EXPERIMENTAL INVESTIGATION ON THE EFFECT OF FUEL TEMPERATURE ON THE PERFORMANCE OF SPARK IGNITION ENGINE WITH HYDROGEN PEROXIDE-GASOLINE BLEND

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DECLARATION

I declare that this project report entitled “Experimental Investigation On The Effect Of Fuel Temperature On The Performance Of Spark Ignition Engine With Hydrogen Peroxide-Gasoline Blend” is the result of my own work except as cited in the references

Signature : .....

Name : .....

Date : .....

APPROVAL

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

Signature :. .....

Name of Supervisor : .....

Date : .....

DEDICATION

This thesis is dedicated to my mother, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my sister, who taught me that even the largest task could be accomplished if it is done one step at a time.

ABSTRACT

There are many experiments and research about additive that added to the gasoline in spark ignition in order to increase the performance of the engine in many aspects, such as hydrogen, LPG, ethanol and many more. Therefore, this project was carried out to study other additive, which is hydrogen peroxide (H_2O_2), one of the chemical that rarely use in research and with different fuel temperature to examine the optimum blend and fuel temperature for performance of the spark ignition engine. Then, the project experiment is running with 100% of gasoline and mix fuel blend by 5% and 10% of H_2O_2 with 45° Celsius and 60° Celsius of fuel temperature at generator engine with carburetor and by collecting the data using DEWESOFT software as to find crank angle and pressure in-cylinder. This experiment is focus to determine the properties of peak pressure, heat release rate, indicated thermal efficiency, fuel consumption, indicated specific fuel consumption, and gross indicated work at performance of the single cylinder engine. The experiment is running at FASA B, Vehicle Green Technology Laboratory. There are also including the Chemistry Laboratory at Technology Campus, which is to find all the chemical properties, which is Density and Energy Content of gasoline alone and fuel blend for 5% and 10% of H_2O_2.

ABSTRAK

Banyak eksperimen dan kajian mengenai bahan penambah yang digunakan pada minyak petrol di dalam enjin palam pencucuh untuk meningkatkan prestasi enjin dalam banyak aspek, seperti hidrogen, LPG, ethanol dan banyak lagi. Justeru itu, projek ini dijalankan bagi mempelajari bahan penambah yang lain, iaitu hidrogen peroksida (H_20_2), salah satu bahan kimia yang sangat jarang digunakan dalam kajian dan dengan berlainan suhu minyak untuk mengkaji gabungan minyak dan suhu yang paling optimum untuk prestasi enjin palam pencucuh. Selepas itu, projek eksperimen ini dijalankan dengan 100% minyak petrol dan campuran minyak petrol bersama 5% dan 10% H_20_2.bersama suhu 45° Celsius dan 60° Celsius suhu minyak di generator enjin yang menggunakan carburetor dan mengumpul data menggunakan perisian DEWESOFT untuk mencari sudut engkol dan tekanan di dalam silinder. Eksperimen ini menfokuskan untuk mengenal pasti puncak tekanan, kadar pembebasan haba, kecekapan haba, kadar penggunaan minyak, kadar penggunan tentu, dan kadar kerja pada prestasi enjin palam pencucuh. Eksperimen ini dijalankan di FASA B, Makmal Kenderaan Teknologi Hijau. Selain itu, Makmal Kimia, Kampus Teknologi juga digunakan bagi mencari ketumpatan dan kandungan tenaga untuk 100% petrol dan campuran minyak 5% dan 10% H_20_2.

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LIST OF ABBREVIATIONS

H_2O_2	Hydrogen Peroxide
BMEP	Brake Mean Effective Pressure
BP	Brake Power
IP	Indicator Power
MEP	Mean Effective Pressure
SFC	Specific Fuel Consumption
BSFC	Brake Specific Fuel Consumption
NO_X	Nitrogen Oxide
H_2	Hydrogen Gas
LPG	Liquefied Petroleum Gas
NGV	Natural Gas Vehicle
RON	Research Octane Number
BTDC	Before Top Dead Center
BDC	Bottom Dead Center
TDC	Top Dead Center
GA	Gasoline Alone
CASE 1	Gasoline with 5% of Hydrogen Peroxide
CASE 2	Gasoline with 10% of Hydrogen Peroxide
CA	Crank Angle
HRR	Heat Release Rate

