FRICTION AND WEAR BEHAVIOR ANALYSIS OF DIFFERENT BEARING MATERIALS

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ABSTRACT

Tribology is the science and technology of interacting surfaces in relative motion of related subjects and practices. Sliding and rolling surfaces represent the key to much of our technological society. Understanding of tribological principles is essentials for successful design of machine elements. When two nominally flat surfaces are placed in a contact, surface roughness causes contact to occur at a discrete contact spots and an interfacial adhesion occurs. Friction is the resistance to motion that is experienced whenever one solid body moves over another. Wear is the surface damage or removal of material from one or both of two solid surfaces in a moving contact. Materials, coatings and surface treatments are used to control friction and wear. One of the most effective means of controlling friction and wear is by proper lubrication, which provides smooth running and satisfactory life of machine elements. Lubricants can be liquid, solid, gas. Present scenario works on solid lubricant as per demands from the industries. For different application such as non-lubricant compressor, gears in micro machinery parts require lubrication. But wet lubrication is not beneficial or not much more significant effects, due to contamination of oil. Some application such as compressors and juice extracting machine, where oil contamination with food and various food products is a serious problem. Some applications have too complicate design and some application has to be installed in complicate placeless where periodically oiling requires for its better performance. The aim of the project work is to find the better combination of metal matrix solid lubricant that acts as solid lubricant for different application. With mixing the brass with different filler material such as. Aluminium, steel (EN08) and Brass, Copper, were investigated in dry sliding conditions. Friction and wear experiments were conducted on pin-on-disc apparatus, using composite pins against polished EN31 steel counterparts, performed within the various

I. INTRODUCTION

1.1 Problem statement

In the petroleum, food processing and chemical industry where high temperatures often evolved, special materials have to be used. The high wear rate at high temperature and high load is a serious problem in a large number of industrial applications such as elevated temperature compressor piston rings and bearings. Meanwhile to meet the combination of light weight and high strength demands, alloy as well as metal matrix composites materials are increasingly used in many industries. However, wet lubrication is not beneficial or not much more significant effects, due to contamination of oil. Some application such as compressors and juice extracting machine, where oil contamination with various food products has a serious problem. Some applications have to complicate design and some application has to be installed in complicate place less where periodically oiling requires for its better performance. In such cases lubrication is also serious problem because of machine location e.g. Fan and blower etc. and complicate design. So present paper includes the testing of wear rate analysis or estimation of different bearing materials performed at various operating conditions

1.2 Objectives

- To conduct the wear test and Study the effect on metal composites for following parameter at different operating conditions.

a. Wear

b. Coefficient of Friction

c. Frictional Force.

- To study the effect on wear with different test parameters like normal load on friction and wear behaviour of Brass, Aluminium, copper, EN08.
- To study the relationship between normal loads coefficient of friction wear rate and wear resistance.
- To find percentage improvement in wear resistance due to addition of wet test as compare to the dry test.

1.3 Scope

- This work is expected to introduce a new class of functional liquid lubricant.
- This project will also help in performance of some materials under liquid lubricant which can be used for high temperature applications and different loading conditions.
- New materials under liquid lubricant help for replacement of present material with more advantages for different applications at different operating condition

1.4 Methodology

The experiment was performed in following steps, This chapter describes the details of processing of the composites and the experimental procedures followed for their characterization and tribological evaluation.

The raw material used in this work is

1. Brass
2. Aluminium
3. Copper
4. Steel (EN08)

6.1 Processing of the Bearing materials:

6.1.1 Specimen preparation:

Commercially available Brass was supplied and machined by Omkar Industries, Ahmednagar. Aluminium of some diameter also supplied by Omkar Industries, Ahmednagar. Copper used also brought from Omkar Industries, Ahmednagar. Steel is also brought from Omkar Industries, Ahmednagar. And the Disk which is made up of Steel (EN31) is also brought from Omkar Industries, Ahmednagar. Which is hardened upto 50 to 52 HRC.

