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“I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering Automotive (Hons.)”

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**PARAMETRIC STUDY OF BIODIESEL BLEND OF DIFFERENT RATIO
(B70, B80 AND B90)**

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**This report is submitted in partial
fulfilment of the requirements for the award of
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DECLARATION

“I hereby declare that this work in this thesis is my own except for summaries and quotations which have been dully acknowledged”

Signature :

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Date :

DEDICATION

Especially for

Beloved mother and father

Harun Bin Samat

Jamilah Binti Yoon

And families who always supporting

And to fellow friends.

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ABSTRAK

Biodiesel adalah pembakaran yang bersih, mesra alam, bahan api diesel alternatif muncul dari sumber yang boleh diperbaharui seperti minyak sayuran dan lemak haiwan yang bertindak balas dengan alkohol (methanol) dan pemangkin (seperti natrium hidroksida) melalui proses konvensional dipanggil *transesterification*. Kandungan biodiesel perlu memenuhi standard yang ditetapkan dari “American Society for Testing and Materials” (ASTM). Salah satu standard yang diterbitkan adalah D6751-08 yang menunjukkan spesifikasi untuk Biodiesel Bahan api untuk B100. Kajian ini bertujuan untuk menyiasat parameter biodiesel dalam variasi keadaan sekitar. Ciri-ciri biodiesel selepas disimpan dalam tempoh tertentu juga akan dikenalpasti. Parameter biodiesel akan mempengaruhi tingkah laku bahan api dalam kebumah pembakaran. Ini termasuk pelaksanaan biofuel terhadap enjin. B5 biodiesel - 95% diesel petroleum dan 5% biodiesel minyak sawit - setakat ini menjadi biodiesel yang serasi dengan kenderaan di Malaysia. Proses pengeluaran serta “additive” di dalam bahan api adalah faktor-faktor yang membawa kepada penggunaan B5. Dalam kajian ini, keempat-empat kelas biodiesel (B5, B70, B80 dan B90) akan dihasilkan (kecuali B5) dan diuji. Terdapat lima parameter yang akan dipantau dan pada masa yang sama impak penyimpanan juga perlu di rekodkan. Parameter-parameter tersebut adalah nilai asid, ketumpatan, takat kilat, kandungan air dan kelikatan. Berdasarkan kajian, B90 akan merekodkan nilai lebih tinggi daripada kesemua 5 parameter jika dibandingkan dengan B70 dan B80. Ia adalah kerana peratusan komposisi bahan biodegradable yang terkandung di dalam B90 tersebut dimana ia lebih hampir kepada B100.

ABSTRACT

Biodiesel is a clean –burning, biodegradable, alternative diesel fuel comes up from renewable resources such as vegetables oil and animal fats which reacts with alcohol (methanol) and catalyst (such as sodium hydroxide) through a conventional process called transesterification. The content of biodiesel needs to meet certain standard for example the American Society of Testing and Materials (ASTM). One of the standard ASTM published is D6751-08 which indicate the Specification for Biodiesel Fuel Blend Stock for Middle Distillate Fuels of B100. This study aimed for investigation of biodiesel parameters in various surrounding condition. The characteristic of the biodiesel after a certain period being stored being identified. Biodiesel parameters will influence the behavior of fuel in combustion chamber. This will include the performance of biofuel towards engine. The B5 biodiesel - 95% petroleum diesel and 5% palm oil biodiesel – has so far being compatible with most diesel vehicles in Malaysia. The production and the additive added to the fuel is one of the factor leading to the application of B5. In this study, all four class of biodiesel (B5, B70, B80 and B90) will be blended (except for B5) and investigated. There will be five parameters to be observe and at the same time the impact of storage also need to be considered. The parameters investigated here are acid value, density, flash point, water content and kinematic viscosity. From the results, B90 shows the highest value for all 5 parameters compared to B70 and B80 because the characteristics is nearest to pure biodiesel, B100.

