EXPERIMENTAL ANALYSIS OF LUBRICATION

OF B30 BIODIESEL FOR FUEL INJECTOR SYSTEM.

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Declaration.

I declared the title of this project “Experimental Study of B30 Biodiesel Lubrication for Fuel Injector System "is the product of my own research, except as stated in the references.

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14th August 2020 (PMS2)

APPROVAL

I hereby declare that I have read this project report and, in my view, this report is adequate for the award of a Bachelor of Mechanical Engineering degree as regards scope and efficiency.

DEDICATION

To my beloved parents, family members and friends.

ABSTRACT

Biodiesel is known as monoalkyl esters, mainly methyl esters (FAME), of long-chain fatty acids obtained from vegetable oils or animal fats. Biodiesel is easy to achieve, and it is renewable resources, and it received special attention. The purpose of this research focuses on tribological properties and lubricant properties of various biodiesel blends, B0, B5, B10, and B30. The standard used for tribological properties using ASTM D4712 standard and lubricant properties is ASTM D445 standard for kinematic viscosity and ASTM D3828 standard for flashpoint temperature. The conventional biodiesel obtained from Petron Gangsa, Durian Tunggal, and Palm Oil Biodiesel received from Malaysian Palm Oil Board (MPOB). All of the properties testings have conducted at Tribological Laboratory, Universiti Teknikal Malaysia Melaka, UTeM. In summary, all of the results of tribological and lubricant properties achieved within the acceptable range of ASTM standards.

ABSTRAK

Biodiesel dikenali sebagai ester monoalkil, terutamanya ester metil (FAME), dari asid lemak rantai panjang yang diperoleh daripada minyak sayuran atau lemak haiwan. Biodiesel mudah diperoleh, sumber daya yang dapat diperbaharui, dan mendapat perhatian khusus. Tujuan penyelidikan ini untuk memfokuskan pada sifat tribologi dan sifat pelincir pelbagai campuran biodiesel, B0, B5, B10, dan B30. Standart yang digunakan untuk sifat tribologi menggunakan standard ASTM D4712, dan untuk sifat pelincir adalah standard ASTM D445 untuk kelikatan kinematik, dan standart ASTM D3828 untuk suhu titik kilat. Biodiesel konvensional diperoleh dari Petron Gangsa, Durian Tunggal dan Biodiesel Minyak Sawit diperoleh dari Lembaga Minyak Sawit Malaysia (MPOB). Semua ujian sifat telah dilakukan di Makmal Tribologi, Universiti Teknikal Malaysia Melaka, UTeM. Ringkasnya, semua hasil sifat tribologi dan pelincir telah dicapai dalam julat standard ASTM yang boleh diterima.

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LIST OF ABBREVIATION

ASTM	American Society for Testing and Materials.
EN	European standard
MPOB	Malaysian Palm Oil Board
KOH	Potassium hydroxide
NaOh	Sodium hydroxide
H_2SO_4	Sulfuric acid
CO_2	Carbon dioxide
SO_2	sulphur dioxide
PM	Promethium

HC	Hydrocarbon
NOx	Nitric Acid
US	United State
WSD	Wear Scar Diamater
PSM	Projek Sarjana Muda
RPM	Rotation per minute

LIST OF SYMBOLS

k	Wear coefficient.
P	Load
H	Hardness
L	Sliding Surface
V	Wear volume
W	Adhesive wear rate
T	Frictional torque
μ	Coefficient of friction.
W	Applied load
r	Distance from the center of the contract surface on the lower balls.

CHAPTER 1

INTRODUCTION

1.1 Background.

In today's generation, there is an all-out effort on reducing the reliance on petroleum for transportation and energy generation throughout the world (Musa, 2010b). The effects of petroleum give us harmful effects for our future generation because of unburned hydrocarbons, CO, and particulate matter emission that is being used in conventional engine oils, which is toxic and non-bio-degradable [Ali, 2013]. In other ways, engine oils may pollute the environment, water, soil, and air (Tabares, 2013). Instead of using biodiesel for general daily use, it also can be used for the replacement of biodiesel if the properties of the biodiesel are enhanced (Musa, 2010b, 2010a). In previous research, it stated that wear and friction of the engine components along with engine performance and engine exhaust emissions could be running smoothly if the quality of lubricants is high. Lubrication is a

method used for reducing the wear of one or both surfaces to make the engine moving relative to each other (Musa, 2010a).

