Environmentally Friendly Lubricating Greases from Coconut Oils and Palm Oil

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Abstract. The purpose of this study is to compare the lubricating grease from coconut oils and palm oil as base oils. The consistency, dropping point, and tribological properties of lubricating greases were investigated and compared between coconut oils and palm oil. The consistency and dropping point were measured to investigate physical properties. Whereas, the pin on disc apparatus was used to investigate wear and coefficient of friction. The results indicate that the coconut oil greases show superior tribological properties when compare to the palm oil grease.

1. Introduction
In grease technology, lubricant base fluids was derived from the refining of crude oil downstream petroleum raw materials. Due to the environment concerns, the worldwide trend of lubricating grease is eco-friendly. The eco-friendly lubricating grease is renewable, biodegradable, and non-toxic [1]. Biodegradability of greases is related to the ability of their base oil to biodegradability. The sources of the base oils could come from vegetable oils or animal fats. In this paper investigated the characteristics of greases with different base oils. The coconut oils and palm oil was used as base oils. The characteristics of grease were investigated consisted of mechanical stability, lubricity and dropping point.

2. Methodology
Coconut oils and palm oil were used as based oil and these oils are a major component to produce grease. There are two kinds of coconut oils: refined coconut oil (RCO) and virgin coconut oil (VCO). Calcium soap was used as a thickener as based oils. Analysis of physical properties of greases consists of penetration by using ASTM D 217-10, NLGI Number by using ASTM D 217-10, and dropping point by using ASTM D 566-09.

Tribological properties were used a pin on disc apparatus. The pins were 7.9 mm diameter and the disks were 170 mm diameter and 5 mm thick. The flat faces of disk were ground to a surface finish of about 0.972 Ra. The surface hardness of the pin was about 610 BHN and that of the disks about 135 BHN. The disk was prepared from AISI 1015 and stainless steel 440C used to prepare the pin. The disk was rotated at speed of 500 rpm and load of 300 N.
3. Results and Discussion

3.1 Physical properties
The penetration value and dropping point of coconut oils and palm oil lubricating greases are shown in Table 1. The penetration tests evaluate consistency of lubricating greases. From the table, it shows that the penetration value of coconut oils is lower than that of palm oil and the dropping point of coconut oils lubricating grease is higher than that of palm oil. This is due to effect of fatty acid chain length in palm and coconut oils. Longer fatty acid chain makes stronger interlocking fibers, resulting in harder grease matrix [2].

Table 1 Physical properties of base oils

| Base oil | Penetration (x 0.1mm) | NLGI Number | Dropping Point (°C) |
|----------|----------------------|-------------|-------------------|
| Palm oil | 292                  | 2           | 110               |
| RCO      | 213                  | 4           | 120               |
| VCO      | 177                  | 4           | 120               |

3.2 Tribological properties

3.2.1 Wear
The wear test was carried out at speed of 500 rpm and load of 300 N load under room temperature by using pin on disc apparatus for a test duration of 50 minutes. Figure 1 shows that wear rate of the disc with different lubricating greases. Wear rate of palm oil is higher than that of coconut oil at the first 10 minutes and after 50 minutes wear rate of palm oil is almost coincide with the RCO oil. Total wear mass of lubricating greases for a test duration of 50 minutes is shown in Figure 2. The wear mass of the VCO is the lowest.

Figure 1. Comparison of wear rate of lubricating grease from coconut oil and palm oil
3.2.2 Scar width and scar diameter
Scar width and scar diameter of disc and pin are shown in Figure 3 and 4 for different lubricating greases. The VCO has the good lubricating greases with 3.889 and 2.082 µm scar width and scar diameter, respectively.

3.2.3 Coefficient of friction.
Coefficient of friction (COF) was measured at the steady state condition. From Figure 5, it shows that CoF of VCO is the lowest among the base oils.
4. Conclusion
Eco-friendly lubricating greases from coconut oils and palm oil have been developed. The performance parameters of wear and coefficient of friction of coconut oil lubricating grease is better than that of palm oil.

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