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PERFORMANCE OF BIO OIL ON JOURNAL BEARING INSTEAD OF SYNTHETIC OIL

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***Abstract* -** Rapid decrease in petroleum resources, we are in search of alternative sources for power generation and environmental hazards alarms to use eco-friendly alternative. Jatropha is a non-edible sourced Bio-lubricant shows excellent coefficient of friction, noble anti-wear capability, low environmental emission. Recent research states Jatropha have higher viscosity and improves the load carrying capacity. Comparative study of popular synthetic lubricant (i.e. 20W40, Turbinol XT46 oil) with Jatropha oil has been carried out. The friction forces and the hydrodynamic friction coefficients are calculated and compared. Rapid depletion of petroleum resources and environmental hazards alarms to use eco-friendly alternative. Jatropha is a non-edible sourced Bio-lubricant shows low coefficient of friction, anti-wear capability, low environmental hazardous.

***Key Words*:Bio-lubricant, Jatropha, journal bearing, load carrying capacity, pressure distribution and viscosity.**

1. INTRODUCTION

Lubricant is a substance that reduces wear and friction by formation of thin oil film in between the contacting areas of two mating bodies. Removal of heat, prevention against corrosion, transmission of power is the basic functions of lubricating oil. Lubricant roles as seal between the two moving boundaries layers and hence trap and remove the wear particles forms in between them. To perform this role lubricating oil must possess some specific chemical and physical characteristics. The viscosity of the lubricant is the principal characteristic of the lubricating oil which greatly influences the friction and wear reduction and thus increases the overall efficiency of power transmission. [1]

At present the world is dealing with increasing crude oil price, depletion of crude oil reserves and global environmental concern about preventing the environment from pollution, have generated awareness in the society for developing and using the environment friendly alternative lubricant from derived sources. Non-edible vegetable oil based bio-lubricants. are environment friendly as they are bio-degradable, non-toxic and having zero contribution in greenhouse effect and potential of these non-edible sourced bio-lubricants for automotive application is discussed and non-edible sourced lubricants lave enhanced lubricity, good anti wear property, higher viscosity and viscosity index, low evaporation and emission, increased equipment life and high load carrying capacity. [2]

Vegetable oil can be used as lubricants in their natural form. Advantages of vegetable oil are that they show higher viscosity index and flash point compared with the mineral oil. Limiting side is that they are susceptible to oxidation hence low oxidation stability, low temperature limitation and unpleasant smell, filter clogging tendency at lower temperature. [3]

By using Cygnus wear setup and four-ball tribo testing machines setup we can find properties of Jatropha oil. Jatropha oil (JO) by volume fraction of 16-56% has been blended with the base lubricant SAE-40 oil to formulate the bio-lubricants and results showed that the lubrication regime occurred during the test was boundary lubricated while the main wear mechanisms are abrasive and adhesive wear. Lowest wear was found with the addition of 12% Jatropha oil in SAE 40 oil and above 22% concentration of JO in SAE 40 oil, the wear rate get increased considerably. The result of tribotest shows an addition of Jatropha oil in the base lubricant shows excellent lubricant additive characteristics, which reduce the friction and wear scar diameter by maximum 35% and 30% respectively during the tribo test. The application of 11% bio- lubricants in the automotive engines will enhance the mechanical efficiency and take part to reduce the dependency on petroleum oil as well. [4]

2. JATROPHA BIO-LUBRICANTS

Jatropha Bio-lubricant is a non-edible sourced vegetable oil which shows potential characteristics to be used as bio lubricant as it have high viscosity and viscosity index compared to other vegetable oils which are close to the commercially used synthetic oils. Analysis showed that the viscosity, density, thermal conductivity and pour point of Jatropha were higher than the values of SAE 20W40 oil engine oil while specific heat, flash point and refractive index values of Jatropha were less than the values of SAE20W40 oil engine oil.

- It's an oil seed tree.
- It produces very high quality bio fuel.

Fig 1. Jatropha seed

1.1. Problem statement

The mineral oil causes oil pollution due to non-degradable that's why bio oils are been used as an alternative for mineral oils .These are pollution free ,it can last longer, it has better properties like flash point ,pour point ,fire point, viscosity, viscosity index, foaming ,acidity alkalinity etc. Bio Oils are used for load carrying capacity of Journal Bearings. It gives minimum oil film thickness.