Due to the rapid growth of populations keep increasing by every year, the demand for energy in the transportation sector has been hiked (Sundus, Fazal, & Masjuki, 2017),(Reddy, Sharma, & Agarwal, 2016). Environmental pollution, such as emissions of unburned hydrocarbons, carbon monoxide, and nitrogen oxides, is affecting the world due to the high usage of fossil fuels in engine contribution (Sundus et al., 2017),(Patil et al., 2018). Thus, global warming, smog, deforestation, ozone depletion, and acidification are the factor that makes a massive impact on the environment (Sundus et al., 2017). There is an essential factor to be investigated for non-polluting, efficient, and renewable fuels for future needs due to limited energy reserves in our world (Reddy et al., 2016),(Balakumar, Sriram, & Arumugam, 2018). Bio-diesel was introduced in the United States by the National soy diesel Development Board in 1992, which has pioneered the commercialization of biodiesel in the United States (Patil et al., 2018). A technically possible, commercially reasonable, eco-friendly, and readily available should be a substitute to biodiesel compared to the diesel engine, and it is a compromising fuel because it reduces major environmental concerns (Sundus et al., 2017),(Balakumar et al., 2018). From edible and non-edible vegetables, animals fat, and waste cooking oils by the process of transesterification, biodiesel can be

produced (Reddy et al., 2016). Biodiesel is regularly used because of an oxygenated, renewable, biodegradable, and environment-friendly, and it has a higher cetin number, absence of sculpture and aromatic compounds, due to its attractive characteristic of biodiesel (Patil et al., 2018).

In this research, commercially available biodiesel available on the market, compared with B20 biodiesel palm oil properties. The main focus is on the characteristic of biodiesel, which is the friction coefficient and wears rate, viscosity, and flash point temperature. The characteristics of the friction coefficient and wear determined by using a four-ball machine tester. The properties of kinematic viscosity will be determined by using viscometer. The properties of flash point temperature, which means the initial mean temperature of biodiesel ignites, by using flashpoint meter. The results of this research provide later in conclusion to discover every property of biodiesel B20 and other commercially available diesel in market fuel for injector systems.

1.2 Problem Statement.

Biodiesel is abstract from renewable resources such as vegetable oils, animal fats, and palm oil, and biodiesel, also known for good substitutional for conventional diesel fuel (Patel & Sankhavara, 2017). Besides that, biodiesel has impressive lubricant properties and can be additive for lubricity petroleum fuels (Hu, Du, Li, & Min, 2005). Many types of biodiesel have derived from non-edible stock such as Karanja, Jatropha, Palm, Jojoba, and many more (Reddy et al., 2016). In Malaysia, many biodiesel can obtain from nearby pump petrol such as B0 (100% diesel), B5 (5% biodiesel and 95% diesel) and B20 (20% biodiesel and 80% diesel). Different theories exist in the literature regarding the problem related to biodiesel problems such as the standard diesel in the market that has increased in pollutant emission (Shahid & Jamal, 2008). Next, It also stated that there is poor ignition quality because of unacceptable of atomization, engine deposit, sticking of piston ring, injector conking and excessive engine wear due to the higher viscosity of biodiesel (Mosarof et al., 2015), (Hassan & Kalam, 2013). Different types of biodiesel blends have different performance and efficiency. In this research, the properties of friction and wear, kinematic viscosity, and flashpoint temperature for each biodiesel tested are to be analyzed. Therefore, this research focuses on which biodiesel to be the most suitable for a lubricant for the fuel injector system.

