India.

*Corresponding author: Address- IET- DAVV Indore, (M.P)-452001. Email: sourabh1117@gmail.com

Abstract.

Aluminium 6063 metal matrix composites play a significant role in automobile, aerospace, and research industries like Defence Research and Development Organization (DRDO) because of their low ductility, higher strength, and modified tribological properties. This experiment investigated the effect of normal load and time. This experiment is conducted under three different loads 10 N, 15 N, 20 N, and time 1 min, 2 min, 3 min under ambient temperature and pressure. For different conditions, the graph is plotted between load vs. wear. Also one is comparative experiment is done between Brass and Mild Steel to check its wear vs. load behaviour. The experimental results revealed controlling friction and wear rate of aluminium- based composites. The friction and load are taken in newton whereas the wear in micrometer for this experiment. This experiment was carried out in a pin on a disc tribometer available in our institute under unlubricated conditions. The analysis can be used to predict the tribological properties of Al- 6063 MMC in engineering applications and can be used in various industries.

Keywords: Aluminium Metal Matrix Composite, Friction, Wear, pin on disc tribometer.

1. INTRODUCTION.

Composites with metal matrix (MMC) are material which possesses excellent possibilities for development and contemporary material sciences. Lately, especially particle reinforced aluminium matrix composites, attract a- considerable amount of attention because they have the potentials of satisfying the recent demands of advanced engineering application such as aerospace and automobile industries.

Specific aluminium alloy has good mechanical properties, but poor tribological characteristics. Improvement of the tribological characteristics of those lightweight materials is done by the development of corresponding composites materials. Typically example of those materials is Al-Si alloy (A6063).

Al alloy was classified as 1XXX to 8XXX series concerning the composition of major alloying elements. Each series have different mechanical properties and physical characteristics. In the past three decades, researchers have shown their interest in those materials and are attempting to enhance their properties to make them suitable for use in complex areas. Aluminium matrix composites reinforced many SiC for different application have been done by many researchers.

Aluminium alloy with composite material is mostly fabricated by casting and powder metallurgy strategies. The casting methods include stir casting, compo casting, squeeze casting, spray casting and ultrasonic-assisted casting. Likewise, powder metallurgy methods include powder metallurgy (PM) processing, vapour deposition and diffusion bonding techniques. Among all processes, the stir casting method is relatively simple and less expensive as compared to other processing methods.

2. MATERIAL SELECTION.

As the base for metal matrix composite, hypoeutectic Al-Si alloy A6063 is used. Aluminium 6063 alloy has higher strength, modified thermal properties and tribological and corrosion resistance. The chemical composition of the Al 6063 composite is given in **Table 1**. The commercial Al alloy 6063 brought from Bombay hardware Indore **Fig 1.** The material is cut into the desired length of 30 mm and machined to a 6 mm diameter as shown in **Fig 2.**

Table 1. Chemical composition (wt%) of A6063 aluminium alloy.

Element	Si	Cu	Mg	Mn	Fe	Zn	Cr	Ti	Al
Percentage	0.5	0.1	0.45	0.1	0.35	0.1	0.1	0.1	balance

Fig 1. Al6063 Specimen.

Fig 2. The Specimen is cut as per machine standards.

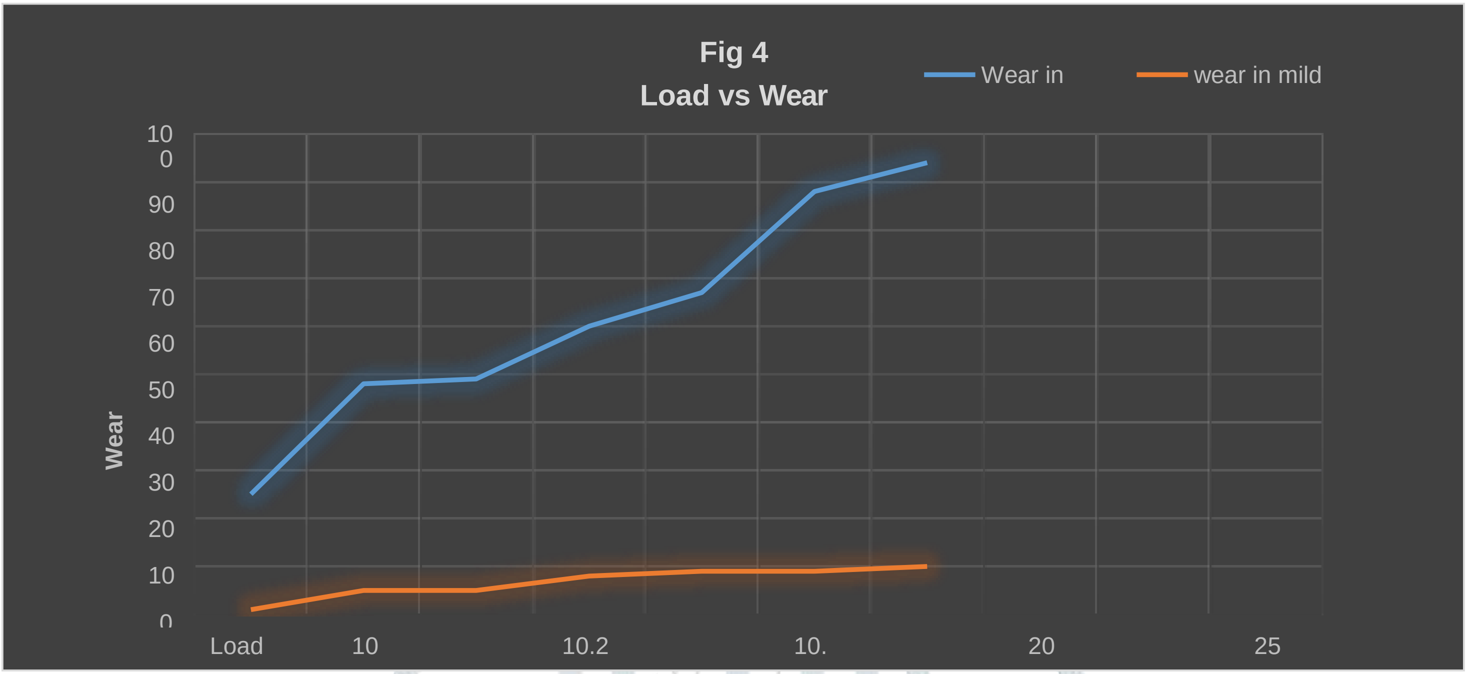
3. WEAR ANALYSIS.