1. Material selection for hydrodynamic bearing

2. Shaft material Steel EN31

3. Preparation of Disk

4. Manufacturing of pins for different bearing materials.

5. **Testing of specimen:**

i) Mechanical Test

a) Compressive Test

b) BHN Test

ii) Tribological Test

a) Selection of operating parameter

b) Analysis of resulting data

Table 6.1.1 Material List

Specimen	Materials
S1	BRASS
S2	ALUMINIUM
S3	COPPER
S4	STEEL (EN08)

Sample preparation for wear test:

The specimen for wear test has been produced by the machining on lathe machine. The Brass and aluminium, copper and steel has fitted in chuck and various instruments are there for measuring purposes. First disk is machined manually on lathe. This mixture than put in cylindrical die with dimensions of 100 mm long and 20 mm in diameter. This die and plunger assembly with raw metal are kept to compression testing machine and applied the load 150 KN for 30 minutes. Similarly, different sample has produced by compacting machine. After the compacting of sample, it has kept in the hot furnace for heating process. The hardening temperature were set from 800 ^{0}C to 850 ^{0}C for 1 hr duration and sample were cooled inside the furnace up to2 hr and then removed from the furnace, again it allows to cooled at ambient temperature and time measure to bring it temperature for room temperature was 2 hr.

Frictional force of Steel (EN08)

Fig 7.4.3 show the effect of frictional force vs Time on characteristics. It has been found that the frictional force initially was 18 N and increased with respect to time to 26 N. As the time interval advanced and formation of transfer film on the counter surface of the rotating part. This avoids the friction and value of frictional force lowered down to 2.6N.

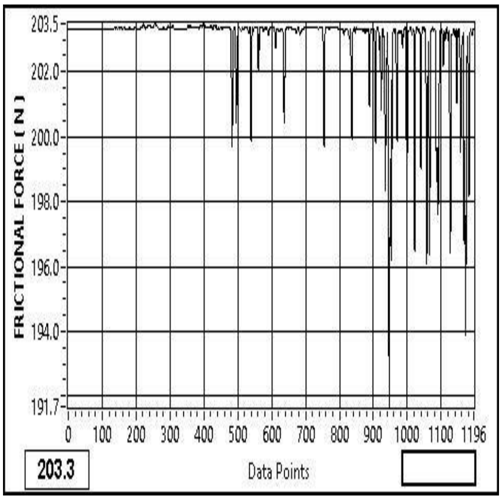
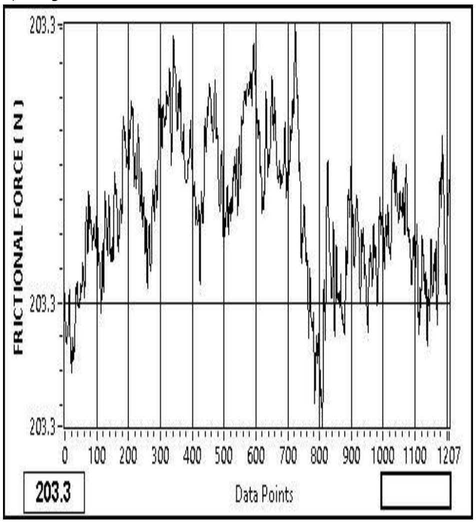


Fig. 7.4.3 Graph Frictional Force Vs Time of Steel (EN08) (Dry



Friction Force of Aluminium (Dry test)

Fig.7.3.3. shows the effect of Time on coefficient of friction characteristics on Aluminium. It was observed that the frictional force and coefficient of friction

has same significant characteristics. The value of coefficient of friction also initially very high because of large value of frictional force exerted on the pin surface but after formation of thin lubricating film this value dropped down to μ = 0.267.

Friction Force of Copper (Dry test)

Fig.7.2.3 shows the effects of Time Vs Coefficient of friction characteristic. From the graph of coefficient of friction, it has been observed that the at the time of start the value of coefficient of friction was large approximate μ = 0.28. This is due to the sudden application of normal load on pin and apposite drag created on the pin due rotation of disc, it developed friction between pin contacts to disc hence increased the value of coefficient of friction. As the time interval advanced the value of coefficient of friction dropped down, this is due to the formation of thin lubrication of the counter surfaces of disc which enable to avoid metal to metal contact and reduced the friction. the value of coefficient of friction obtained after the 20-minute test was μ = 0.26.

Wear characteristic for Brass (Dry Test)

The Fig. 7.1.1 shows the effects of Time Vs Wear characteristic for Brass. It has been observed during wear test on wear testing machine for same operating parameters discussed in above, the wear characteristic increased for same operating conditions with respect to time. As time increased there was continuous and linear growth of wear characteristic against the time. For the 30-minute duration the wear for Brass was found approximate 591 micron. And the specific wear value calculated from the formulae mentioned calculation and it was found to 3.48×10^{-4} mm^3 / Nm.