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LIST OF SYMBOLS

μ	=	dynamic viscosity
Hg	=	mercury
K	=	Kelvin
mm	=	millimeters
g/ml	=	gram per milimeter
rpm	=	revolution per minute
ρ	=	density
g	=	gram
mm ² /s	=	square millimeters per second
M	=	Molar mass
°C	=	temperature
C ₆ H ₁₄	=	hexane
wt. %	=	weight percentage
kg/m ³	=	kilogram per meter cube

LIST OF ABBREVIATION

KOH	=	Potassium hydroxide
R&D	=	Research and development
B5	=	5 wt% biodiesel- 95 wt% diesel fuel
B80	=	80 wt% biodiesel- 20 wt% diesel fuel
B90	=	90 wt% biodiesel- 10 wt% diesel fuel
B100	=	100 wt% biodiesel
FTIR	=	Fourier transform infrared
NO _x	=	Nitric oxides
CO	=	Carbon monoxide
NaOH	=	Sodium hydroxide
PME	=	Palm methyl ester
ppm	=	parts per million
FFA	=	Free fatty acid
EN	=	European standard
FAME	=	Fatty acid methyl ester
ASTM	=	American society for testing and materials

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The palm oil nowadays has become the successful commercial plantation in tropical lowland areas. The product of the single crop; palm kernel oil, crude palm oil, palm kernel meal, is playing a major role to the human need for instant cooking oil. Then, the technology development and the production of palm oil based product getting widespread with food additives, soap, cosmetics need, chemical industries and animal feed (Oliver Pye, 2009). The global production of biodiesel has been rapidly increasing around three or four decades back and the major productions are in Indonesia and Malaysia in Southeast Asia. The expansion of plantation area and production in recent years was particularly rapid in Indonesia, which overtook Malaysia as the world's largest producer in 2007.

A year later, the total production of palm oil was about 45 million tons, where 19 million was produced in Indonesia and the rest by Malaysia itself. These two combinations of production recorded around 88% of the global annual production (MPOB 2009). The

world largest user of palm oil are China, India and Europe, such as Ireland (Teoh Cheng Hai, 2009).

Those production scales prove to the world the crisis we had with this unstoppable usage of pure petroleum. The demand of limited sources, energy and safe atmosphere for the future encourage research and development (R&D) to indulge in finding the other renewable alternative. By using the plant-based element, they came up with biomass fuel, like biodiesel. This biodiesel is known to have less carbon emission; depends on the percentage, biodegradable, and renewable sources of energy. This type of fuels is sustainable since the plantation of palm oil is massive, especially in Southeast Asia Region. The product of biodiesel can reduce the contamination in our atmosphere as well as decreasing the gases that cause the greenhouse effect.

1.1 BACKGROUND STUDY

Biofuel, or in this case, biodiesel, is generally made up from the vegetable oils and animals fat with an addition of catalyst and alcohol. The whole process is called transesterification. Other than biodiesel, the byproducts of the process are soap, excess alcohol, glycerol and the amount of trace water. These side products need to be filtered phase by phase to retrieve the high quality of biodiesel.

Biodiesel production is a huge mass production process just similar the conventional diesel manufacturing. The only difference is the resources for both fuels. When discussing about renewable natural sources like plants and animals, most of people would agree to use them as the world is already contaminated with hazardous emission from vehicles. In addition, plants and animals are easier to consume compared to natural oil deep inside the earth core which took a billion years of production. Biodiesel is the solution to realizing the world aspirations for a better atmosphere in the future.

Unfortunately, there are a few drawbacks by using biodiesel as the main fuel. The production is very costly to build its own power plant. Because this is a new resource, thus, the procedure, machines and apparatus are slightly different from the one used for

conventional fuel. In other words, people need to start something new to the industry. In a certain country, such as Malaysia itself, only B5 can be implemented because of the production scale obstruction.

Plus, the researcher found that biodiesel will not give the same amount of power compared to conventional or common fuel. This is proven because the conventional diesel consists of pure natural petroleum with less additives instead of biodiesel, which has its own percentage of additives. In other perspective, it is a scarification to have less power for the vehicle as long as it is better for the environment. Some of professionals surprisingly not fully supporting having animals and plants as fuel resources. Even people in certain country starving for food, how could we working on those nutrition sources for fuel? Make sense.

Biodiesel emits less carbon into atmosphere and biodegradable. Everything have its own pros and cons. For biodiesel, world needs to sacrifice something to get a bigger advantage in the future.

1.2 PROBLEM STATEMENT

In this study, three types of biodiesel (B70, B80 and B90) are being investigate the parameter and how it can affect the performance of engine. There are few characteristics that can determine the performance of fuel which are flash point, density, acid value, viscosity and water content. For each parameter, there are particular experiment involved in obtaining the results.

