UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PRELIMINARY STUDY OF THE AVAILABILITY OF USING LUBE OIL BASED ON PALM OIL AS LOCAL STRAIGHT VEGETABLE OIL FOR ENGINE APPLICATION

This report submitted in accordance with requirement of the UniversitiTeknikal Malaysia Melaka (UTeM) for the Bachelor's Degree inMechanical Engineering Technology(Maintenance Technology)(Hons.)

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's inMechanical Engineering Technology (Maintenance Technology) (Hons.). The member of the supervisory is as follow:

……

(Azrin bin Ahmad)

ABSTRAK

Kajian mengenai haus merupakan satu kajian yang panjang. Kajian ini dilakukan bertujuan untuk menyiasat komposisi minyak sawit yang sesuai umtuk ditambah kepada minyak asas mineral dan untuk melihat diameter haus yang dihasilkan. Dalam kajian ini, minyak konvensional telah digunakan sebagai minyak asas. Pelbagai peratus minyak sawit telah dicampurkan kepada minyak mineral. Eksperimen ini telah dijalankan dengan menggunakan empat penguji bola dan kelikatan kinematik. Untuk melihat permukaan objek yang telah haus akibat daripada geseran, imej pada permukaan kerja akan diambil dengan menggunakan mikroskop optic. Ujian ini dilaksanakan untuk memastikan objektif yang dinyatakan dapat dicapai. Kajian ini perlu didokumentasikan kerana ia boleh dijadikan bahan rujukan yang baik untuk kajian yang seterusnya dan juga untuk penyelidikan yang berkaitan dengan minyak pelincir yang juga menggunakan minyak sayuran sebagai pelincir.

ABSTRACT

The investigation of wear is an extended study. The aim of this is to investigate the suitable composition of palm oil to be mixed with the mineral base oil and its wear scar diameter that produce. In this study, the conventional oil was used as a base lubricant. The various blend of palm oil is mixed with the base lubricant. The experiment was conducted by using four ball tester and kinematic viscosity test. To investigate the wear and friction behaviour, image of the work surface will be taken by using the optical microscopy. Test has been done to ensure that in can meet the objective stated. The progress of this study needs documenting, as it can be a good reference for the next student who involve in this study as well for a research related to the using lube oil based on the local straight vegetable oil.

DEDICATION

This thesis is dedicated to my parents

Abdul Rahman bin Haron and Aisyahbinti Ismail

who introduced me to the joy of reading from birth, enabling such a study to take place today.

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Special thanks and appreciation to my parents and family for their cooperation, encouragement, constructive suggestion and full of support for the report completion, from the beginning till the end.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

CI	-	Compression Ingnition
CPO	-	Crude apalm Oil
cSt	-	Centistokess
POIM	-	Palm Oil Reseach Institute Malaysia
POME	-	Palm Oil Methyl Esther

CHAPTER 1
INTRODUCTION

1.1 Introduction to Lubricant

Lubricant is a substance that used to reduce the friction and wear between two moving surface. It also used to clean, improves sealing, reduces corrosion and improves cools up the engine(Idros, Ali, & Islam, 2012). The major function of the lubricant is to avoid the extreme and wear that destroy the surface due to friction that goes on between the parts. In some way, the purposes of the lubricant in an engine are to bring into being an efficient engine that extends the lifespan of the engine and will contribute to energy saving and clean burning (Huda, et al., 2010). On the other hand, lubricants are used to separate the moving parts in a system. It will reduce the friction and surface fatigue, simultaneously reduced the heat generation, vibrations and operating noise. The thin film modes of a lubricant between devices against asperities of the devices are generally used as a protector. It is because without a protector, it will cause the surface wear and damage due to the pressure that form between the devices in sliding motion.

The friction and wear between a component and mechanical devices can be minimizing by applying the lubricant. Furthermore, lubricant can also be used as a medium for heat transfer to remove the heat from the device during the operation. The most important properties of lubricant are their viscosity. When the lubricants have the higher viscosity, it also requires large forces against its own intermolecular forces in sliding motion between the devices. While, if the lubricants have the lower viscosity, it will causes the surface of the devices to be rubbed directly and further damage the devices (Chen & Chih, 2011). Currently, the demand of lubricant in industrial application is extremely huge especially in an automotive industry. Since,

the uses of this lubricant will produce hazardous waste product because of their high content of pollutants which came from thermal degradation products andcombustion products of fuel and lubricant(Rincorn, Canizares, & Garcia, 2006). So that, in order to overcome this problem and to avoid the environmental pollution that cause by the lubricant, the developing of bio-lubricants like soybean oil, castor oil, corn oil, canola oil and others is greatly valuable in the 21st century.

