Frictional performance of banana peel blended paraffin oil under high loading capacity and high temperature

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ABSTRACT – Increased severity in operating conditions coupled with the environmental and toxicity issues related with using conventional lubricants. In addition, high price of fossil fuels has led to exploration of new kind natural additives as bio-lubricant. Banana Peel as agricultural wastes are potential to be developed as bio-oils that to replace the petroleum products, due to their environmentally friendly characteristics, biodegradable, nontoxic and renewable. The purpose of this study is to determine tribological properties as bio-lubricant under severe operation conditions to identify their ability for lubricants. Tribological performance of Banana Peel (BP) as a bio-lubricant was tested using four-ball test according to ASTM D 2783-03. Experimental results showed significant improvement in overall performance with increased BP content compared with paraffin oil (PO) through coefficient of friction parameter (COF) at 100 ˚C, lower value of COF which 0.086 for 50 %BP followed by 20% BP, 5% BP and 100 %PO at values 0.089, 0.456 and 0.595 respectively. As results, banana peel as extreme pressure additives has been proven itself able for use in lubrication applications in industry.

1. INTRODUCTION

Lubrication is the process or technique employed to reduced friction between two surface and wear of one of them or both. Most of friction and wear are created during start-up and shout down of engines, whereas Boundary Lubrication (BL) occur at low speeds. The major reasons of using lubricants in engines are to control friction properties, reduce wear, and improve the efficiency. Other reasons are for cooling, sealing, load balancing, cleaning and rust prevention. Engine oils consist of the base oil and additives. Mineral based oil is used in most application to increase effectiveness in lubrication of various industrial parts fixed and mobile. Although this oil is very useful, it is also an environmental hazard, poses damage on human, high price and is non-renewable source. Vegetable oils are known as renewable resources, environmentally friendly, non-toxic fluids, and are readily biodegradable [1-4]. The bio-based lubricant is promising to protect the surfaces from wear and damage in comparison with the mineral oil due to lower value of dynamic pressure [5]. In recent years, great development in engines and requirement on load carrying capacity of new and environmentally friend source (agricultural waste) especially at severe operating conditions. Vegetable oils as additive have several properties which can achieve this purpose comparable to mineral oils, such as high lubricity, low volatility, high viscosity index, environmental friendly, more biodegradability, low COF and low wear [6-7].

Banana skin been often referred as slipping tool by literatures. friction under banana skin was measured on flat panel common floor material during the sliding motion of shoes sole. The frictional coefficient was about 0.07 and this much lower than value on common materials and similar on well lubricated surfaces [8]. The dispersion of banana peel in paraffin is stable and smooth without any sedimentation problem. Moreover, oil shows good and promising tribological characteristic of lubricant [30]. In this study, Banana Peel (BP) had been investigated as an additive in lubrication system. This is a novel attempt to use banana peel in lubrication system. Hence, it is important and necessary to evaluate the characteristics of BP as lubricant additive to show their effect of load and temperature on friction performance to test their ability for industry application.

2. RESEARCH METHODOLOGY

2.1 Material Preparation

Cavendish banana skin or banana peel (BP) which is pericarp (outside skin) had been chosen as natural additives in paraffin oil. Paraffin oil as based-oil has been mixed with banana peels because of simple structure, unique tribological behavior and flexible for use under different percentage in preparation of lubrication samples by using ultrasonic homogenizer. Ball bearings are common in mechanical studies, because they are widely used in automotive industry.

2.2 Lubricant Composition

There were four types of lubricant samples which are state in Table 2.1 below.

Table 2.1 Composition of lubricant samples

Lubricant samples	Composition of Lubricant sample
Sample A	100% Pure Paraffin oil
Sample B	Paraffin oil +5% Banana Peel
Sample C	Paraffin oil +20% Banana Peel
Sample D	Paraffin oil +50% Banana Peel

Ultrasonic Homogenizer was used to mix the paraffin oil with banana peel in one hour. The mixing of paraffin oil and banana peel was refined by using the clothe filter.

2.3 Friction Test

Three design parameters were performed which are percentage of lubricant, load and temperature. The four sample of lubricant are test under the constant temperature of 100℃ which the load gradually increased until obtaining load capacity. Friction test were carried out according to standard test methods for measurement of Coefficient Of Friction (COF) and Extreme Pressure (EP) properties of lubricants until obtaining welding point on four-ball testing, according to ASTM D 2783-03 (ASTM 2003). The test has been conducted for 30 minutes on four samples and the loads on ball bearings were in the range of 500 N to 1750 N as shown in Figure 2.1.

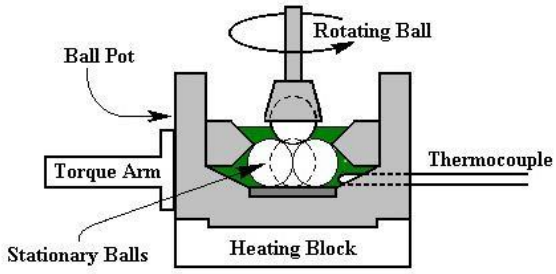

Figure 2.1 Schematic diagram of Four ball tester

3. RESULTS AND DISCUSSION

Coefficient of friction had been reduced significantly by dispersing different concentration of banana peel compare to paraffin oil at 100°C. This because of banana peel made both "ball bearing effect" and 'polishing effect", and consequently smoothing the rough friction contact surfaces. estimated that polysaccharide follicular gel played the dominate role in lubricating effect of banana skin after the crush [8].

Moreover, negative effect of friction reduction was observed in PO due the ploughing effect in this lubricant. This means that the film lubricating could not withstand severe load, resulting in real welding for steel balls. Meanwhile, for bio-lubricant, there was no real welding between them, except for 5% BP at 100 ˚C. Figure 3.1 below show at 100 ˚C, values of COF for all lubricants of 100% PO, 5% BP, 20% BP and 50% BP at start and welding point were 0.12, 0.121, 0.121, 0.13 and 0.595, 0.456, 0.089 and 0.086 respectively.

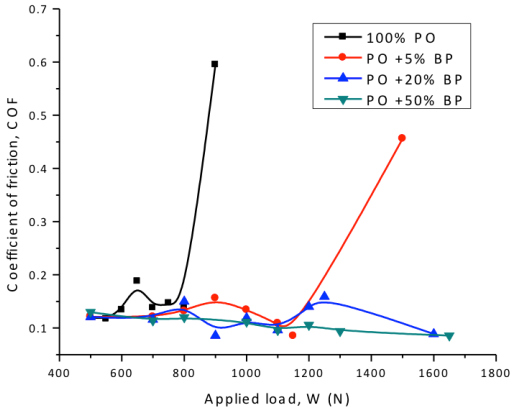

Figure 3.1 Effect of applied load, N on Coefficient of friction, COF at 100 ˚C

4. SUMMARY

This study was examined the effect of banana peel in paraffin oil. The result shows that the coefficient of friction was stable by using banana peel as friction ad dive at high load under 100°C. The value of Coefficient of friction at 100 ˚C was 0.086, 0.089, 0.046, 0.595 was refer to 50% BP, 20% BP, 5% BP and 100% PO respectively. Banana peel as natural additives has ability to improve physical and tribological properties of paraffin oil.

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