Tribological tests are done on Pin on Disc tribometer as shown in **Fig 3** following ASTM G99 standard. Samples are of 6mm diameter rod having 30 mm in length, whereas the counter body discs of 50 mm in diameter were made of steel 90MnCrV8 with the hardness of 62-64 HRC. It has a sliding velocity of 1.5 m/s. a weight loading system was used to apply a load of 10 N, 15 N, 20 N on the pin against the disc. The disk rotates horizontally and thoroughly wiped by cotton material and confirmed that the specimen was not lubricated and debris formed was not eliminated. In the machine, there is an arrangement to adjust the time according to operator requirement so we change time to take different readings. The time we take here is 1 min, 2 min, 3 min.

An LVDT (linear variable differential transducer) shown in on the lever arm helps to determine the wear at any point in time by monitoring the movement of the arm. Once the surface in contact wears out, the load pushes the arm to remain in contact with the disc. This movement of the arm generates a signal which is used to determine the maximum wear and the coefficient of friction are monitored continuously as wear occurs.

Fig 3. Pin on Disc Tribometer.

4. Comparative Experimental and Wear Behaviour of Brass and Mild Steel



In an experiment analysis, it has been seen that the brass wear was increasing linearly and in mild steel, the wear was increasing at starting and remains constant with the increment of load as shown in **Fig 4**. It is clear from figure 5 that Mild Steel has less wear rate as compared to brass and mild steel as it developed a protective layer in atmospheric condition. The wear rate increases with the increase in disc speed and load but the variation with load is more sudden. The major amount of wear occurs due to the sticking of the material due to the heat generated at the frictional contact.

5. RESULT and DISCUSSION.

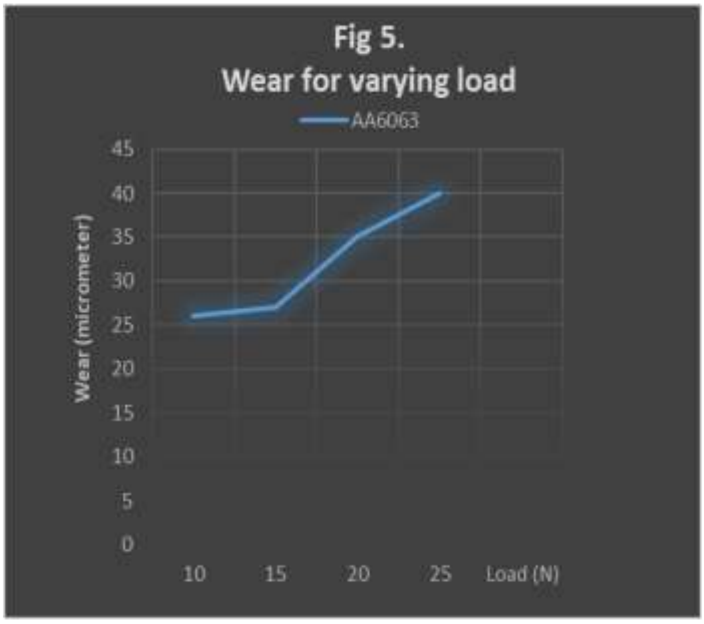
A pin-on-disc test apparatus was used to determine the sliding wear characteristics of the hybrid composite. The tribological tests are carried out on pin-on-disc testing machine ED-201(Ducom, India) under dry non-lubricated condition and at ambient temperature (30 C). The configuration of the testing machine has an EN-32 steel disc. The composite samples having a dimension of 12 mm diameter and 30 mm length are pressed against a rotating steel disc of hardness 65HRC. The track diameter was 50 mm and parameters such as the load and time were varied in the range as shown in **Table 2**.

