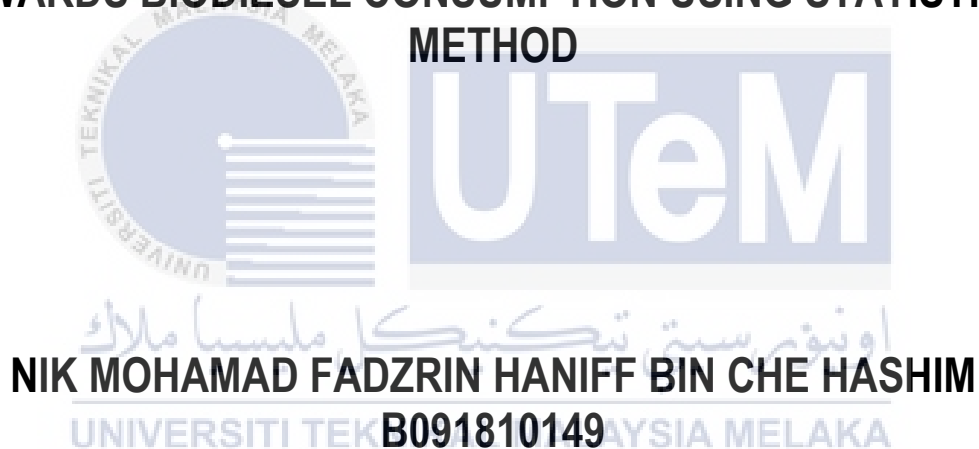




**ANALYSIS ON THE EFFECT OF DIFFERENT PARAMETERS
TOWARDS BIODIESEL CONSUMPTION USING STATISTICAL
METHOD**



**BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY
(AUTOMOTIVE TECHNOLOGY) WITH HONOURS**

2022



Faculty of Mechanical and Manufacturing Engineering Technology

A faded version of the UTeM logo and university name is visible in the background behind the title text.

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METHOD**

Nik Mohamad Fadzrin Haniff Bin Che Hashim

**Bachelor of Mechanical Engineering Technology (Automotive Technology) with
Honours**

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METHOD**

NIK MOHAMAD FADZRIN HANIFF BIN CHE HASHIM



Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this research entitled “Analysis On The Effect Of Different Parameters Towards Biodiesel Consumption Using Stastical Method” is the result of my own research except as cited in the references. The research has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature



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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

Signature :



Supervisor Name :

Ezzatul Farhain Binti Azmi

Date :

27 / 1 / 2022



DEDICATION

For both my dear parents

Che Hashim Bin Che Ya And Raja Maimunah Binti Raja Mamat



My siblings

UTeM

اونيور سي تي كنيكل ايسيا ملاك
Norfadhilah Binti Che Hashim

Nik Nor Fadzlida Binti Che Hashim

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
Nik Nor Farahana Binti Che Hashim

Other relatives and friends

ABSTRACT

The continual depletion in the world of fossil fuel resources and the increasing demand in energy consumption have prompted the need for the production and utilization of alternative fuels. Among other alternative fuels, biodiesel has received considerable attention worldwide. Nowadays, Malaysia's fuel price mainly increases every week for diesel fuel such as Diesel Euro5 and Euro2M. All diesel users use this fuel as an energy source to operate the vehicle. As a consumer, it is necessary to save fuel consumption on the car for more durability. This research was conducted to analysis on the effect of different parameters towards biodiesel consumption. Objective for this research is to measure the fuel consumption against engine rotation per minute (RPM) and different engine thermal conditions. Next, to compare the fuel usage that more saving and durable fuel between biodiesel and diesel. Then to analyze the best fuel consumption according to the different parameters using the statistical method. The method for collecting data is using the engine stand Common rail Turbo Diesel Engine (D-4D) by filling a total fuel of 1000ml and measuring the remaining fuel in the tank based on the engine is running for 15 minutes. This engine stand was chosen cause of the external fuel tank is already next to the engine, it is simple to take a reading of the fuel level. This fuel tank placement will make it easy to do reading by suctioning all fuel from the tank and measuring using a measurement jug for accurate data. This engine also can use biodiesel blend up to 20% with little or no modification. In addition, the data analyzed by using Generalized Factorial Design with the help of SPSS software. The result from the experiment found that the fuel consumption of Diesel Euro 5 use less than Biodiesel B20. However, in term of price analysis the Biodiesel B20 is more cost-effective than diesel. Furthermore, Biodiesel B20 is the best suggested for diesel users in terms of price saving and can reduce emission compared to conventional diesel. In conclusion, the results of this research can help a consumer to choose the best fuel for daily savings.

