UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TO INVESTIGATE THE FRICTION AND WEAR OF THE RECYCLE ENGINE OIL

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Maintenance) with Honours.

by

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I hereby, declared this report entitled to investigate the friction and wear of the recycle engine oil is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Maintenance) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Kajian ini adalah untuk mengkani geseran dan calar terhadap minyak engine yang dikitar semula dengan X1-R sebagai bahah tambahan. Tujuan kajian ini adalah untuk menganalisis kelikatan, pekali geseran dan mengkaji jenis calar minyak engine yang di kitar semula. Kajian ini terdapat lima sample pelincir iaitu 100% minyak enjin digunakan, 95% minyak enjin digunakan + 5% X1-R, 90% minyak enjin digunakan + 10% X1-R, 85% minyak enjin digunakan + 15% X1-R dan 80% minyak enjin digunakan + 20% X1-R. Kajian kelikatan dilakukan dengan menggunakan viskometer yang dipanaskan pada suhu 40ºC dengan mengikuti standard ASTM D445, untuk pekali geseran adalah dengan menggunakan Four Ball Tester dengan mengikuti standard ASTM D4712 dan untuk mengkaji sifat calar dilakukan dengan menggunakan ujian mikroskopik. Kelikatan menunjukkan bahawa tebal minyak, semakin tinggi kelikatan minyak akan lebih tebal. Hasilnya menunjukkan kelikatan yang lebih tinggi ialah 85% minyak enjin yang digunakan + 15% X1-R dengan nilai 71.8 cSt. Kemudian, pekali geseran menunjukkan bagaimana minyak pelincir mencegah setiap galas bola disebabkan geseran yang kurang menghasilkan kualiti pelincir yang tinggi. Hasilnya menunjukkan 85% minyak enjin yang digunakan + 15% X1-R menghasilkan kurang geseran geseran yang 0.083471. Ciri-ciri calar itu menunjukkan jenis calar yang berlainan berlaku pada permukaan galas bebola.

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ABSTRACT

This investigation is about to study the friction and wear of recycle engine oil blends with additives X1-R. The objectives of this study are to investigate the viscosity, to study the coefficient of friction and to investigate the wear characteristic of recycle engine oil. There are 5 sample of lubricant which is 100% used engine oil, 95% used engine oil + 5% X1-R, 90% used engine oil + 10% X1-R, 85% used engine oil + 15% X1-R and 80% used engine oil + 20% X1-R. The investigation for viscosity is conducted by using heated viscometer at 40ºC by following standard ASTM D445 , for the coefficient of friction is by using Four Ball Tester by following standard ASTM D4712 and for the wear scar characteristics was done by using microscopic testing. The viscosity is show that the thick of the oil, the higher the viscosity the oil will more thick. The result show the higher viscosity is 85% used engine oil + 15% X1-R with value 71.8 cSt. Then, the coefficient of friction shows how the lubricant prevent contact each ball bearing due the less friction produce the high quality of lubricant. The result show 85% used engine oil + 15% X1-R produce less coefficient of friction which is 0.083471. The characteristic of wear it is show the different types of wear occur on the surface of ball bearing.

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DEDICATION

Dedicate to my beloved father and mother, Zakaria Bin Jaafar and Wan Meriam Binti Wan Semail. Also to my respectful lecturer and to all my friend in UTeM for their encourage.

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LIST OF SYMBOLS

SSU	-	Saybolt universal second
RW1	-	Redwood 1 second
cSt	-	Centistokes
μ	-	Coefficient of friction
Fn	-	Friction fore
FN	-	Applied normal force

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LIST OF ABBREVIATIONS

OEM	Original equipment manufacturing
SAE	Society of automotive engineers
ISO	International organization for standardization
ASTM	American society for testing materials
API	American petroleum standard

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CHAPTER 1

INTRODUCTION

1.1 Background

The request for lubricant oils is ceaselessly expanding with the expansion in the foundation of industrial facilities and the high increment in the quantity of vehicles and others transportation. Lubricant oils have been utilized essentially to reduce contact between moving parts of different hardware or gear, limiting material wear, and enhancing the proficiency of hardware/apparatuses which have back to back centrality in fuel and vitality reserve funds. Lubricants oil also function to make sure the equipment free from contaminants, avoid the component from the corrosion and remove heat. Be that as it may, the oil spent can be an extraordinary wellspring of tainting on the off chance that it is tossed as a waste or can be considered as another asset if appropriately utilized, and all rely upon the strategies for how oil can be reused (Hayalu, 2014).

When engine oil is depleted from a motor, it is never again clean in light of the fact that it has grabbed materials, earth particles, and different chemicals amid motor activity. This lubricants oil is presently named utilized oil. The United State Environmental Protection Agency state that Utilized - oil is characterized as any oil that has been refined from crude petroleum or on the other hand any synthetic oil that has been utilized and because of such utilize, is defiled by physical or chemical pollutant (Zitte et al, 2016). Around 30% of lubricants are hopelessly lost amid the activity of equipment: it consumes in motors, vanishes, spills, washed away, and so forth. The rest

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of the part is experienced to serious changes affected by working conditions and should be expelled from the machine (Kulash, et al, 2017).

