Simulation Investigation of Effect of Bio- Lubricant between Tribological Systems of Piston Ring.

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Abstract - **In an Engineering situation, a particular machine is selected on the basis of its reliability and life span. The life span and reliability are in turn governed by the frictional wear characteristics of individual component of machine. The life of any machine is determined by the life of its most sensitive part that is susceptible to wear. In Tribological system "piston -ring-liner" observed 40-50% of mechanical frictional losses. To reduce such losses Lubricants perform as anti-friction media. They maintain reliable machine functions, provide smooth operations, and lower the risks of frequent failures. To manufacture lubricant important source is Crude oil. But in today's scenario, crude oil increasing prices as well as depletion of crude oil reserves in the world, and global concerning protecting the environment from pollution have renewed interesting developing and using environment-friendly lubricants derived from alternative sources. A bio lubricant is renewable lubricants that is non-hazardous, biodegradable and emits approximately zero greenhouse gas. The objective is to presents the potential of a bio lubricant based on jetrofa oil as an alternative lubricant. The mechanical properties as well as advantages and disadvantages of the different piston ring material are discussed in the first section. The second part describes the potential of jetrofa oil-based bio lubricants as alternative lubricants. The final part describes the simulation effect of bio-lubricants on piston ring liner system.**

keywords - **Piston Ring, Sliding Wear, Bio Lubricant, Effect**

I. INTRODUCTION

In mechanical systems, the frictional loss is one of many factors in energy consumption. To reduce friction and wear, oil lubricant have been studied to be used as lubricant additives that have promising effects on friction and wear reduction in automotive, mining, and other industrial applications. Oil lubricant of various compositions and sizes have demonstrated certain degrees of friction modifying and anti-wear effects. We recently reported that in the boundary lubrication region, the addition of oil lubricant can reduce the friction coefficient up to 70%, and wear use as high as 75%. Such lubricants consisting of a base oil and dispersed jetrofa oil lubricant emerged as a new class of lubricants, the bottleneck for further development, however, is the aggregation of jetrofa oil lubricant in a base oil. A stable suspension of jetrofa oil lubricant is essential for a usable lubricant. The aggregation of jetrofa oil lubricant limits their ability to lubricate the contact area

The MoS2 jetrofa oil lubricant can reduce 75% of friction when mixed with lubricant oil. Such reduction was achieved by ultrasonic dispersion immediately before testing, the aggregation of jetrofa oil lubricant could increase friction due to the reduced "shear" effects. Understanding the principles of dispersion is essential to developing novel lubricants. This review is divided into two parts. The first part reviews the methods used to disperse jetrofa oil lubricant in lubricant oil.

Nanotechnology is regarded as the most revolutionary technology of the 21st century. It can be used in many fields and usher's material science into a new era. After investigations on the tribological properties of lubricants with different jetrofa oil lubricant added in it. A large number of papers have reported that the addition of jetrofa oil lubricant to lubricant is effective in reducing wear and friction. Jetrofa oil lubricant is found better among all added into the oil. Among those that were added into oils, jetrofa oil lubricant have received much attention and exhibited excellent applications for their good friction reduction and wear resistance properties. The reduction of wear depends on interfacial conditions such as normal load, geometry, relative surface motion, sliding speed, surface roughness, lubrication, and vibration. Chemical additives in lubrication fluid controls anti- wear properties, load-carrying capacities, and friction under the specified boundary lubrication conditions. Since stabilization of jetrofa oil lubricant has been resolved by the

Addition of a dispersing agent or the use of a surface modification preparation technique, inorganic jetrofa oil lubricant have received considerable attention in the lubrication field. Jetrofa oil lubricant have received considerable attention because of their special physical and chemical properties. The preparation of organic–inorganic complex jetrofa oil lubricant was causing more interest in science and industry. Experimental done on number of jetrofa oil lubricant for lubrication oil additive. However, few of them were used and studied as water base lubrication additives. With the research and development of nanomaterial, many scientific researchers added jetrofa oil lubricant into lubricating oils to improve extreme pressure, anti-wear and friction reducing properties, and the efficiency and service life of machinery were improved and prolonged. The application of advanced nanomaterial has played an active role in improving and reforming traditional lubrication technology. Y.Y. Wu et al. examined the tribological properties of two lubricating oils, API-SF engine oil and Base oil, with mos2 and Nano-Diamond jetrofa oil lubricant used as additives.