1.2. Objective

To find the equivalent oils instead of mineral oil like bio lubricants such as jatropha which helps to determine the followings:

- Viscosity of oil
- Load carrying capacity of journal bearing

3. HYDRODYNAMIC JOURNAL BEARING

Hydrodynamic journal bearing is the very important component or part of any rotating machine and the working performance of hydrodynamic journal bearing depends upon the working performance of its lubricant during the lubrication. The Journal Speed and eccentricity ratio plays an important part in the working performance of journal bearing. A finite length short journal with L/D ratio 0.5 is used throughout the study and all dimension of hydrodynamic journal bearing used in this extensive study are as shown in table.

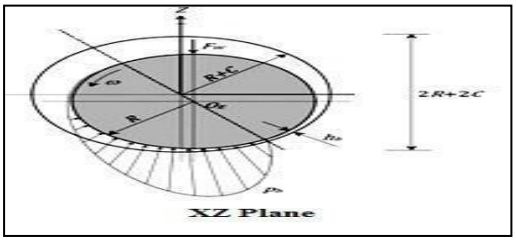


Fig 2: Schematics diagram of journal bearing with its pressure distribution

Table 3.1. The properties of the lubricants used in the experiments.

Properties	Turbinol XT 46	Jatropha
Viscosity at 40°C	42	52
Viscosity index	98	110
Flash point	215	265
Pour point	-6	1

4 .EXPERIMENTAL SETUP

4.1. Journal bearing tester

Fig 3. Journal bearing tester TR-60

Specifications

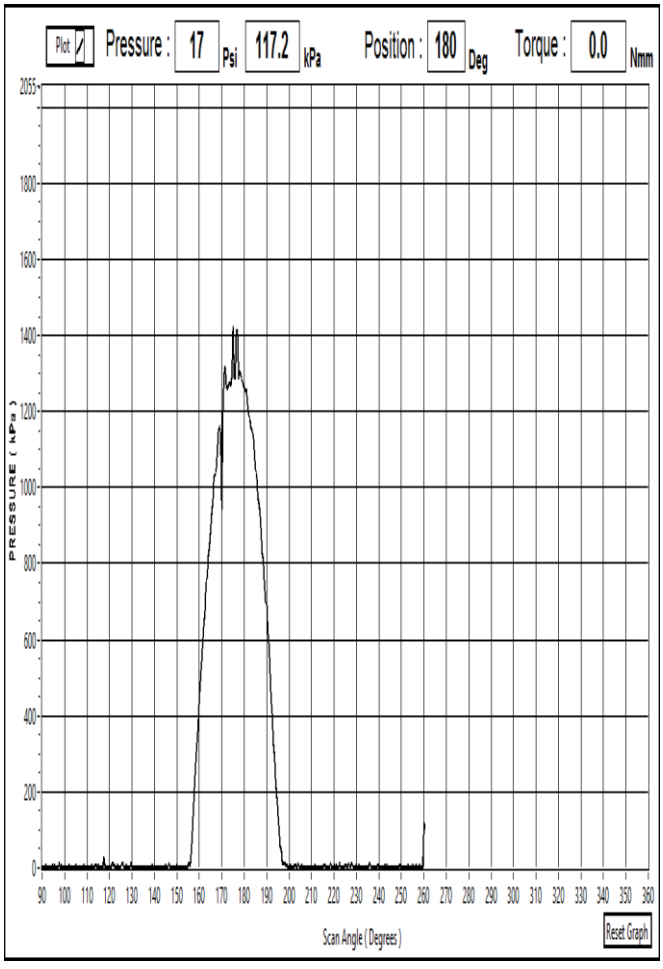
1. Journal Diameter : 39.90mm
2. L/D ratio : 1
3. Radial load :750N max
4. Speed range : 150 to 2000 rpm
5. Test bearing : 40.120 mm(inner diameter)
6. Journal Material : EN 31
7. Bearing material : Brass
8. Radial Clearance : 0.075mm
9. Oil tank capacity : 3 Lit
10. AC Induction motor : 1HP,1415 rpm,50Hz, 5A

