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Effect of load on friction and wear of banana peel as an additive

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ABSTRACT – Banana peel is a natural additive which can be used as an additive in the engine oil that can be promotes as a sustainable material development via the usage of renewable resource. In this paper, the preliminary study on the friction and wear of banana peel was mixed into paraffin oil carried out using four ball tester at different load and temperature. Ultrasonic homogenizer was used to mix the banana peel in paraffin oil. Wear scar diameter was measured using inverted microscope. As a yield, the addition of banana peel into paraffin oil has reduced the friction but also increases the wear at different load and temperature.

1. INTRODUCTION

Nowadays, lubrication system is widely being used and it has become the most important part in improving the engine performance and also can reduce friction and wear problems. Lubricant is used to reduce the frictional force between surfaces for most practical usage compared to the surface themselves [1]. Beside, unstable oil prices, the reduction of crude oil reserves in the world and the demand to protect the environment against pollution are all the factors that have attracted interest of researchers in developing alternative lubricant [2].

Vegetable oil is practical and good alternative resource because of their environment friendly, non-toxic and easily biodegradable. The low superior anti-corrosion properties are containing in the vegetable [3]. The banana peel has the capability to be utilised as an alternative lubricant because it could help to reduce the coefficient of friction (COF).

According to research by Mabuchi et al. [4], the frictional coefficient under banana peel as flooring material. They found that, the frictional coefficient was about 0.07 and estimate the polysaccharide follicular gel in banana skin played a dominant role in lubricating effect of banana peel after crush and the alter to homogenous sol. In addition, global production of banana is estimated to be around 48.9 million tons [5]. Hence, it is very essential to investigate the potential of banana peel as an alternative lubricant in terms of friction and wear to ensure it can be adapted by the industry.

2. METHODHOLOGY

In this research, tribology characteristics of lubricant additives (paraffin oil with 5% BP, paraffin oil with 20% BP and paraffin oil with 50% BP) and pure paraffin oil (100%) were conducted utilizing a four ball tester (TR 30L) at different load and temperature as shown in Table 1. The duration period was 30 minutes and the speed was 1000 rpm.

Table 1 Parameters for tribology testing.

Parameter	**Value**
Load (N)	60, 250, 500
Temperature (°C)	27, 80, 100

The fresh epicarp was ground into small particles by using a blender. Preparation of lubricant sample was determined by using the Equation (1). $V_{\%}$ is volume percentage $V_{substance}$ is volume of substance and $V_{solution}$ is volume of solution.

$$V_{\%} = \frac{V_{\text{substance}}}{V_{solution}} x100\% \quad (1)$$

Viscosity index of all lubricants were measured using Brookfield viscometer. Four ball tester was used to determine the friction and wear for all lubricants. Data acquisition system was used to gather the data which generated by four ball tester in form of frictional torque, T (N/mm). The frictional torque was converted to kg/mm in order to utilised in determining the coefficient of friction using equation (2).

$$\mu = \frac{T\sqrt{6}}{3Wxr} \quad (2)$$

Where, W is the applied load (kg) and r is the distance from center of the contact surfaces on the lower balls to the axis of rotation, namely, 3.67mm.

Wear scar diameter was measured in effort to attain the wear volume losses using inverted microscope.

Equation (3) is expressed to define the wear volume losses. Where, d is the wear scar diameter of ball bearing (mm), R is the radius of ball bearing (mm).

$$V = \frac{\pi(d)^4}{64(R)} \quad (3)$$

3. RESULTS AND DISCUSION

3.1 Kinematic viscosity index

Table 2 shows the result of kinematic viscosity on four lubricant samples at the different temperatures. From the table, the pure paraffin oil attains higher value of kinematic viscosity than pure paraffin oils. The presence of banana peel as additive in paraffin oil has contributed to the value of kinematic viscosity are lower. This is due to low kinematic viscosity of banana peel.

Table 2 Kinematic viscosity.

Temperature (°C)	Kinematic viscosity (mm^2/s)		
	27	80	100
100% PO	24.58	11.20	11.17
PO + 5% BP	24.55	11.00	10.82
PO + 20% BP	24.55	9.23	8.80
PO + 50% BP	24.46	8.76	8.11

3.2 Effect of load on coefficient of friction

Figure 2 depicts the variation of the coefficient of friction (COF) with the load for the various lubricants under different temperatures. There is a decreases of in the COF with the increases in the load. The comparison between pure paraffin oils and lubricant additives is implemented to evaluate the reduction of COF value. Thus, the paraffin oils indicate the higher COF value compared to lubricant additives. The paraffin oils and lubricant additives obtain the lowest value of COF are 0.06 and 0.007 respectively. The reduction of percentage in COF attained of 87.9 %.

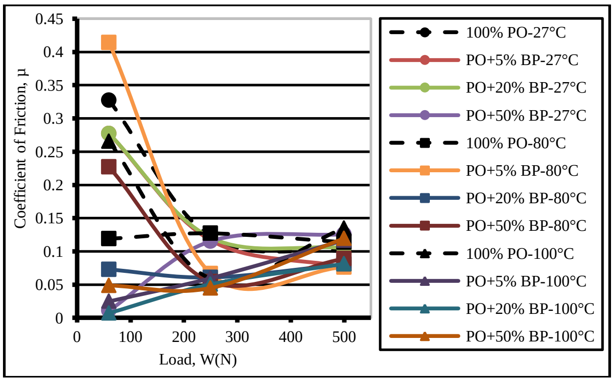

Figure 2 Effect of load on coefficient of friction.

3.3 Effect of load on wear volume losses

Figure 3 shows the effect of different percentage of pure paraffin oils and lubricant additives on the wear volume losses (WVL). The WVL gradually increases with increase in load. The pure paraffin oils and lubricant additives obtain the lowest value of wear volume losses are 3.45 x $10^{-13}m^3$ and 2.36 x $10^{-12}m^3$ at 60N respectively. The percentage of WVL by lubricant additives have increased to 85.38%. This result show the use of banana peel as additive is not suitable for reducing wear. This is due to low kinematic viscosity index of banana peel comparing to pure paraffin oil. This will lead to more contact surface during the friction test which increased the wear volume.

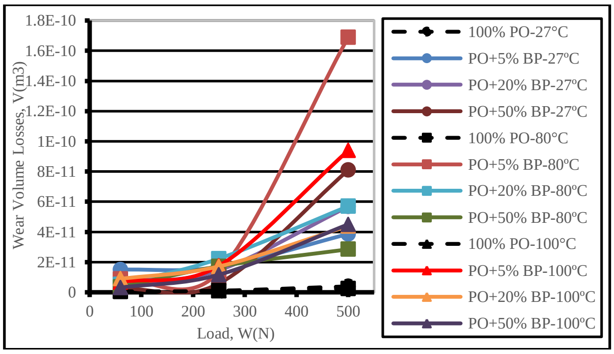

Figure 3 Effect of load on wear volume losses

4. CONCLUSION

The addition of banana peel in paraffin oil significantly affects the tribology characteristics in reducing the friction coefficient at 0.007. However, the wear volume is higher by using banana peel as additive comparing to paraffin based oil.

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