

Tribological Studies on Aluminium-Graphite Composites

Jijith PK

PG Scholar

Dept. of Mechanical Engineering
Govt. Engineering college,
Trissur, Kerala, 680009
India
jijith3@gmail.com

Mahipal D

Associate Professor

Dept. of Mechanical Engineering
Govt. Engineering college,
Trissur, Kerala, 680009
India
mahipalrit@yahoo.com

Abstract- Aluminium composites have been used in several applications in aerospace and automotive industries. Among the materials of Tribological importance, Aluminium-Graphite composite have received extensive attention for practical as well as fundamental reasons. This investigation describes about the wear characteristics of Aluminium-Graphite composites using pin-on-disc wear test at room temperature. It is found that addition of Graphite improves the wear resistance, machinability, and corrosion resistance up to a certain limit of addition. It has been found that the wear rate is strongly dependent on applied load, sliding speed and composite composition. From experiment it is concluded that Aluminium-Graphite composite can be used as a potential structural material. An increase in hardness and with increase in weight percentage of materials has been observed. The best results (maximum hardness) have been obtained at 6 % weight fraction of Graphite in Aluminium composite.

I. INTRODUCTION

The literature survey is carried out to study and evaluate the abrasive wear properties of Aluminium composites. The various operating parameters such as normal load, sliding distance, and sliding speed for abrasive wear are studied. Aluminium composite and is gaining wide spread acceptance for automobile, industrial and aerospace applications because of their low density, high strength and good structural rigidity.

In this experiment the test was conducted with the following parameters

- (1) Load
- (2) Speed
- (3) Track diameter

Examples of components that have been manufactured using metal include pistons for diesel engines and connecting rods, brake disks for railway brake equipment. The material to be tested is made in the shape of a pin and it is rubbed on to the hard disc of Tribometer and its wear is analyzed. ASTM Test G99 standards are followed.

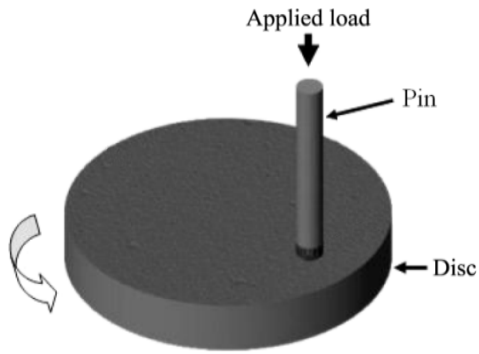
II. OBJECTIVES

The objective of the present investigation is as follows:

- To study the wear resistance properties of Aluminium composites.
- To find the effect on adding graphite to Aluminium.
- To study working of Tribometer.
- To obtain the hardness of Al-Gr composites
- To obtain the best composition of Aluminium-Graphite composites.

III. TRIBOLOGY

The term Tribology was first used in 1966 in a report of the UK Department of Education and Science. The word Tribology is derived from the Greek word 'tribos' means rubbing. In a nutshell the meaning of Tribology is "science of rubbing". It is the science and technology of interacting surfaces in relative motion and of related subjects and practices. The interactions taking place at the interface control its friction, wear and lubrication behaviour.



Sample whose wear rate is to be found out is made in the shape of a pin of 6mm diameter



The sample is then rubbed on to the hard disc of Tribometer and its wear rate is analyzed by coupling the Tribometer to the computer. The results can be obtained and viewed on computer monitor.

IV. COMPOSITE

An composite is a material that has metallic properties and is formed by combination of two or more chemical elements of which at least one is a metal. The metallic atoms must dominate in its chemical composition and the metallic bond in its crystal structure. Commonly, composites have different properties from those of the component elements. An composite of a metal is made by combining it with one or more other metals or non-metals that often enhances its properties. The physical properties, such as density and conductivity, of an composite may not differ greatly from those of its component elements, but engineering properties such as tensile strength and shear strength may be considerably different from those of the constituent material.

