Effect of Lubricants on Friction and Wear behavior of Bronze filled PTFE

S. P. Thorat[1], Prof. V. S. Aher[2] and Prof. A. K. Mishra[3]

***Abstract*—Lubrication occurs when two surfaces are separated by a lubricant film. A lubricant is a substance that reduces friction and wear by providing a protective film between two moving surfaces. Lubricants are available in liquid, solid, and gaseous forms. A good lubricant exhibits the following characteristics: high VI, high boiling point, thermal stability, low freezing point, corrosion prevention capability, and high resistance to oxidation**

Tribology is the science of rubbing surfaces in relative motion. In this investigation, two number of lubricants are used i.e. IPOL 3 and BECHEM 92 which are used in the Sugarcane application. It is the study of the friction, wear and lubrication of engineering surfaces with a view of understanding surface interactions in detail and then prescribing improvements in given applications. One of the important objectives in tribology is the regulation of the magnitude of frictional force according to whether we require a minimum or a maximum. This objective can be realized only after a fundamental understanding of the frictional process for all conditions like load, sliding velocity, lubrication, surface finish, temperature and material properties. [5]

I. INTRODUCTION

Lubrication occurs when two surfaces are separated by a lubricant film. A lubricant is a substance that reduces friction and wear by providing a protective film between two moving surfaces. Lubricants are available in liquid, solid, and gaseous forms. A good lubricant exhibits the following characteristics: high VI ,high boiling point, thermal stability, low freezing point, corrosion prevention capability, and high resistance to oxidation

Tribology is the science of rubbing surfaces in relative motion. It is the study of the friction, wear and lubrication of engineering surfaces with a view of understanding surface interactions in detail and then prescribing improvements in given applications. One of the important objectives in tribology is the regulation of the magnitude of frictional force according to whether we require a minimum or a maximum. This objective can be realized only after a fundamental understanding of the frictional process for all conditions like load, sliding velocity, lubrication, surface finish, temperature and material properties. [5]

Surface texturing as a method for enhancing the tribological properties of surfaces for many years. Adding a controlled texture to one of two faces in relative motion can have many positive effects, such as reduction of friction and wear also increase in load capacity (adding texture to both faces tends to increase friction and cause other negative effects). Early studies recognized the potential of microasperitiesto provide hydrodynamic lift during film lubrication, while later research indicated that small-scale texturing could also provide lubricant reservoirs in poorly lubricated conditions and trap wear particles in boundary and dry lubrication. A further use of micro textured surfaces may be found in the use of partial texturing – a textured region can take the place of macro-geometry such as steps or inclined planes meant to provide hydrodynamic lift. All of these effects may decrease friction and wear between two sliding surfaces, but some experimental results also show a negative effect from surface texturing. In some cases texturing is not optimized for a given case, in others there is no optimal case any kind of texturing may be worse than a smooth surface. Research and analysis presented to date demonstrates both the potential to improve tribological properties via surface texturing, and the need to understand the materials, lubricants, and running conditions before a surface texture is applied.

A. Importance of Lubrication

An unlubricated sliding part creates tremendous friction that needs great amount of power to move, slide or operate them. If friction reached the critical level, the heat will fused the part and that will cause seizure that will ultimately bond the parts or burn them beyond use. Proper lubrication eliminates the friction that totally contributes to this failure phenomenon. It continuously reduces the coefficient of friction, thereby reducing the force to move and heat that leads to seizure, bonding and fire. The general purpose of lubrication is to

Mr. S. P. Thorat is a student of Mechanical Engineering, Amrutvahini College of Engineering Sangamner, India.
(Email: satyam.thorat@gmail.com).
Prof. V. S. Aher is a professor at Department of Mechanical Engineering, Amrutvahini Collage of Engineering, Sangamner, India.
(Email: @gmail.com)
Prof. A. K. Mishra is an Assistant Professor at Department of Mechanical Amrutvahini Collage of Engineering, Sangamner, India.
(Email:akmmechanical@gmail.com).

separate the two sliding bodies to reduce friction. To overcome these problems apply extreme pressure (EP), anti-wear (AW) and Shear stability (SS) additives.

B. Properties of Lubrication

i. To prevent rust and reduce oxidation.
ii. To act as an insulator in transformer applications and
iii. To act as a seal against dirt, dust, and water.

To reduce wear and heat loss that results from the contact of surfaces in motion that is to reduce the coefficient of friction between two contacting surfaces.

Polyamide is extensively used for a wide variety of structural applications as in aerospace, automotive, earth moving, medical, electrical, electronics, computer and chemical industries. On account of its good combination of properties, these are used for producing a number of mechanical components such as gears, cams, wheels, brakes, clutches, bearings, gaskets, seals as well as wires, cables, textile fibers, electronic components, medical implants, surgical instruments etc.