ABSTRAK

Penurunan sumber daya bahan bakar fosil secara terus-menerus seiring dengan meningkatnya permintaan dalam penggunaan tenaga mendorong keperluan untuk produksi dan penggunaan bahan bakar alternatif. Di antara bahan bakar alternatif lain, biodiesel telah mendapat perhatian besar di seluruh dunia. Pada masa ini, harga bahan bakar di Malaysia meningkat setiap minggu untuk setiap bahan bakar diesel seperti Diesel Euro5 dan Euro2M. Semua pengguna diesel menggunakan bahan bakar ini sebagai sumber tenaga untuk mengendalikan kenderaan. Sebagai pengguna, keinginan untuk menjimatkan penggunaan bahan bakar pada kenderaan agar lebih tahan lama. Penyelidikan ini dijalankan untuk menganalisis kesan penggunaan biodiesel terhadap perbezaan parameter. Objektif kajian ini adalah mengukur penggunaan bahan api terhadap putaran enjin per minit (RPM) dan keadaan terma enjin yang berbeza. Seterusnya, untuk membandingkan penggunaan bahan api yang paling menjimatkan dan tahan lama antara biodiesel dan diesel. Kemudian untuk menganalisis penggunaan bahan api terbaik mengikut parameter yang berbeza menggunakan kaedah statistik. Kaedah pengumpulan data dengan menggunakan enjin stand Common rail Turbo Diesel Engine (D-4D) dengan mengisi jumlah bahan api sebanyak 1000ml dan mengukur baki bahan api dalam tangki berdasarkan enjin berjalan selama 15 minit. Enjin ini dipilih kerana tangki bahan api luaran sudah berada di sebelah enjin, mudah untuk mengambil bacaan paras bahan api. Penempatan tangki bahan api ini akan memudahkan untuk melakukan bacaan dengan menyedut semua bahan api dari tangki dan mengukur menggunakan jag ukuran untuk data yang lebih tepat. Enjin ini juga boleh menggunakan campuran biodiesel sehingga 20% dengan sedikit atau tiada pengubahsuaian. Selain itu, data dianalisis dengan menggunakan Generalized Factorial Design dengan bantuan software SPSS. Hasil daripada eksperimen mendapati penggunaan bahan api Diesel Euro 5 menggunakan sedikit minyak berbanding Biodiesel B20. Walau bagaimanapun, dari segi analisis harga Biodiesel B20 adalah lebih kos efektif daripada diesel. Tambahan pula, Biodiesel B20 adalah yang terbaik dicadangkan untuk pengguna diesel dari segi penjimatan harga dan boleh mengurangkan pelepasan berbanding diesel konvensional. Kesimpulannya, hasil kajian ini dapat membantu seseorang pengguna untuk memilih bahan api yang terbaik untuk penjimatan harian.

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LIST OF SYMBOLS AND ABBREVIATIONS

ANOVA	-	Analysis of variance
APEC	-	Asia-Pacific Economic Cooperation
ASTM	-	American Society of Testing and Materials
B5	-	Blends 5%
B20	-	Blends 20%
B100	-	Blends 100%
BDC	-	Body Dead Center
CI	-	Compression engine
CO	-	Carbon monoxides
EN	-	European Committee for Standardization
HC	-	Hydrocarbons
IC	-	Internal combustion engine
km	-	Kilometres
kPa	-	Kilopascal
kW	-	Kilowatt
Nm	-	Torque
NO _x	-	Nitrogen oxides
OEM	-	Original Equipment Manufacturer
OPEC	-	Organization of the Petroleum Exporting Countries
P	-	Pressure
PM	-	Foreign matter
ppm	-	Parts per million
Psi	-	Pound per square inch
RM	-	Ringgit Malaysia
RPM	-	Engine rotational speed
SFC	-	Specific fuel consumption
TDC	-	Top Dead Center
USD	-	United States Dollar
WCO	-	Waste cooking oil