The experimental results show that jetrofa oil lubricant, especially base oil added to standard oils exhibit good friction-reduction and anti-wear properties. The addition of base oil jetrofa oil lubricant in the API-SF engine oil and the Base oil decreased the friction coefficient by 16.4 and 4.8%, respectively, and reduced the worn scar depth by 16.7 and 72.8%, respectively, as compared to the standard oils without jetrofa oil lubricant. In addition, investigations were performed using TEM, OM, SEM, and EDX to interpret the possible mechanisms of anti-friction and anti-wear with jetrofa oil lubricant.

The tribological properties are investigated for metal oxides, rare earth compounds, metals, metal borates and metal sulphide used as lubricate additives. The anti-wear mechanism of a metal oxide Nano particulate additive was tribo-sintering of jetrofa oil lubricant on the wear surfaces. That process reduced The metal-to- metal contact and created a load bearing film. The mechanisms change due to colloidal effect, rolling effect, protective film, and third body on the friction-reduction and anti-wear of jetrofa oil lubricant in lubricants as the result of. The results of these investigations show that jetrofa oil lubricant deposit on the rubbing surface and improve the tribological properties of the base oil, displaying good friction and wear reduction characteristics. The synthesis is done on oil is done in our study which gives very good dispensability in organic solvents. In order to estimate the ranges of applications of jetrofa oil lubricant, it was necessary to investigate its tribological behaviour under increasingly severe contact conditions.

II. ADVANTAGES OF BIO LUBRICANT

A number of advantages have been exhibited by bio lubricants which give them an edge over the conventional lubricants. These advantages have been highlighted by a number of researchers Bio lubricants have excellent lubricity of about 2 to 4 times their petroleum based corresponding lubricants. This is enhanced with the polar nature of the lubricants and also enhances the affinity towards the metal surface resulting in substantially increased thin film strength as indicated in Figure 1. This wetting tendency helps in reduction in friction and energy saving in the range from 5 to 15% of the equipment operation. Bio lubricants have higher viscosity index: The viscosity does not vary with temperature as much as the petroleum based lubricants. This makes bio-lubricants suitable for high temperature applications, typically 250°C and above. They also produce fewer emissions due to higher boiling temperature ranges of esters. This can be an advantage when designing lubricants for use over a wide temperature range (Askew, 2004). Bio lubricants possess lower volatility, higher flash/ fire points, less vapour emissions and oil mist, and constant viscosity that make them offer better safety. Bio lubricants exhibit better skin compatibility and less dermatological problems. Bio lubricants also have biodegradability and non-water polluting characteristic which reduces the costs of disposal in addition to making them ecofriendly. Bio lubricants are also cost saving on account of less maintenance, due to longer intervals between re-lubrication.

Bio lubricant excellent lubricity, minimizing of corrosion of metal surfaces, non-toxicity, and biodegradability, coupled with energy saving makes them suitable to be used in all fields of industry. The increased use of bio-based products will also be expected to reduce petroleum consumption, increase the use of renewable resources, better manage the carbon cycle, and may contribute to reducing adverse environmental and health impacts

III. STRIBECK CURVE

Stribeck curve describes the friction levels of contacts with different film thickness to surface roughness ratios with lubrication regimes of the major components in automotive engines such as piston rings, engine bearings and valves as shown in Figure 1. Internal combustion Engine lubrication is categorized into three main regimes: boundary, mixed and elastohydrodynamic lubrication. In piston rings/liner assembly, the previous lubrication regimes can be obtained over the stroke depending on operating conditions. Generally, boundary lubrication exists under the effect of low speed and high load conditions. Hence, Nano-lubricant additives are very important in boundary lubrication because of the higher friction coefficient. Current challenges for reducing the friction and wear require an adaptable lubricant for different operating conditions. Thence, most researchers have focused on Nano-lubricant concept in the internal combustion engines as the main strategy for suppressing the friction coefficient and the wear of contact surfaces, in a manner that will ultimately lead to an improved tribological performance.

