A Review on Study on Dry Sliding Wear behavior of Different Material with EN31 Steel on Wear and Friction Monitor Machine

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Abstract— In this study, encompasses the properties of the brass, gun metal, aluminium and the assessment of their tribological response when subjected to Pin-on-Disc wear test, which will perform on wear and friction monitor machine. The EN31 steel disc will attach with motor of machine and varying the speed. The Pin of Gun metal, brass, aluminium will fit in the pin holder of wear and friction monitor machine. An attempt has been made to study the influence of wear parameters like sliding speed in rpm, time in second, load in N and also study friction force and temperature. A plan of experiments, based on the techniques of Taguchi, will perform to acquire data in controlled way. An orthogonal array and the analysis of variance (ANOVA) will employee to investigate the wear behaviour.

Key words: EN31 Steel, Dry Sliding Wear

I. INTRODUCTION

The word 'tribology' is derived from the Greek word tribos which means rubbing. So, the literal translation of the word is 'the science of rubbing'. Tribology is defined as the science and technology of interacting surfaces in relative motions and of related subjects and practices. The subject 'tribology' generally deals with the technology of lubrication, control of friction and prevention of wear of surfaces having relative motion under load. Tribology is the art of providing operational analysis to problems of great economic significance, namely, maintenance, reliability and wear of equipment starting from household appliances to spacecraft. To have a thorough understanding of the subject and its application to machine elements, it is necessary to have an in-depth knowledge in many areas such as chemistry of lubricants, Physics of fluid flow, surface topography, contact mechanisms, material science, mathematical engineering. Thus, the subject is truly multi-disciplinary in nature [1].

The removal of material from one or both of two solid surfaces in relative motion (Sliding, rolling) is termed as 'wear'. Surface damage due to material displacement with no net change in volume or weight is also called 'wear'. It occurs as a natural consequence and mostly through surface interactions at asperities. It is a system response and it is not a material property. Interface wear is strongly dominated by operating conditions. Wear can be either desirable or undesirable. Desirable cases of wear include machining, polishing, shearing and writing with a pencil whereas undesirable cases include almost all machine applications such as bearings, gears, cams and seals. Sometimes it is erroneously assumed that high friction means high wear rates. But this is not true. Interfaces with solid lubricants and polymers shows relatively low friction but high wear, which ceramics show moderate friction with extremely low wear. In some isolated cases, friction and wear may be correlated. But, in general, friction and wear are two distinct system responses [1].

Friction and wear occur at machinery components which run together. The researchers investigate friction and wear behaviour of materials because of the adverse effect observed in the performance and life of machinery components. Much of the research reported in the literature was carried out under the atmospheric conditions. At present, there is a steadily rising industrial need for materials to be used in applications such as machining, metal forming, bearings and gears, where friction and wear play an important part. New materials or improved existing materials are called for, in order to extend the lifetime of existing devices and components. Gun metal, aluminium, brass have inherent advantages of having high specific strength and good heat transfer ability, which makes them suitable alternative to replace components made of ferrous alloys. In the present investigation gun metal has strength, ductility, excellent machinibility and good bearing and wears properties [2].

A. Methods used for Evaluation of Wear

The most common methods of studying the wear consists of examination of sliding material before and after the test, any difference in material is attributed to wear. The detection of wear generally uses one or the other techniques of weighing, mechanical gauging and examination of surface and sub-surface features and wear debris [7].

B. Weighing

This is the simplest way of detecting the wear in which specimen is weighed before and after running, using sensitive weighing balances (accurate >0.1 mg) and weight loss is calculated to get wear rate [7].

C. Gauging

In this method, the wear is measured by decrease in dimensions, using mechanical (dial gauge).

D. Optical

There are number of methods for measuring wear using the optical technique. One way is to make small micro-hardness indentation on a surface and to study how its size is reduced during the sliding. The horizontal limit of resolution this method is about 10^{-5} m [7

E. Why Material Used

Wear is one of the most commonly encountered industrial problems leading to the replacement of components and assemblies in engineering. Therefore, many efforts have been made to produce more durable materials and techniques to reduce the wear of tools and engineering components.

These include modification of bulk properties of the materials, surface treatments and application of coating etc. Over the last few years, many efforts have been made to understand the wear behaviour of the surfaces in sliding contact and the mechanism, which leads to wear. The application of gun metal, brass, aluminium and its alloys for the machine parts are increasing day to day in the industry.

However limited work has been reported on the wear behaviour of gun metal, brass, aluminium and its alloys with the application of grain refiner and modifier. The commercial gun metal casting alloys are the most common particularly due to some very attractive characteristics such as good appearance, excellent cast ability and pressure tightness, low coefficient of thermal expansion, good thermal conductivity, good mechanical properties and corrosion resistance. [8].