- 4x4 / 4WD - Four-wheel drive
°F - Fahrenheit
°C - Degree Celsius



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CHAPTER 1

INTRODUCTION

1.1 Background

Biodiesel is short for "biological oil" and is one of the alternative fuels produced from renewable resources. Specifically for biodiesel, there are many feedstocks, including those made from canola oil, soybean oil (Bharti et al., 2021), coconut (Rajesh et al., 2021), vegetable oil (Selaimia et al., 2015) and animal fats. Waste animal fats and used frying oils ("yellow grease") are potential feedstocks. Like petroleum-derived diesel, biodiesel operates in diesel compression engines used in many industrial applications such as cars, buses, ships, and trains (Elkelawy et al., 2020). This is because the biodiesel derived from a wide range of feedstocks can be used in conventional diesel engines (up to 20% blend ratio) with little or no modification (Mohamed et al., 2020).

The continual depletion in the world of fossil fuel resources and the increasing demand in energy consumption have prompted the need for the production and utilization of alternative fuels. Among other alternative fuels, biodiesel has received considerable attention worldwide (Avinash et al., 2014). Several advantages, such as being renewable from waste sources recycling, its simplicity and flexibility in the production methods, and its reduced emissions compared to conventional diesel (Lin et al., 2011). Besides that, biodiesel has a higher cetane number than diesel in performance and efficient combustion (Hayes et al., 2015).

As the day runs out of fossil fuels and rising oil prices, engine manufacturers worldwide are encouraged to seek alternative approaches to improve fuel economy and reduce harmful emissions from internal combustion engines. One of the possible ways to improve diesel engine performance is by using alternative fuels such as biodiesel as a complementary material that can turn diesel and indirectly lead to fuel consumption savings and toxic gas emissions. However, a detailed study of the biodiesel fuel and the percentage required for optimal engine performance should be conducted in selecting any particular additive. (Bari & Mohammad Esmaeil, 2010) used mustard seed- rapeseed methyl ester (RME) as an additive for diesel and studied engine performance with an engine dynamometer. They found that biodiesel oil was resulting from membrane mustard seeds improved thermal brake efficiency, braking power, and engine performance.

Recently, diesel engine applications have seen a rapid increase worldwide, especially in Europe, where about 44% of new vehicles are powered by diesel engines (Halderman, n.d.). Diesel engines convert the chemical energy contained in the fuel into mechanical power. Diesel fuel is injected under pressure into the engine chamber, where it mixes with air, and internal combustion takes place. Exhaust gases released from combustion contain several fractions, namely some carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x) and foreign matter (PM). It is known that all these gases are harmful to human health and the environment (Maurer et al., 2017).

In order to study the effectiveness of Biodiesel B20 and Diesel Euro 5 on fuel consumption, it is essential to perform these experiments to test engine performance. Experiments were conducted using Toyota diesel engines to test engine performance in terms of fuel-saving. In contrast, Digital Laser Tachometer RPM was used to retrieve rotational speed data based on flywheel speed on diesel engines. It is an essential additional

method for experimental study because analysis of different speeds of RPM data can give response results to the amount of fuel consumption in the engine. In addition, the thermal conditions on the engine is also taken to determine if the engine's temperature is in a cold or hot state because the amount of fuel consumption in the engine will be different if the engine temperature is different (Roberts et al., 2014).

1.2 Problem Statement

In this day, the need for fuel oil is increasing. This is due to the increase in population accompanied by the rise in welfare people, which impacts the increasing demand for transportation facilities and industrial activities. Meanwhile, petroleum, which is the source of fuel primary, is getting more and more limited day by day. Because petroleum is a non-renewable fuel, with the increase in its use, it will continue to decrease, and one day it will definitely run out. Many efforts have been made to deal with this energy crisis by conducting various studies to find new technologies for producing alternative renewable fuels. One form of this energy is biodiesel, which can substitute fuel for diesel oil in diesel engines.

