

Palm oil as an alternative lubricant oil: A brief review

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KEYWORDS

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Viscosity

ABSTRACT

This paper emphasize on the application of palm oil as an alternative lubricant. This issue has relevant consequences toward automotive industry and the entire society. To date, numerous research has been done to evaluate the potential of palm oil as a promising candidates to replace petroleum base lubricant in order to create healthy environment by utilizing renewable sources available.

1. Introduction

Nowadays, lubricant play a very important role in engines and machines which are mainly used to reduce the friction and wear between two contacting surfaces. It can performs a variety of functions such as protect metal surfaces against corrosion, acts as a heat transfer agent, flushes out contaminants, absorbs shock and act as a seal against dirt, dust and water. By providing a protective film between two sliding solid bodies, it can reduce the frictional force, amount of wear and the degree of surface adhesion.

Most of lubricating oils used today are based on mineral oil which being extracted from petroleum oil. Referring to the statistic, approximately 37.9 million metric tons of lubricants were used in 2005 globally [1]. Although this oil is very useful and widely used, it is also becoming an environmental hazard due to their toxicity and non-biodegradability.

Because of growing attention to the environmental issues, the industry has been trying to formulate biodegradable lubricants which can be used to substitute the usage of petroleum based oils as lubricants. From recent study, vegetable oils have potential to be used as alternative lubricants for industrial and automotive applications due to their environmental friendly characteristics. Vegetable oil, especially palm oil is one of the promising candidate that can be develop to replace petroleum base oil as an alternative lubricant in the future.

Palm oil production in Malaysia is one of the highest among the producing countries and this is attributed to the climate and good management arising from R&D [2]. By fully utilizing the palm oil as an alternative lubricant,

it can bring more profit to Malaysia and contributing to the greener environment.

2. Palm oil.

There are two types of oil that can be obtained from the oil palm: palm oil from the flesh of the fruit (mesocarp) as shown in Figure 1, and palm kernel oil from the seed or kernel (endocarp). The unripe fruits contain very little oil but the mesocarp of ripe fruits has an oil content of 70%–75% of its total weight.

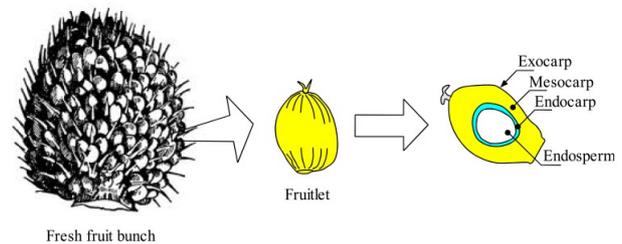


Figure 1: Palm fruit cross section diagram.

Palm oil is semi-solid at room temperature; a characteristic brought about by its approx. 50% saturation level. In its virgin form, the oil is bright orange-red in color due to its high content of carotene. Palm oil contains palmitic acid (a fatty acid made by our body), the monounsaturated oleic acid, polyunsaturated linoleic acid (an essential fatty acid) and stearic acid [3].

Due to this composition, it can act as anti-wear protector and friction modifiers, due to strong interactions with the lubricated surfaces. In addition, their amphiphilic nature gives them a good film/force relationship, due to the long fatty acid chain and the presence of polar groups in the palm oil [4]. For this reason, palm oil

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have the peculiarity of being effective as both boundary and hydrodynamic lubricants.

3. The advantages and disadvantages of palm oil.

The main important aspect to consider palm oil as a new alternative lubricant is because of its biodegradability, generally less toxic and renewable. Thus, it can be used in sensitive environments and prevent pollution because of their environmental benefits.

Besides that, vegetable oils have excellent lubricity, which is far superior compared with that of mineral oils. Several research have been done to study the performance of palm oil as compared to the commercial engine oil. The results shows that palm oil produce lower coefficient of friction and establish strong stability of the lubricant film [5,6]. It will contribute to the wear prevention of the contacting surfaces and increase the efficiency of the mechanical system.