1.3 Objective

The objective of the project is:

1. To investigate the tribological properties of for various blending of biodiesel.
2. To determine the kinematic viscosity, and flashpoint temperature for various blending of biodiesel.

1.4 Scope of Research.

The scope of the research are:

1. The properties of conventional biodiesel and palm oil biodiesel, B0, B5, B10, and B30 is determined before the research being conducts.
2. This research focuses on finding friction coefficient and wear rate, kinematic viscosity, flashpoint temperature by using ASTM D4712 standard for friction coefficient, ASTM D445 standard for kinematic viscosity, and ASTM D3828 standard for flashpoint temperature.

1.5 General methodology.

The details and description of the methodology to obtain the objective of this research explained later in Chapter 3. In most cases, the flow of this project is as below.

1. **Literature review.**

Obtain a legit source of journals, articles, books, websites, or any other related material about this project.

2. **Research setups.**

The sample of biodiesel B10, B20, and B30 palm oil obtained from the Malaysian Palm Oil Board (MPOB) and B0 (Diesel Max) and B5 (Euro 5) obtained from the commercially available in the market.

3. **Research and analysis.**

This research of properties of B20 biodiesel fuel with commercially available diesel in the market such as B0 (Diesel Max) and B5 (Euro 5), B10, and B30 palm oil biodiesel obtained from Malaysian Palm Oil Board (MPOB) and diesel for fuel injector systems focus on friction and wear rate, kinematic viscosity, and flashpoint temperature. The results and data, collected and analyzed to investigate the tribological performance.

4. Thesis writing.

A complete thesis composes in this research, including the data and analysis from this research. The general methodology of this research is simplified in the flow chart as shown below.

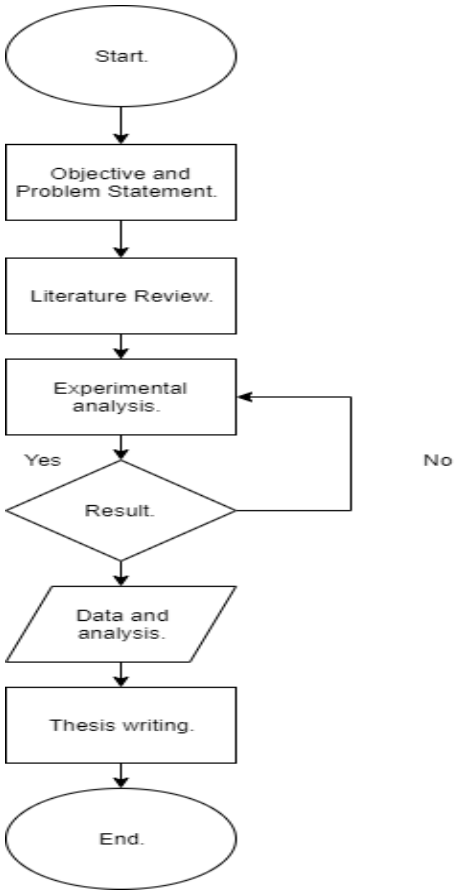

Figure 1.1: Flowchart for thesis writing.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction.

Over the years, the usage of non-renewable resources such as fossil fuel increasing in demand, and it harms the environment. A large and growing body of literature focusing on the investigation of transport industry non-polluting, clean, and practical resources energy for future needs (Reddy et al., 2016). To saves the world from decreasing the amount of using non-renewable energy used for transportation, another alternative must implement to reduce the dependence of non-renewable energy. Biodiesel introduced to replace fossil fuels because it easily obtained from seeds of crops, edible oils, and animal fats as well (Patil et al., 2018). Furthermore, biodiesel also has advantages that could lead to being the most suitable replacement for fossil fuels because of high-efficiency content, higher productivity, and wide-ranging quality of oil (Reddy et al., 2016). In this section, the production of biodiesel and palm oil biodiesel discussed further based on previous research and the impact towards the engine by using biodiesel. The main properties of biodiesel tested, which are friction,