In this work attention is given to investigate the effect of lubrication on tribological properties of composite materials considering various conditions so as to observe the comparative friction and wear behavior of polyamide composite with & without surface texturing on mating surface under varying lubrication, loads at varying velocity by using a pin-on-disc type wear tester at NTP. Experimental work will be carried out by varying loads. Minimum load is 117 N and maximum load is 184.07 N will use by applying the weights at minimum sliding speed is 0.09 m/s and maximum speed will be 0.12 m/s used for this study keeping the rest of the parameters constant. The test will be carried out for material Pure Polyamide (PA6, PA66), its composites, and 10% glass fiber particles, PTFE composites with 40% Bronze in dry and wet condition. In this work AISI SS 304 stainless steel disc one having plane surface & other one having surface textured pattern on it will be used as counterpart surface and tests will be carried out at ambient conditions using a pin-on-disc Tribometer(TR-20LE).

C. EXPERIMENTAL METHODOLOGY

The TR-20LE Pin on disc wear testing is advanced regarding the simplicity and convenience of operation, ease of specimen clamping and accuracy of measurements, both of wear and frictional force along with lubrication and environmental facility.

The machine is designed to apply loads up to 20 kg and is intended both for dry and lubricated test conditions. It facilitates study of friction and wear characteristics in sliding contacts under desired test conditions within machine specifications. Sliding occurs between the stationary pin and a rotating disc. Normal load, rotational speed and wear track diameter can be varied to suit the test conditions. Tangential frictional force and wear are monitored with electronic sensors and recorded on PC. These parameters are available as a function of load and speed.

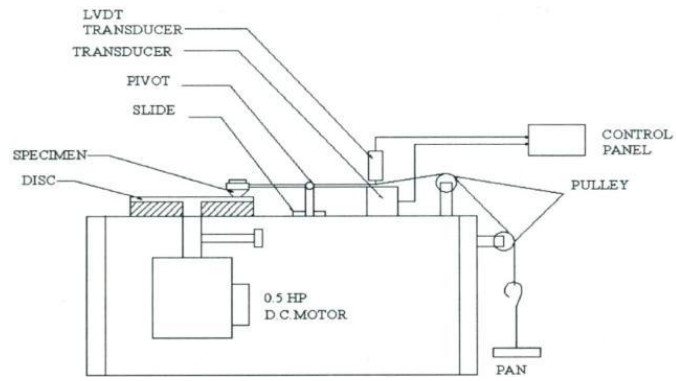


Fig.1. Experimental setup of Pin on Disc Tribometer

II. SURFACE TEXTURING

A. Tribology

Tribology is defined as the science and technology of interacting surfaces in relative motion, having its origin in the Greek word tribos meaning rubbing. It is the study of the friction, lubrication and wear of engineering surfaces with a view of understanding surface interactions in detail and then prescribing improvements in given applications. Since World War II the rapid rate of technological advancement has required great expansion in research on what to do about surfaces that rub. One of the important objectives in Tribology is the regulation of the magnitude of frictional force according to whether we require a minimum or a maximum. This objective can be realized only after a fundamental understanding of the frictional process is obtained for all conditions of temperature, sliding velocity, lubrication, surface finish and material properties.[22]

B. Surface Texturing in Tribology

Various forms and techniques of surface texturing were developed over the years for enhancing Tribological performance. The vibrorolling method was developed by Schneider in 1984, it consists of producing shallow grooves by plastic deformation using a hard indenter on metallic parts. An extensive work has been done on vibrorolling in Eastern Europe that somehow went unnoticed in the western world. At about the same time Suh and co-workers in the US presented the idea of modulated surface for removing oxide wear debris from the interface of electrical contacts. They initially used an etching technique which was later replaced by abrasive machining to form grooves that they termed undulated surfaces. Like in the function of the undulations is to act as traps for wear debris thereby reducing the ploughing and deformation components of friction and wear. Reactive ion etching (RIE) was employed by a group lead by Kato in Japan to study the effect of surface texturing, in the form of micro-dimples, on parallel sliding faces of SiC in water. Other

techniques include Abrasive jet machining, LIGA, and lithography and anisotropic etching. Most of the work described above is experimental, using various types of pin on disk and ring on ring test machines. This is probably due to the fact that the involved phenomena are very complex, and only in limited cases can be described analytically. However, in spite of the lack of extensive theoretical modeling and optimization of the texturing dimensions, remarkable improvement in terms of friction and wear reduction was demonstrated in these experiments with various texturing forms.

C. PROBLEM DEFINITION

Sugar industry in India is the second largest manufacturing industry. Presently Indian sugar industries are operating at different cane crushing capacity ranging from 1000 to 10,000 tone"s per day. In sugar industry juice from sugar cane is extracted in milling section. The sugar mills use number of running components fabricated with ferrous and non-ferrous alloys which requires frequent or continuous lubrication. These mills often suffer from corrosion related problems which in turn results in the need for large maintenance, thereby increasing the production cost. Now there is a scope to reduce the cost of sugar production and increase the efficiency of the sugar mills by replacing some of the conventional material components by those of newly developed light weight composites.