In practice, fuel will face variety of conditions and temperature inside the engine. The temperature basically playing such a role. Furthermore, the deposits and clogging due to biodiesel have been an issue but traceable to biodiesel that is either of low quality or has gone through degradation process which can increase the acidity of oil. Therefore, the sources of this kind of problem might be detected form the characteristics of the fuel itself by laboratory parameter testing.

1.3 OBJECTIVES

- I. To store a biodiesel blending (B70, B80 and B90) at three storage conditions; ambient, low and high temperature (25°C, 9°C and 40°C).
- II. To investigate the parameter of biodiesel (acid value, flash point, density, kinematic viscosity and water content) in five weeks period.
- III. To identify the impact of storage of biodiesel in five weeks' time.

1.4 SCOPE OF STUDY

- I. Blending process using the blending machine, according to the percentage of each sample (B70, B80 and B90).
- II. Storing all biodiesel sample (B70, B80 and B90) using storage box featured with thermostat, bulbs as heating agent and cables for completing the circuit. This is to give variant temperature and conditions.
- III. Storing the biodiesel sample for five weeks in the storage box.
- IV. Carry out experiment to identify the parametric of biodiesel; Trivector Analyzer for water content, hydrometer for density, viscometer for kinematic viscosity, titration for acid value and SETA Flash Point for flash point experiment.
- V. Carry out a simple emission test to identify the emission of hydrocarbon and carbon dioxide of selected biodiesel and to be compared with standard diesel.

CHAPTER 2

LITERATURE REVIEW

2.0 BACKGROUND OF STUDY

Biodiesel produced from biodegradable resources and emit less carbon into the air. The advantages of biodiesel over diesel fuel are higher combustion efficiency, higher cetane number, non-toxic, better lubricity and higher biodegradability and also less carbon monoxide emissions. Whereas the disadvantages of biodiesel include slightly higher NO_x emissions, cold kick start, low energy burst, higher copper strip corrosion and higher viscosity (Saxena P., et al, 2013). Biofuels are good in a way, unfortunately, the productions are more costly than diesel because of insufficient animals and plants fat to totally replace fossil fuel (Sirlaine A.P, 2013).

NO_x is the term for mono-nitrogen oxides (nitric oxides and nitrogen dioxide). They are formed from the combination nitrogen and oxygen gases in the air due to combustion especially in higher temperature. Combustion off fuel, such as coal and oils, contribute almost 50 to 80 per cent emission of NO_x of after product (Mat Yasin, 2013). High traffic area like the city are most likely to have higher emission of this chemical waste.

Ambient temperature plays an important role in degradation of biodiesel that contain organic compounds. Degradation, or simply said the degeneration of biodiesel is caused by few factors such as temperature of surrounding and the exposure to air enhance with the water content inside the fuel, through hydrolysis (Mohajan S., et al, 2006). The enrichment of oxygen surrounding due to storage condition and humidity exposure multiplying the oxygen content promoted the further oxidation of carbon monoxide (CO) during combustion process. It looks like higher content of oxygen is important due to oxygenated nature of palm oil, subsequently reduce the carbon in the palm oil blends (Khalid A., et al, 2013). With due to all factors been stated, this study will analyze the impact of biodiesel storage up to 5 weeks duration as well as the performance in steady state.

2.1 PRODUCTION OF BIODIESEL

Biodiesel is one of these sustainable sources from future which is non-petroleum based comes out from animal and vegetables extract (fats). It has cleaner combustion emission and decent behavior for environment surrounding. Even then, biodiesel still cannot be main alternative fuel that can be made commercially available because of its higher production cost and non-availability for raw material in very long period (Canesin E.A, 2013).

Transesterification is a common reaction for biodiesel, where an ester is transformed into another by interchange of alkoxy radical group. It involves stripping of glycerin from fatty acids with a catalyst such as sodium hydroxide or potassium hydroxide and replacing it with an anhydrous alcohol that is normally methanol (Canesin E.A, 2013).

2.1.1 Mass production

The following is the production of biodiesel added with methanol and sodium hydroxide (NaOH) as catalyst. Refinery section basically has four subsection; degumming, bleaching, layer ester section and transesterification. All