A. ALUMINIUM GRAPHITE COMPOSITES

The Aluminium composite is used in this experiment as the matrix and graphite of 125 μm as reinforcement. The liquid metallurgy route has been adopted to prepare the cast composites of Aluminium- Graphite.

V. WEAR

Wear can be defined as the progressive loss of material from one or both surface when two surfaces are in relative motion with each other.

Several types of wear can be found in machinery as:

- 1) Abrasive wear
- 2) Solid particle erosion
- 3) Sliding and adhesive wear
- 4) Fretting wear
- 5) Corrosive wear
- 6) Impact wear

VI. EXPERIMENTAL DETAILS

Materials used for testing are :

Aluminium-Graphite composites of composition having

- (1) Graphite 4%
- (2) Graphite 6%
- (3) Graphite 8%

A cylindrical sample of 6 mm diameter of above composition is machined for wear test. Surfaces are polished prior testing. Sample of Al-Gr composite of 6 mm diameter is used for testing.



DUCOM WEAR AND FRICTION MONITOR

The variables involved in wear test are:

- Normal load
- Speed
- Sliding distance

SPECIFICATIONS OF TRIBOMETER

Parameter	unit	Minimum	Maximum
Disc speed	rpm	10	800
Pin diameter	mm	2	10
Pin length	mm	10	50
Wear track dia	mm	10	80
Normal load N	N	0	100
Frictional force	N	0	100

VII.RESULTS AND DISCUSSION

A. Hardness measurement

Hardness is the basic requirement of a material for use in specified machine parts. The Hardness of the sample are measured using Vicker’s Hardness test

Vicker’s hardness value for the materials are

Hardness(HV)

4% graphite	-60
6% graphite	-75
8% graphite	-65

B. Graphs

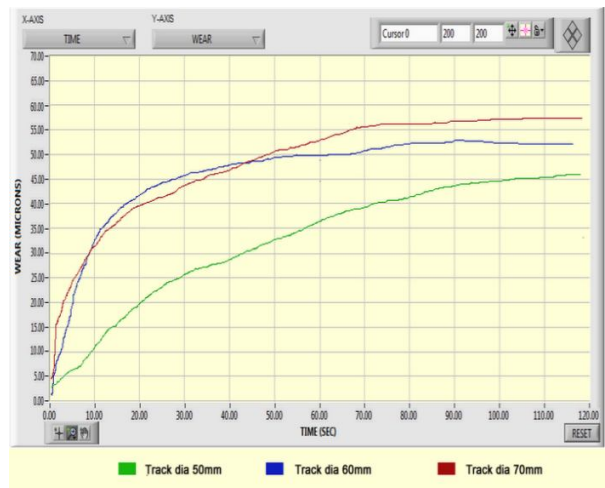
Three graphs are plotted for each variables used for experiment.

(1)Effect of track diameter on wear of Al-Gr sample

4 % Graphite



6% Graphite



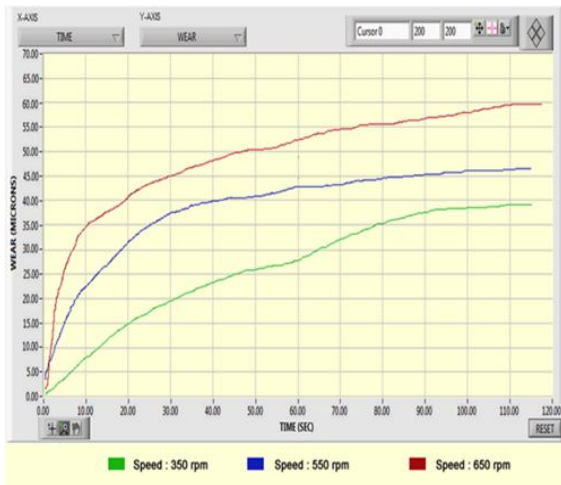
8% Graphite



With decrease in track diameter, time required for the wear to be static increases. In this test for track diameter, static wear is test was done varying the track diameter and keeping load (2.5Kg) and sliding speed (500 rpm) as constant. Wear rate is minimum for 6% Graphite composition.