III. PREPARATION OF SPECIMEN

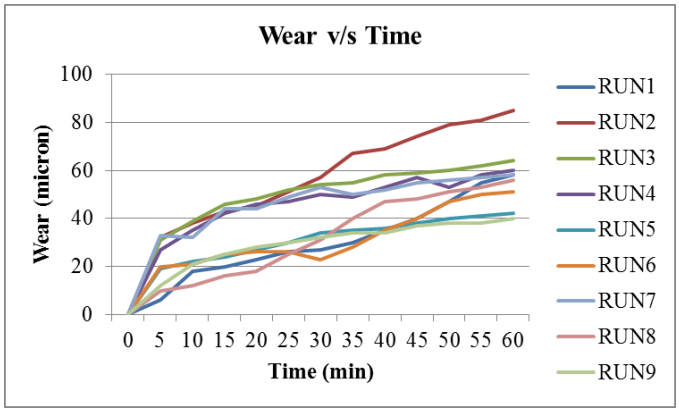
PTFE composite material is in the form of cylindrical rod with dimensions 6 mm diameter and 105 mm length. The test specimens (pins) of 6 mm diameter and 30 mm length are cut. Surface texture patterns were made on the SS 304 plate by the Lasers. The size of the dimple is taken 300 Micron & densities of the dimples as 10%. The experimentation was carried out at the three velocities 0.09m/s, 0.108m/s and 0.120m/s and at the different load conditions.

Table. 1Typical properties of 40 % Bronze filled PTFE composites

Sr. No.	Property	Unit	40 % Bronze filled PTFE
1.	Density	gm / cc	3.1-3.2
2.	Tensile Strength	kgf / cm2	125-150
3.	Elongation	%	100-175
4.	Compressive Strength	kgf / cm2	85-100
5.	Flexural Strength	kgf / cm2	85
6.	Flexural Modulus	kgf / cm2	14000
7.	Hardness	Shore	70-75

Experimentatal Result

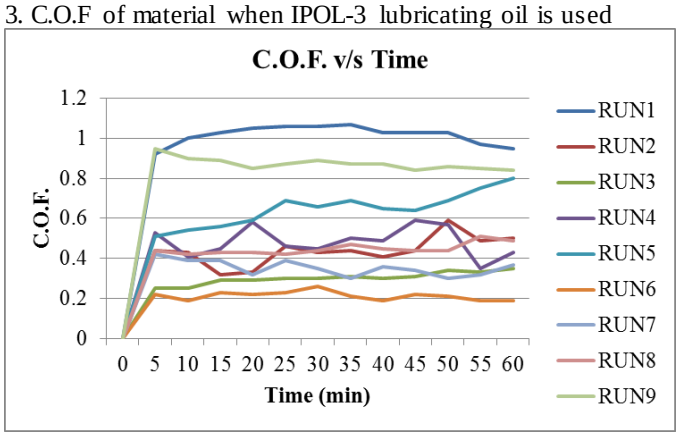
1 Wear of material when IPOL-3 lubicating oil is used



Graph:

Graph:

3. C.O.F of material when IPOL-3 lubricating oil is used



V. CONCLUSIONS

- Coefficient Of Friction icreases with test duration because of constatnt film of IPOL lubricant.
- The wear rate is upto 80 micron for 60min test duration with IPOL3
- There will be a chance of reduce the wear rate with different lubricants.
- There will be a chance of Improvement in wear resistance and reduction in coefficient of friction of polymer composites.
- Also there will be a chance of significance improvement in the life of component.

VI. REFERENCES

[1]. H. Unal et.al.(2006) 'An approach to friction and wear properties of polytetrafluoroethylene composite'

[2]. S.M. Muzakkir et. al. (2011) 'Tribological failure analysis of journal bearings used in sugar mills'

[3]. Wan Yi, Xiong Dang-Sheng "The effect of laser surface texturing on frictional performance of face seal" journal of materials processing technology 1 9 7 (2 0 0 8) 96–100

[4]. Andriy Kovalchenko et al. "Friction and wear behavior of laser textured surface under lubricated initial point contact" Wear 271 (2011) 1719– 1725

[5]. Kristian Tønder "Micro- and macro-modifications of pivoted slider bearings: Performance comparisonand texturing versus width reduction" Tribology International 44 (2011) 463–467

[6]. Piotr Ste et al. "Deterministic and stochastic components of regular surface texture generated by a special grinding process" Wear 271 (2011) 514–518

[7]. G. Ryk et al. "Testing piston rings with partial laser surface texturing for friction reduction" Wear 261 (2006) 792–796.

[8]. Kristian Tønder "Dimpled pivoted plane bearings: Modified coefficients" Tribology International 43 (2010) 2303–2307