5. TRIALS

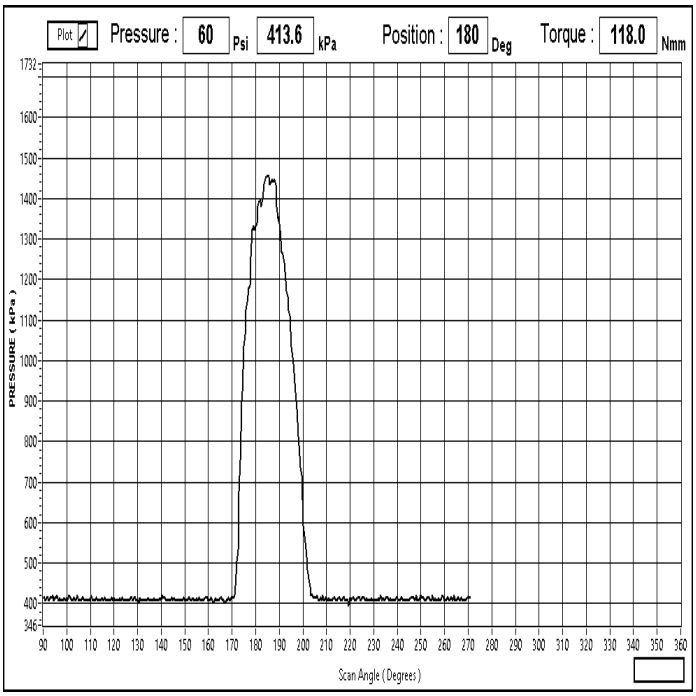
5.1. Trials on Journal Bearing Tester for Maximum Pressure

Lubricants	Load	Rpm	Maximum Pressure
SAE 20W40	450N	1500	**1400**
TURBINOL XT46	450N	1500	**1450**
JATROPHA	450N	1500	**1650**

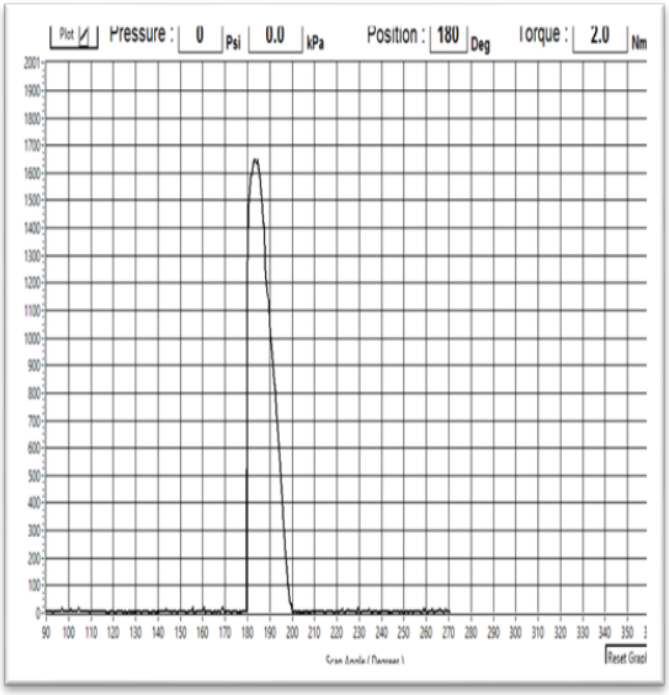
Table 5.1Reading of Maximum Pressure



Graph 5.1 20W40



Graph 5.2 Turbinol XT 46



Graph 5.3 Bio oil

5.2. Trials For Load Carrying Capacity

Load carrying capacity (W):

$$W = (\pi\mu Ul^3/4c^2) \times \epsilon/(1-\epsilon^2)^2 \times \sqrt{(\frac{16}{\pi^2}-1)\,\epsilon^2+1}$$

Lubricants	Load/ RPM	Load Carrying Capacity
SAE 20W40	450N / 1500	101× 10^3 N
TURBINOL XT46	450N / 1500	106× 10^3 N
JATROPHA	450N / 1500	132.85× 10^3 N

Table 5.2 Load Carrying Capacity

5.3 .Trials For Pressure Distribution

Pressure Distribution (P):

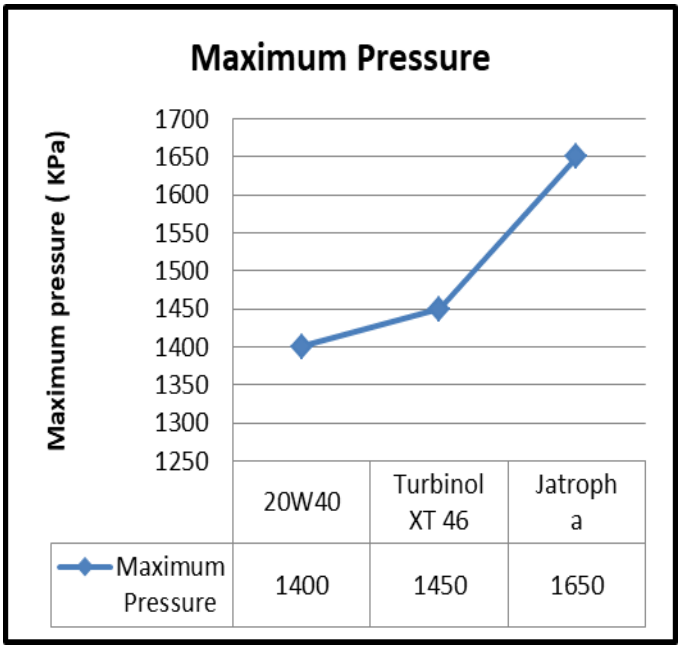
$$P = \frac{3\mu U\epsilon sin\theta}{rc^2(1+\epsilon cos\theta)^3}\left[\frac{l^2}{4} - Z^2\right]$$