(2)Effect of Sliding speed on wear of Al-Gr sample

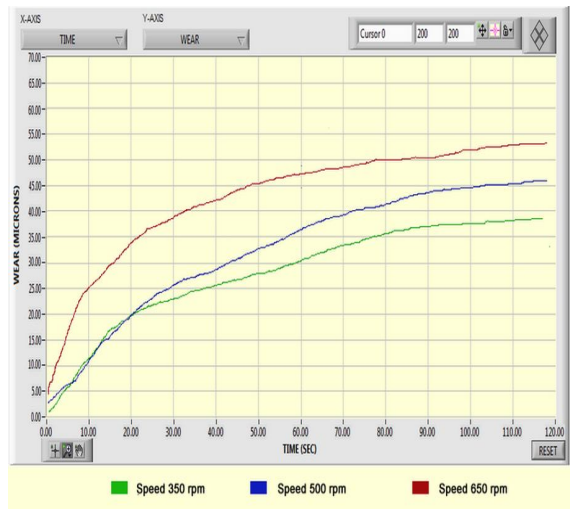
4 % Graphite



6% Graphite



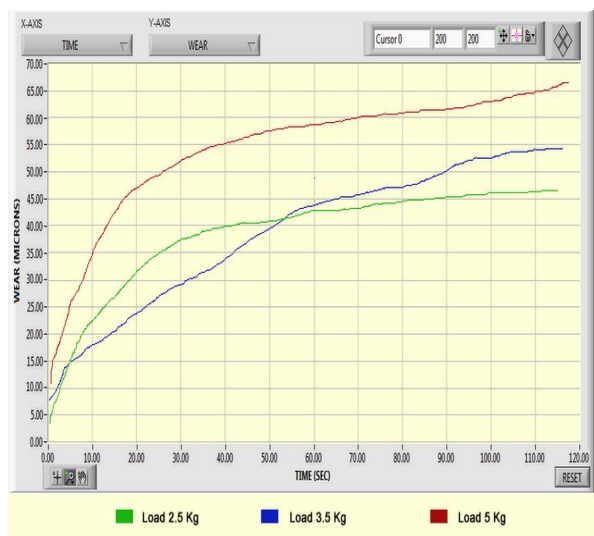
8 % Graphite



Wear is also dependent on sliding speed. Here the sliding speed is measured in rpm. The more is the sliding speed, the more distance will be covered by the sample. So static wear will be achieved faster. Wear will be higher for higher speed. The above figure shows that with increase in sliding speed wear increases. From graph it can be shown that at a particular time, wear is maximum for sliding speed 650 rpm where it is minimum for sliding speed 350 rpm. Wear rate is minimum for 6% composition.

(3)Effect of Normal Load on wear of Al-Gr sample

4% Graphite



6 % Graphite



8% Graphite



The more is the normal load, the more will be the wear. The tests were done varying the normal load and, keeping the track diameter and sliding speed fixed. In atomic level the surface of a material cannot be fully flat. When two surfaces are in contact, they touch each other at some points and when load is applied, plastic deformation occurs locally in those points which lead to removal of material. More the load more will be the plastic deformation. Hence wear will be more. Wear rate is minimum for 6 % composition as obtained from the graph.

VIII. CONCLUSION

The various compositions of Al-Gr is prepared. Hardness values are obtained using Vicker's test apparatus. Test are conducted using Tribometer.

Various graphs are obtained and readings are analyzed. It is found that,

- (1) Addition of Graphite increases hardness up to a certain limit
- (2) Hardness value of Al-Gr composite of 6% Graphite composition is greatest
- (3) The sliding wear rate is less than for 6% Graphite in Aluminium composition.
- (4) The composition which has minimum wear rate is the best sample which can be used for practical application.

IX. REFERENCES

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