Another important property of palm oil is their high flash points. Typically, the flash point of vegetable oils is 326 °C, whereas that of common mineral oils is 200 °C. In general, flash and fire points identify lubricant volatility and fire-resistance properties. Both factors are important for transportation and storage requirements. Due to higher flashpoint value as compared with mineral oils, it can considerably reducing the risks of fire in case of a lubricant leak, and providing extra safety [7]. Table 1 summarizes some of the advantages of palm oil as an alternative lubricant.

Table 1: Advantages of palm oil as lubricant.

Properties	Advantage
Higher lubricity	Lower friction losses, better fuel economy
Lower volatility	Decrease exhaust emissions
Rapid biodegradation	Reduced environmental hazards
Better skin compatibility	High cleanliness and less dermatological at work place
Higher flash points	Provide higher safety
Higher boiling temperatures	Less emissions

Despite their advantages as mentioned above, palm oils suffer from several major drawbacks in term of thermal and oxidative stability. Low oxidative stability indicates that palm oil will oxidize rapidly during use if untreated, becoming thick and polymerizing to a plastic-like consistency. Furthermore, it have

weakness in term of viscosities as well. It will constraint the application of palm oil as an engine oil. For engine oil, a small change in viscosity is desirable to provide wide range of operating temperatures over which a given oil will provide satisfactory lubrication.

4. The various applications of palm oil

Palm oil have potential to be develop commercially because it provide significant advantages as an alternative lubricants for industrial and maintenance applications due to their superior inherent qualities. It can be used in various industrial and maintenance applications. Some of their important applications are as follows; industrial oils such as metalworking fluids, machine oils, compressor oils, hydraulic oils and special oils such as process oils, white oils and instrumental oils.

In addition, palm oil can cover majority of the lubricant use in automotive applications. These oils can constructively replace mineral oil as engine oils, hydraulic oils, compressor oils, lubricants for generators, pump sets, transmission fluid and metal-working oils. It will surely reduce high percentage consumption of petroleum based lubricant.

5. Palm oil development method

Due to the several weakness of palm oil as discussed before, it cannot be used directly as lubricants. In order to improve palm oil to have satisfactory lubricant performance, several modification technique have to be done. The available method which is widely being used by the researchers lately including chemical modification especially by using esterification process. It is one of the most promising method to increased thermo-oxidative stability of palm oil while maintaining the beneficial viscosity and lubricity characteristics of the base oils [8].

Another method which is currently use for palm oil development is by using anti-wear additive. Majority of the researchers tend to blend nanoparticle additive together with vegetable oils. It normally give positive feedback as the coefficient of friction are slightly reduced due to the rolling effects between the rubbing surfaces and contribute to the wear prevention [9].

6. Future prospects

The increase in world lubricant demand is clearly being contributed by the rapid industrialization and increasing vehicle ownership. This will lead to the environmental

issues due to the high consumption of petroleum based lubricant form year to year. Thus, a proper strategies and planning should be carried out in order to overcome this issue.

Recently, Malaysia is a world's largest producer and exporter of palm oil and accounts for 10% of the country's Gross Domestic Product (GDP). For this reason, Malaysia should be leading country to commercialize the palm oil as a new environmental friendly lubricant and manage to create green and healthier environment for the future

In facts, palm oil exceed the performance of mineral oil in term of viscosity, volatility requirement, and response to additive. However, providing better performing lubricants for specific applications are becoming the challenge in the lubricant industry. Thus, further scientific research are necessary to solve several weaknesses of palm oil before it can be widely commercialize.

7. Conclusion

Due to the advantages and good lubricating characteristics of palm oil, it has huge potential to be develop as a substitute for petroleum base lubricant. Although a number of studies are already available in this field, further systematic research that can confirms the tribological behavior of palm oil must be conducted. The present study can support the establishment of alternative lubricant, as well as encourage and support research on using renewable natural sources as alternatives.

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