The main advantages of the jetrofa oil lubricant additives compared to conventional lubricant additives are stated as follows:

Jetrofa oil lubricant are often efficient at room temperature.

Activation of jetrofa oil lubricant surface.

Increase of surface area and extreme small sizes.

Jetrofa oil lubricant sized smaller than 100 nm have thermal conductivity higher than of the fluids.

Jetrofa oil lubricant provide excellent Tribological performance as solid lubricant

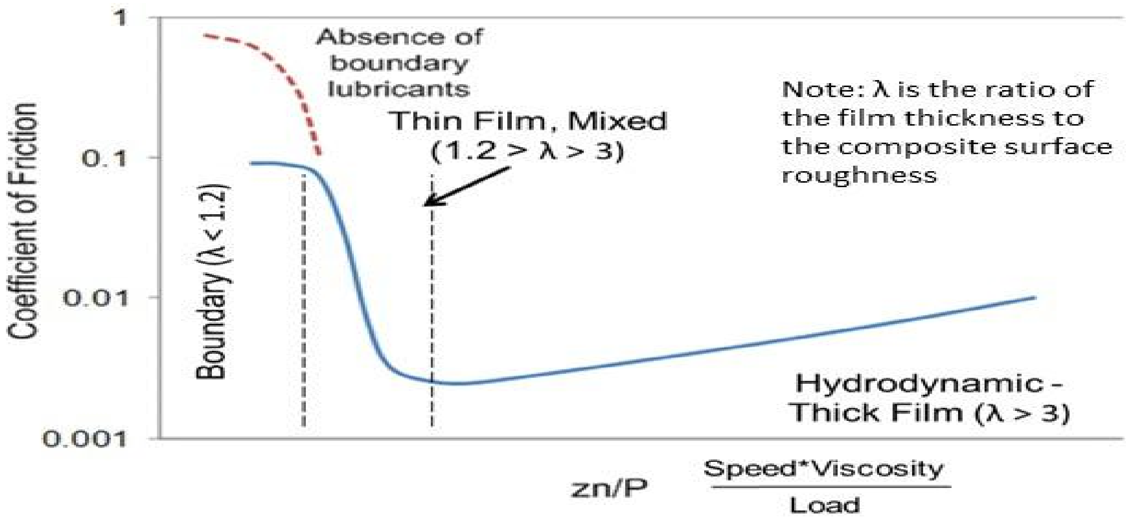

Figure 1. Lubrication stribeck curve of Piston sliding were

IV. Important Considerations While Jetrofa oil lubricant Selection

Designing of Jetrofa oil lubricant Selection lubricant additives Preparation depends upon so many factors. These factors are analyzed to get design inputs for Jetrofa oil lubricant Selection and lubricant additives Preparation the list of such factors is mentioned below

(a) Study of lubricant oil and finished quantity size and property.
(b) Type and capacity of the lubrication oil, its extent of automation.
(c) Provision of lubrication preparation devices in the machine.
(d) Available jetrofa oil lubricant and their property.
(e) Available indexing devices, their accuracy.
(f) Evaluation of variability in the performance results of the preparation.
(g) Rigidity and of the preparation under consideration.
(h) Study of experiment machine, safety devices, etc.
(i) Required level of the accuracy in the work and quality to be produced.