Lubricants	Load/ RPM	Pressure Distribution
SAE 20W40	450N / 1500	324× 10^3 N/m^2
TURBINOL XT46	450N / 1500	347× 10^3 N/m^2
JATROPHA	450N / 1500	423× 10^3 N/m^2

Table 5.3 Pressure Distribution

6. RESULTS AND DISCUSSIONS

6.1. Maximum Pressure:

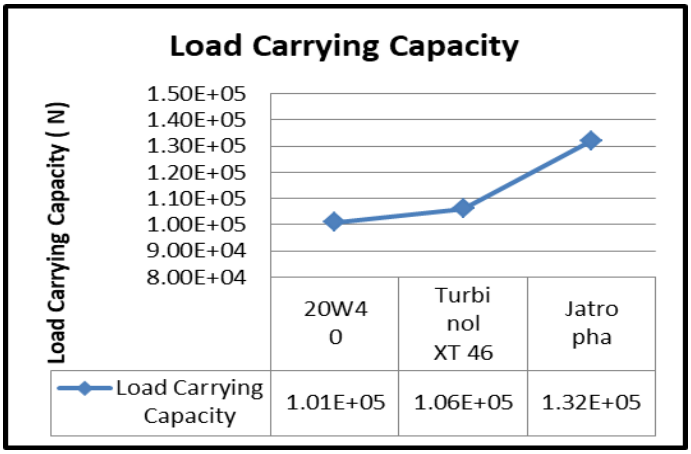


Graph 6.1: Comparison of Maximum Pressure

6.2. Load Carrying Capacity

Table 6.1: Reading of Load Carrying Capacity

LUBRICANTS	LOAD CARRYING CAPACITY
20W40	101×10^3 N
Turbinol XT 46	106×10^3 N
Jatropha	131.25×10^3 N



Graph 6.2: Comparison of Load Carrying Capacity

6.3. Pressure Distribution

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Lubricants	Pressure Distribution
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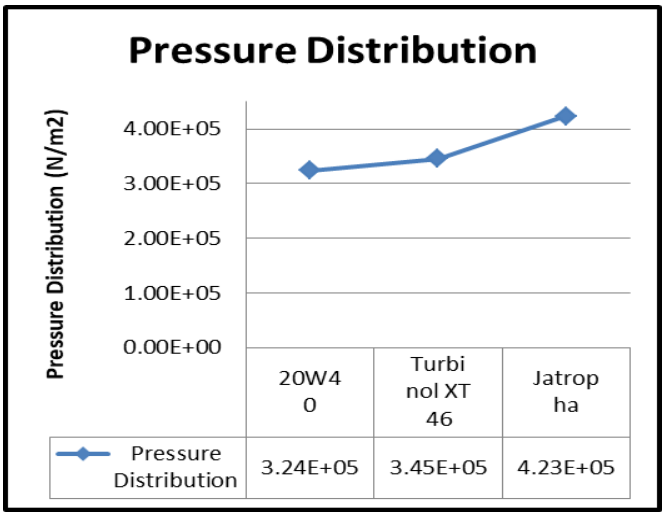

Graph 6.3: Comparison of Pressure Distribution

7. CONCLUSION

After testing of three oils that is SAE20W40 ,Turbinol XT 46 and Jatropha bio lubricant. we conclude that we got maximum tribological properties for Jatropha bio-oil as compared to XT 46 and 20W40, So it is benifical to use. The main property like biodegradability of a bio oil lubricant that's why bio oil lubricant is ahead of other bio oils with acts as non pollutant for environment. Jatropha works on low operating temperature generates high torque but power loss is high, this is because of high viscosity. Jatropha Biolubricant shows better results for load carrying capacity as that of the 20W40 and Turbinol XT 46 and both theoretical and analytical results shows enhancement in load carrying capacity of the Jatropha bio-lubricant rises with increase in journal speed and eccentricity ratio. Jatropha can be used as alternative biolubricant for journal bearing because it has biodegradability property and increased load carrying capacity hence can be used as alternative bio-lubricant for journal bearing application. Also jatropha shows the higher pressure distribution than SAE 20W40 and Turbinol XT46.

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