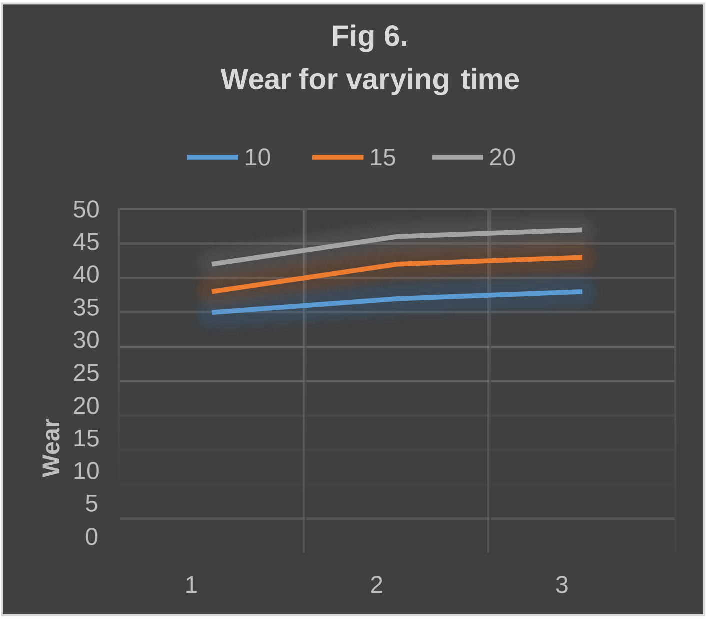
Table 2. Varied load and time during Experiment.

Level	Load (N)	Time (min)
1.	10	1
2.	20	2
3.	30	3

The amount of wear generated depends upon the applied load, sliding time, material properties and environment. For getting reliable and repeatable wear data, contact between the worn disc and the specimen pin is to be 100% and virgin material of the specimen pin is to be exposed to the worn disc. EN-31 steel disc has been used with the hardness of 62-64 HRC and the pin was prepared with the dimension of 6mm diameter and 30 mm length as per ASTM G99-95 alloy standards. Velocity is 1.5 m/s. The variation of wear due to change of load and time can be observed in **Fig 5** and **Fig 6.**

The experimental plan aims to find the important factors and combination of Factors Influencing the wear process to achieve the minimum wear rate and from the **Fig 5**, and **Fig 6**, it is concluded that the effect of Load is greater than time on the wear of aluminium 6063 alloy.





6. CONCLUSION.

1. The wear plot endorsed the strength of Al/SiC composites. The higher wear rate implies weak bonding between aluminium grains and SiC composite boundary layers and the lower wear rate implies good Al/SiC interface bonding.

2. Under identical test conditions if the load and sliding velocity increase the wear rate also increases.

3. The material undergoes heavy wear due to sticking of the surfaces as a result of heat generated from friction. The number of wear increases as the normal load and disc speed increases and the test pin and the disc exhibits a high amount of chatter due to the sticking of surfaces.

4. It is clear from **Fig 5.** that Mild Steel has less wear rate as compared to brass and mild steel as it developed a protective layer in atmospheric conditions. The wear rate increases with the increase in disc speed and load but the variation with the load is more sudden. The major amount of. wear occurs due to the sticking of the material due to the heat generated at the frictional contact

5. The effect of Load is greater than time on wear of aluminium alloy

7. REFERENCE.

1. Aravindan M.K and Balamurugan K (2016) "Tribological and Corrosion Behavior of Al6063/SiC metal matrix composites", International Journal of Advanced Engineering Technology.

2. Das D K, Mishra P C, Singh S and Thakur (2014), "Properties of ceramic-reinforced aluminium matrix composites - a review", International Journal of Mechanical and Materials Engineering

3. Sharma P (2012) "Determination of Mechanical Properties of Aluminium Based Composites", International Journal on Emerging Technologies, Vol. 3, No. 1, pp. 157-159.

4. Vinaykumar S Shet, Mahadev U M. (2017) "Investigation on Tribological Behavior of Metal Matrix Composites (Al6063-TiO2)", International Journal of Recent Engineering Research and Development, Vol. 2, pp. 117-148.

5. Rana Ramakant, Batra Mitul, Sharma V K, Sahni Aditya (2016) "Wear Analysis of Brass, Aluminium and Mild Steel by using Pin-on-disc Method" International Conference on Manufacturing Excellence.

6. Mishra Ashok (2012) "Tribological Behaviour of Al-6061 / SiC Metal Matrix Composite by Taguchi's Techniques", International Journal of Scientific and Research Publications, Vol 2.

7. Singh M, Mondal D P, Modi O P, Jha A K (2002) "Two-body abrasive wear behaviour of aluminum alloy sillimanite particle reinforced composite, Elsevier Publication, pp.357–368.

8. Nunes P.C.R and Ramanathan L.V (1995) "Corrosion Behavior of Alumina-Aluminum and a Silicon Carbide-Aluminum Metal Matrix Composites", Corrosion, pp. 610–617.

9. Chowdhury M.A (2011) "The Effect of Sliding Speed and Normal Load on Friction and Wear Property of Aluminum", International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS Vol: 11 No: 01.