Used engine oil is an exceptionally perilous dirtying item that contains polynuclear aromatic hydrocarbons (PAH) and elevated amounts of substantial metals. For example, benzo[a]pyrene, are outstanding that can affects nature. Impressive amounts of substantial metals, for example, copper, zinc, cadmium, and lead, are contained in used engine oil; these metals are profoundly dangerous to living beings. Engine oil contamination can harm the soil and the oceanic conditions, and the air when excess oil is singed. A recommended solution for this problem is the restoration of the lubrication base oil from the used engine oil.

1.2 Problem statement

Used engine oil is a high contamination material that requires capable administration. Utilized engine oil may make harm the earth when dumped into the ground or into water streams including sewers. This may bring about groundwater and soil sullying. Reusing of such debased materials will be useful in decreasing engine oil costs and it is also will give the positive impact to the environment. Nowadays, the recycle engine oil has been widely used in motor industry. The problem is what is the effect of recycle engine oil to the engine performance.

For this project, the study was held to investigate the characteristic of the recycle engine oil and compare to the original engine oil. The characteristic will be compare is viscosity, coefficient of friction, and types of wear of the lubricant oil.

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1.3 Objectives

Lubricant oils have been utilized essentially to reduce contact between moving parts of different hardware or gear, limiting material wear, and enhancing the proficiency of hardware/apparatuses which have back to back centrality in fuel and vitality reserve funds. Moving parts would wear easily without wear easily and it is also can reduce the lifetime of that part and the engine oil with low viscosity that known as insufficient lubrication will occur that cause increase in wear, friction and heat. This will affect the engine performance.

The objective of this study is as follows:

1. To investigate the viscosity of the recycle oil.
2. To study the coefficient of friction of recycles oil
3. To investigate the characteristic of wear of recycle oil.

1.4 Scope

1. To determine the viscosity of the base oil and recycle oil by using heated viscometer
2. To determine the coefficient of friction of base oil and recycle oil by using four-ball tester
3. To determine the wear by using microscopic/SEM

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CHAPTER 2

LITERATURE REVIEW

2.1 Lubricant

A thousand years ago ancient of Egypt has used the lubricant. From the record of ancient of Egypt shows that people at that time used water as a lubricant to carry the monument. The function of lubricant is to transmit forced, to transport foreign particles, and heating and cooling of the surface. The ideal lubricant is lubricant that produce less friction and not cause wear occur and that can operate at any temperature in a long time that cannot affect the properties of the lubricant. Lubricant act as a substance that reduce the friction between two contact surface that reduce the heat produces when two surfaces contact is moving.

The additive of lubricant oil has begun with the first used of sulfur in mineral oil and fatty oil in the early 20th century. The used of additives is to improve lubrication under heavy load. The nano hardness and the modulus of the friction surface are increased by 67 and 90%, respectively by using the additive because the additive have improved the surface mechanics properties of steel-steel friction pair (Yu et al., 2007).

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2.2 Types of lubricant oil

2.2.1 Synthetic oil

Synthetic oil is types of lubricant that consist of chemical compound that artificially made (synthesized). Synthetic oil is manufactured by using chemically changed petroleum component. It is also can be synthesized by other materials. Synthetic oil acts as extra for lubricant that refined from petroleum while working in high of temperature because it t gives better mechanical and compound properties than those found in conventional mineral oils.

Synthetic base stock can be classified in three major classes which is organic ester, plyglycols and hydrocarbon (Jackson, A. 1987). Hydrocarbon consists of alkylated aromatics, polyaphaolefins and polysobutenes. But the use of hydrocarbon is not popular in the because of the raw material is too expensive and low in yield process. Polyol ester and dibasic ester is the most basic chemical uses for organic ester in lubricant industry. The organic ester has their own advantages in term of temperature where the ester temperature gelation is low and temperature of deposits is high because of the glycerine portion of molecule. Polyglycol, for example, ethylene oxide and propylene oxide beforehand utilized as brake liquids yet now accessible as lubricant base stock.

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Synthetics oil is in addition utilized as a portion of metal stamping to gives natural and different advantages when contrasted with conventional oil and creature fat based items. These items are additionally refers as non-oil or oil free .Usually, special synthetics oils are produced for some reason requests. For instance, conventionals mineral-oil based lubricant couldn't meet greatly low-(Arctic) or high-temperature activities and fire resistances requirements

There are some synthetic oil are used the same additives as the mineral based oil. But, some of the synthetics oil needs to develop new additive. This is exact of the fully formulated lubricant for internal combustion engines and heavy-duty gear cases. There are many types of synthetic oils that have some advantages compare to mineral based oil. The advantages are volatility, toxicity and low pour point. Besides that, it is also high in oxidation stability, flash point, and fire point and viscosity index.

Table 2.1 Advantages of synthetic oil

Synthetic base type	Main advantages	Application
alkylbenzenes	Low temperature Performance	(refrigeration) compressor oils mineral oil-like solvency
polyalphaolefins	Wide temperature Performance range, low volatility	Engine oils, gear oils, hydraulic oils
Diesters	Wide temperature Performance range, low volatility	Gas turbine oils, air compressor oils, hydraulic oils
Phosphate Esters	Fire resistance	Fire-resistant hydraulic fluids
Polyalkylene Glycols	Wide temperature Performance range, hydrolytic stability, fictional properties	Gas compressor oil, gear oil
polyolesters	Wide temperature Performance range, low pour point	Jet engine oils, refrigeration compressor oils (chlorine-free refrigeration)

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