Next is increasing in fuel prices in the market. As Malaysians, it is easier to see why there is an increase in fuel prices, but we have to accept that the cost of petrol and diesel in our country is already floating according to the world market. This means the price we can see now is similar to the actual price of 1 litre of fuel worldwide. The price has to be more similar because we are still using the average every week, which will probably result in a slight difference compared to the actual price. Among the factors that caused the increase in fuel prices globally is Venezuela. Currently, the Venezuelan government under Nicholas Maduro is balancing a country hit by a severe crisis. The crisis began after the fall in world oil prices. As the world's largest oil producer, Venezuela suffered a loss of government revenue that would burden Venezuelan society. The next factor is the role of OPEC, which

managed to form an understanding in limiting oil production was in 2001. A similar agreement was signed in November 2016 among OPEC countries (Malaysia is not an OPEC member) to reduce oil production to the appropriate level to increase oil prices to USD60 - USD70. Indirectly, that is the cause of the weekly change in oil prices that is happening right now in Malaysia.

There are various types and qualities of petroleum fuels on the market today that have different performances. Each fuel quality in the current market has its characteristics and advantages, such as fuel-saving and performance, which need to be proven effective on vehicle engines. As in Malaysia, two types of diesel are used in vehicles: Euro 2M and Euro 5. The main difference between Euro 5 and Euro 2M used in cars is sulphur content in both fuels. The more sulphur, the worse the effect on the environment. The higher the sulphur content in the vehicle will cause the acid level to be high in the engine. The sulphur content of Euro 2M is 500ppm compared to Euro 5, which is only 10ppm. Therefore, Euro 2M diesel is too high a pollutant compared to Euro 5. Some road users compare their preferred diesel fuel in their way to evaluate which product is better in terms of fuel consumption savings over vehicle engines. Figure 1.1 shows the statistic price for diesel euro5 in Malaysia that constantly changes every week. For the first week, which is 4 April 2020, the price was RM 1.68. As shown, the amount of euro5 at that time is below RM 2.00 per litre. Then, after a few months, the price for euro5 increased until the maximum cost was RM 2.25 on 13 February 2021. According to the highest rate of euro5 for this week, the consumer may choose the other diesel fuel to move their vehicle. Therefore, the inconsistency of vehicle fuel price changes drives the use of alternative fuels for saving, such as biodiesel and others.