1.2 Vegetable Oil as a Lubricant

In recent years, lubricants are exposed to the environment through evaporation, leakage, and spills have led to concern of pollution and environmental health (Sahai & Preeti, 2013). In the present day, vegetable oil is becoming the most important source of bio-lubricant. The needs of renewable and biodegradable lubricants had become the most environmental concern issue nowadays. Lubricant that made from the vegetable oils is already used since the earliest time. It also used in many applications especially in industry. The remaining of the world petroleum resources had become the serious concern today. Mineral oil has conquered the lubrication application since the last 100 years. Now as the mineral oil and the synthetic oils are not readily biodegradable, the environmental issues starts to arise.

Today, the vegetable oil is gaining its popularity because of its advantage to the environment such as its biodegradability, renewability resources and the posses of adequate performances in a variety application (Bari & Hayder, 2009). The enormous advantage of vegetable oils is that there are widely introduced as a renewable sources. Furthermore, when operate in an engine, vegetable oil has shown its potential to reduce carbon monoxide and hydrocarbon emissions. Vegetable oil can be use as a bio-lubricant in two ways which is by directly blending vegetable oil with commercial lubricant or converting the vegetable oil fatty acid methyl ester (FAME) to use as the lubricant additive. For instance, it were reported that, palm oil based lubricant that blends improved the wear lubricity and wear properties compared to the commercial mineral based lubricant. Moreover, it is also reported that, vegetable oil like coconut oil will produce less smoke, good thermal and oxidative stability in an 2-stroke engine (Masjuki et al., 2011).

In addition, the problem arises that is related to the vegetable oils during the engine tests can be classified into two group which is operational and durability problem. Operational are allied to the starting ability, combustion, ignition and the performances. While, durability problem are allied to the deposit formation and also lubricating oil dilution. From the observation, when using the straight vegetable oil for long hours, its tends to choke the fuel filter because of insoluble present in the straight vegetable oil and high viscosity. The higher viscosity of the vegetable oil will causes the fuel atomization become poor, high spray jet penetration and thus large droplet size. This will results in poor combustion accompanied by the loss of power and economy (Agarwal et al., 2007).

The lubricant formulation is based on such criteria including the benefits and the limitation of vegetable oils. The appliances of vegetable oil functioned as an anti wear and reducing friction, fatigue resistance and assist the load capacity between two contacting surfaces. This is because vegetable oil produces low friction coefficient, better pitting resistance and equal scuffing load capacity even though it shows poor thermal and oxidative stability. During the extreme loads, vegetable oils also will become less effective. Thus, it indicates that, vegetable oils are particularly effective as a boundary lubricant since the high polarity of the base oil as a strong interactions within lubricated surfaces (Syahrullail et al., 2013). Table 1.1 shows the advantage and disadvantages of vegetable oil as a lubricant.

Table 1.1: Advantages and disadvantages of vegetable oils as a lubricant

Advantages	**Disadvantages**
High Biodegradability	Low thermal stability
Low pollution of the environment	Oxidative stability
Compatibility with additives	High freezing points
Low production cost	Poor corrosion protection
Wide production possibilities	
Low toxicity	
High flash points	

1.3 Problem Statement

Mineral oil which is derived from the crude petroleum and synthetic oil from petrochemical are mainly used as based oil in lubricant.There have been the serious anxieties about the remaining of the world petroleum resources. By using the mineral and the synthetic oil, it will cause environmental problem because it is not environmentalfriendly.Its raw material also unstable and poses to fire hazards. Whereas, the use of vegetable oil as a base of lube oil have been practised. Vegetable oil can and have been used as a lubricants in their natural form. It has an excellent lubricity which is far superior than a mineral oil and also have high Viscosity Index (VI), than petroleum oils.