II. Material Selection

After the literature reviewed gun metal, brass, aluminium material is selected because of in the present investigation, there is a steadily rising industrial need for materials to be used in applications such as machining, metal forming, gears, where friction and wear play an important part. New materials or improved existing materials are called for, in order to extend the lifetime of existing devices and components. Gun metal, brass, aluminium have inherent advantages of having high specific strength, good mechanical properties, good corrosion resistance and good heat transfer ability, good appearance and easy of working and joining which make them suitable alternatives to replace components made of ferrous alloys. In the present investigation, gun metal, brass, aluminium has strength, ductility, excellent machinability and wears properties [5].

A. Wear and Friction Monitor Machine

Fig. 1: Wear and friction monitor machine [16].

The pin-on-disc test apparatus will apply to the wear and friction monitor machine. It is shown in figure 3.1, which was used to investigate the dry sliding wear characteristics of the gun metal, brass, aluminium. The setup consists of a stationary pin, which was direct contact on a rotating disk [16].

B. Pin on Disc Set Up

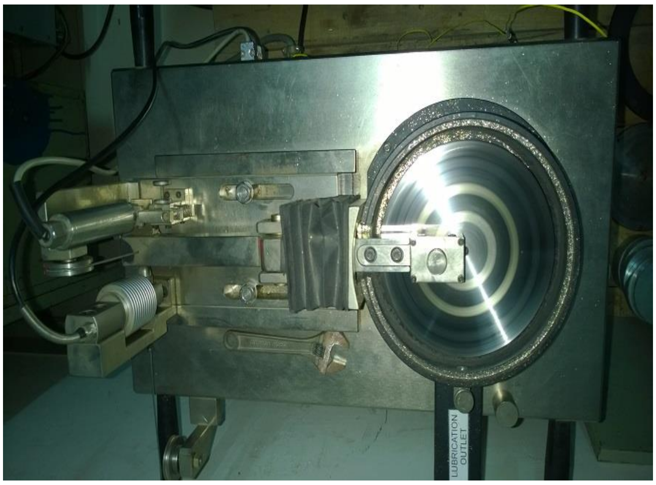

Fig. 2: pin on disc set up

C. Wear and Friction Monitor Machine Specification

Wear Disk Diameter	Diameter : 165mm
	Thickness : 8mm
	Material : EN 31, hardened to 60 HRc.
Pin diameter & length	Diameter : 3,4,6,8,10&12mm
	Length : 20mm to 30mm
	Material : MS & Al
Disk speed	Minimum : 200rpm
	Maximum : 2000rpm
Normal load	Minimum : 5N
	Maximum : 200N
Frictional force	maximum 200N, resolution of 1N
Wear	0 to 2000 micron

Table 1: Wear and Friction Monitor Machine Specification

D. Manufacturing of Pin

The material of Brass, Gun metal, aluminium purchase from the metal shop whose diameter is 12 mm and length is 300 mm.

But the material required for my experiment work is 8 mm diameter and 25 mm length. For this purpose I made fabrication of Brass, Gun metal, aluminium pin on the lathe machine in workshop at Ahmedabad institute of technology.

E. Fabrication of Pin

Fig. 3: fabrication of brass, gun metal, aluminium

After material selection, cylindrical road fitted in three jaw chuck of lathe machine for turning operation. Final specimen for wear measurement generated with 8mm diameter and 25mm length.

F. Input Parameter

- Sliding speed (rpm)
- Load (N)
- Contact Time (Second) [16]

G. Output Parameter

- Friction force (N)
- Wear (micron) [16]

H. Application of Gun Metal

- Valve bodies
- Jewelry
- Door handles
- Clock components
- Pump bodies
- Marine engines
- Pump casting
- Bushings

I. Application of Brass

- Fabrication of Nuts, bolts, and threaded parts.
- Valve bodies.
- Pipe/water fittings.
- Ornamental trim.
- Jewelry.
- Door handles.
- Clock components.
- Heat exchangers.
- Marine engines.
- Pump casting.
- Bushes bearings.

J. Application of Aluminium

- Aircraft fittings
- Marine fitting and hardware
- Electrical fittings
- Magneto parts
- Brake pistons
- Valve and valve parts
- Cycle ring

III. SUMMARY

In this chapter to detail in wear and friction force for different type of wear mechanism like Abrasive wear, Adhesive wear, Erosive wear, Surface fatigue wear, Corrosive wear and calculate the wear testing method and different method used for the gaughing, optical, weighing.

Wear is one of the most commonly encountered industrial problems leading to the replacement of components and assemblies in engineering. Therefore, many efforts have been made to produce more durable materials and techniques to reduce the wear of tools and engineering components

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