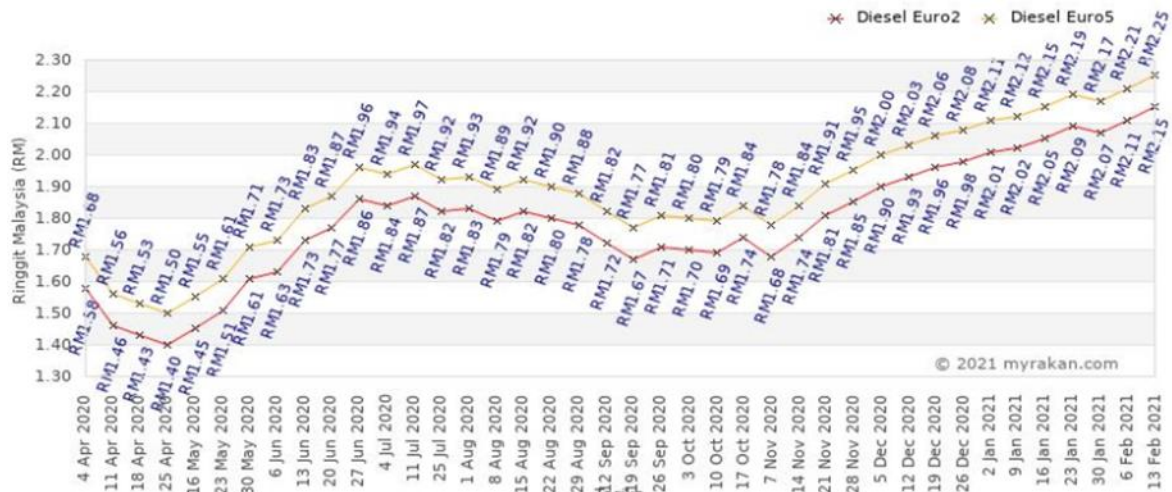


Figure 1.1 Changes diesel oil prices in Malaysia

Biodiesel is an oil additive for vehicle engines that has been formulated cause biodiesel has similar combustion properties with diesel from petroleum and can replace them in most cases. Consumption of used fuel, better known as biodiesel fuel, has been prevalent since the end as an alternative to save vehicle fuel consumption, but some users are still hesitant to use such products. Therefore, to solve this problem, this research will be conducted to investigate and solve the issues discussed among users. The study showed will also prove the effectiveness of biodiesel oil on diesel engines.

1.3 Research Objective

This research aims to determine the effectiveness of biodiesel in a diesel engine. Specifically, the objectives are as follows:

- a) To measure the fuel consumption against engine rotation per minute (RPM) and different engine thermal conditions.
- b) To compare the usage most saving and durable fuel between biodiesel and diesel.
- c) To analyze the best fuel consumption according to different parameters using the statistical method.

1.4 Scope of Research

In this research, the test will be conducted using the engine Toyota RAV4 D-4D 4-cylinder Turbocharged 1CD-FTV to test the use of fuels for data retrieval. This engine was selected because it uses diesel type fuel to start. In addition, this engine can be categorized as a relatively new engine and indirectly does not require any modification to the engine to use biodiesel as a fuel. The procedure for retrieving the obtained data also becomes more straightforward and more accurate. Each parameter used on the engine is easy to set without affecting the recorded data, compared to if the experiment was performed using a vehicle. This is because many factors that can affect data reading become inaccurate, for example, uneven road surfaces that can make it difficult for vehicle speed to be maintained according to predetermined parameters. In addition, getting more accurate data will cause costs and risks to increase because the tank on the vehicle needs to be modified, such as bypass tank, to make it easier to know the remaining fuel volume in the tank.

Next, fuel is an essential requirement for diesel vehicles to move their cars. The experiments conducted focused on diesel Euro 5 fuel in the current market that is easy to find in Melaka and Biodiesel B20, which can be found at the Petronas Kampung Tok Senik petrol station on Pulau Langkawi, the first petrol station in Malaysia to sell Biodiesel B20.

In this research, the analysis will be using variance (ANOVA). This statistical method is used to test the research hypothesis, which assesses whether there is a mean difference between groups. By comparing various samples, the advantage of Anova is that it can test the differences between more than two groups. Compared to the independent sample test, which can only test the difference in the mean of the two groups.

Basically, the more the level pedal is pressed, the faster the engine works, causing the car to move faster, then the oil consumption will be increase. This research will focus on the difference engine rotation per minute (RPM) can affect the fuel consumption of different fuel types. This research also focuses on different engine thermal conditions to determine whether more fuel consumption on the engine at cold or hot temperatures. Knowledge about the engine's temperature is important to ensure that the engine vehicle is always in good condition. If the engine temperature is not in normal condition, it can cause uneven fuel consumption on the car. Indirectly, it will also cause increased fuel consumption. So this research will study the best engine thermal condition while driving.

Lastly, this test will use the Engine Oil Pump 12V electric for data collection. This tools is used for sucks out the oil in the tank and will be transferred into the measuring jug to find out the remaining volume of oil, and at the same time can obtain data for the percentage of fuel consumption after the engine was running. This oil pump is a plug-and-play tool that will be connected to the battery on the engine first before using it. Using this method will be able to determine which type of fuel is more effective and appropriate.

1.5 The importance of the project

Following research are important of the project would facilitate the achievements of this aim:

- a) To determine the best diesel fuel in terms of saving and performance of the Engine.
- b) Help solve the problem of confusion about biodiesel among diesel users.
- c) To demonstrate the effectiveness of biodiesel as an alternative fuel on engine performance and dismantle the advantages and disadvantages of diesel fuels.