The viscosity of a high VI oil changes less than low VI for a given temperature change. The oil viscosity does not reduce as much when exposed to high temperature and does not increase as much as the petroleum oils when it exposed to cool temperature.Vegetable oil also have a high flash points.Then, it is biodegradable which is less toxic, renewable and reduce dependency on the imported oils (Schobert, 2013). Vegetable oil also have high pour point. This can be address by winterization or addition of chemical additives (Honary, 2001).

Every year more than 10 million tons of mineral oil-based lubricant and hydraulic fluids leak to the ground and dispose to the environment. This result as a problem to the environment since the mineral based oil will contribute a bad effect and it will inhibit the growth of plants which was contaminated to the ground water which the reaction is more than 100 years and are toxic to the aquatic life. In order to solve this problem, there is a growing interest in the used of green lubricant. The uses of mineral oil as based oil are replaced with the vegetable oil.

Vegetable oil is selected for their suitability to be used as industrial lubricant. The problematic state of the art here is that vegetable oils performance will be affected while operating at a high pressure and temperature. It is due to their chemical and physical composition can changes due to oxidation. The most terrible cases are when the oxygen bond in vegetable oil can lead to metal oxidation and weaken the structure of the metal. Then, under extreme load, vegetable oil will become less effective (Sharullail et al., 2013).

1.4 Objectives

From the background and the problem statement that have been stated, the objective of this research is:

1. Testing the availability of using the local straight vegetable oil with mineral oil compared to the conventional product.
1. To find the suitable composition of palm oil that needs to be mix with the mineral oil as a lubricant

1.5 Scopes

In order to achieve the objective, a few scopes have been drawn:

1. Determining the properties of bio lubricant by using tribological test and oil analysis test
2. Determining the composition of straight vegetable oil that suitable to be mixed with the mineral oil to form a lubricant
3. Test and characterized the newly developed lubricant oil to show it availability by using four ball tester method and heated viscometer.

CHAPTER 2
LITERATURE REVIEW

2.1 Oil Lubricant

Lubricant plays an important role in the expectancy life of an engine. The engine would become overheated and deteriorated very quickly without oil. By using lubricant, it will help to mitigate this problem. Then, if they are properly monitored and maintained, it can extend the life of an engine.

Lubricant is a substance that is used to reduce friction and wear between moving surfaces. A good lubricant will have the characteristics such as high boiling point, low freezing point, high viscosity index, high thermal stability, hydraulic stability, corrosion prevention and high resistance to oxidation. Lubricant also used to separates the moving parts in a system. So that, it will reduce the friction and surface fatigue simultaneously reduces heat generation, vibration and operating noise.

There are complex processes to make a proper lubrication of an engine. The lubrication oil can perform many functions under a different operating condition which is:

1. Provide a barrier between the moving parts to reduce the friction and wear.
2. Disperse heat.
3. Absorb and suspend the dirt and others particle. Dirt will be carried out by the oil to the oil filter where it can be trapped.
4. Neutralize the acid that can build up and destroy the polished metal surface.
5. Coat all engine parts.

6. Resist sludge. Oil is able to endure the high temperature without changing in their physical properties or breaking down.

2.2 Mineral Oil

There are various types of lubricant that available all over the world which is synthetic oil, mineral oil, re-refined oil and vegetable oil. Nowadays, most of the lubricants in the market are based on mineral oil which is derived from the petroleum oil. This is not adaptable with the environment because petroleum oil are not environmental friendly, non-biodegradable and it also toxicity.

Mineral oil which are derived from the crude petroleum are have been widely use. Nevertheless, since there are issues on the environmental effect of mineral oil such as the contamination of soil and water from the event of spillage will result a serious catastrophic disaster on the environment due to the presence of non-biodegradable lubricants. Most of the current lubricant contain petroleum base stocks, which is toxic to the environment and are hard to dispose after use.

2.3 Vegetable Oil

Vegetable oil can play a vital role to replace the petroleum lubricant as it possesses various advantages. The greatest part of the vegetable oil are triglycerides which contain three hydroxyl groups and long chain of free fatty acids that attached at the hydroxyl group by the ester linkages acids. These triglycerides will provide the high strength of the lubricant film that interact directly with the metallic surface and reduce friction and wear. The strong intermolecular reaction will provide a resilient to the vegetable oil to change in temperature and provide more stable viscosity.