V. Problem statement

1) Bio- lubricant easy Aviable and More Cooling Property, Good frication Characteristic.
2) Previous techniques are more time consuming. And more frication.
3) Less surface area and good lubrication property.
4) It may cause frication due to high temp or increase cycle time of replacement of part
5) Chances of slippage are more while higher applied force chance to accident occur.
6) Increase life of Piston Ring

VI. Necessity of work

The principal motivation for formulating new additives using jetrofa oil lubricant as a promising solution for improving the Tribological behavior is that jetrofa oil lubricant have the potential to offer significant tribological benefits of both solid and liquid lubrication and extend the life of the mechanical components. The decline of the friction coefficient between the rings/liner assemblies plays a critical role in improving engine performance and fuel efficiency. Bi lubricant additives play a significant role in the formation of a tribofilm layer on the worn surfaces via physical or chemical absorbed mechanism to enhance protection of the worn surfaces and create a rolling effect between sliding surfaces

VII. Objective of work

Analytical design of "of Tribological Properties of jetrofa oil as bio-lubricant".
Modelling and Simulation of "of Tribological Properties of jetrofa oil lubricant".
Preparation of Prototype sample of "of Tribological Properties of jetrofa oil lubricant".
Experimental workout of "of Tribological Properties of jetrofa oil lubricant".
Study of comparative result of "of Tribological Properties of jetrofa oil lubricant

VIII. Facility required

Flash and Fire point test, three ball Turbo tester,
Viscosity test
Glass flask
Mixing chamber

IX. METHODOLOGY

Aim: Experimental Investigation of Tribological Properties of jetrofa oil lubricant for piston ring

Problem Definition: The principal motivation for formulating new lubricant using jetrofa oil lubricant as a promising solution for improving the tribological behavior.

Existing Problem:

1) Previous techniques are more time consuming. And more frication.

2) Less surface area and good lubrication property

3) It may cause frication due to high temp or increase cycle time of replacement of part

4) Chances of slippage are more while higher applied force chance to accident occur.

Solution: The decline of the friction coefficient between the rings/liner assemblies plays a critical role in improving engine performance and fuel efficiency. Lubricant additives play a significant role in the formation of a tribofilm layer on the worn surfaces via physical or chemical absorbed mechanism to enhance protection of the worn surfaces and create a rolling effect between sliding surfaces

Analysis: -
Analytical design of "of Tribological Properties of jetrofa oil as bio-lubricant". Modelling and Simulation of "of Tribological Properties of jetrofa oil lubricant".
Preparation of Prototype sample of "of Tribological Properties of jetrofa oil lubricant". Experimental workout of "of Tribological Properties of jetrofa oil lubricant".5. Study of comparative result of "of Tribological Properties of jetrofa oil lubricant

Result

X. EXPECTED OUTCOME

Based on the above experiment, the following conclusions can be summarized:
1. The rate of wear for various percentage of Jatropha oil based bio-lubricant was different. However, the rate of wear for 10% and 20% of Jatropha oil based bio-lubricant are near to the pure lubricant SAE 40.
2. In this experiment, we can found temperature of lubricating oil increases with sliding increasing time for each percentage of Jatropha oil based bio-lubricant. However, JBL10 showed significant performance as it generates less amount of heat compared to the other samples.
3. In this experiment, we can found that having lower wear resistance bio-lubricant contains higher coefficient of friction.
4. Since Jatropha oil based bio-lubricants have higher coefficient of friction compared to pure lubricant SAE 40; it can be assumed that the fatty acid molecules available in Jatropha oil do not build a soap film on a surface test.
5. For each experiment, Iron, Aluminum and Chromium content increase because of wear occur in pin and disc. 6. In term of viscosity, except JBL40 and JBL50, all bio-lubricants meet the ISO VG100 requirements.

XI. ACKNOWLEDGMENT

I have taken efforts in this project. However, it would not have been possible without the kind support and help of any individuals and organizations. I would like to extend my sincere thanks to all of them. I highly indebted to Guide Prof Dr. Abhang L.B. for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project. I thank and appreciations also go to our colleague in developing the project and people who have willingly helped me out with their abilities.

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