LIST OF SYMBOL

ρ_a	=	Inlet air density
m_a	=	Steady-state flow of air into the engine
V_{disp}	=	Displacement volume
N	=	Engine speed
W_b	=	Brake power
$\dot{m}_f$	=	Rate of fuel flow to the engine
Δv	=	Different volume BDC to TDC

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The crisis of energy and the problem of environment issues that identified to the utilization of fossil fuels in the engine expand the competitive to the world. Furthermore, the expanding vitality request, exhausting oil saves and ecological contamination issues connected with the utilization of fossil fuels have started restored enthusiasm to discover other clean fuels.(Pan et al, 2015). The majority of energy requirements in transportation are still addressed by fossil fuels. The fast consumption of fossil fills and the consistent increments of oil costs are convincing engine manufactures makes to find another option fuel. Besides, it is an unavoidable need to create fuel because of the harm to the earth and to people brought about by the utilization of oil. (Sandalci et al, 2014).

The non-renewable nature and restricted assets of petroleum powers has turned into a matter of incredible concern. The monetary and political variables are significantly connected with their appropriation. The ignition of these energizes in SI engine causes pollution. Every one of these perspectives has attracted the thought to preserve and extend the oil assets by method for option fuel research

Internal Combustion Engine is most strength utilized engine as a part of car field to change over the chemical energy into the valuable mechanical movement to move the vehicle. Considerable measures of option fuels have been all through to supplant the utilization of current essential energizes that are gas and diesel in other to improve the output

performance of the engine. There are some researchers towards other sources and not only dependable on fossil fuels (Yunus et al, 2015).

Such as, NGV, Hybrid System, biodiesel (Shehata, 2013), LPG (Sulaiman et al, 2013), and Electric Car like Tesla. However, there are researchers that still dependable on the fossil fuels but in order to reduce the vitality of using one sources there are use addition to the fuel as their alternative. Researchers are struggling to find the alternative fuel and additive to the diesel or gasoline engine towards the optimum performance and lower emission. Some researcher tended towards, addition of ethanol in gasoline (Schifter et al,2011), addition hydrogen blend with gasoline (Shivaprasad et al, 2014), and addition hydrogen peroxide blend with diesel (Khan at al, 2013).

Investigation had been made on various type of fuel in recent years form improving the quality and performance of gasoline fuel. Significant attention has been given to option fuel with predominant physiochemical properties for protect the environment and improving the fuel effectiveness viewpoint, especially the alcohol based fuels. One of the research is more consideration has been given to ethanol due to its outstanding properties. Mixes of methanol and ethanol in gasoline utilized as a part of fuel, with an emphasis on mixes containing 85% alcohol (M85 and E85) were assessed as option light-duty vehicle fills (Khan et al., 2013).

Besides that, there are some researchers tests fuel using hydrogen peroxide that also enhances the performance of the engine. Hydrogen peroxide has the criteria of highly reactive and storable fluid oxidizer; this specialty puts hydrogen peroxide forward in alternative fuel. (Sabourin et al, 2008). In previous research, H_2O_2 has been used as additive in other fuels like LPG. H_2O_2, is reported that will be the renewable fuel and will be label as low emission high quality of alternative fuel when it is blend with LPG. (Muhammad Saad Khan et al, 2009).

H_2O_2 also has been used for additive in diesel engine and according to ASTM Standards fuel tests they reported that hydrogen peroxide are fit to improve the fuel diesel properties(Khan et al., 2013). They are also found the advantages of hydrogen peroxide on methane premixed flame, H2O2 were considered as easy ignited fuel and effective for improvement flame temperature. In addition, H_2O_2 is responsive stimulator or an oxidizer compound pathways and to further upgrade substance radicals.(Chen et al, 2011).

1.2 PROBLEM STATEMENTS

Hydrogen peroxide have been used with previous research with gasoline or diesel because of it is in the weak acid category along with much stronger oxidizing properties. Hydrogen peroxide and water charge supplies extra oxygen to guarantee complete combustion of the hydrocarbon fuel and at the same time the high vitality content present in the hydrogen peroxide serves to support the power yield of the engine. As the development of hydrogen is difficult to achieve that brings hydrogen economy is also difficult to attain. Hydrogen peroxide is move beyond as the alternative fuel that can give competitive to the hydrogen gas.

However, there are some issues that we had to face through this experiment. Some of the research like there use the 30% purity of hydrogen peroxide in their research. As we know this situation happen because of the market price of H_20_2 is expensive. This will be lead to the limitation in this research where the pure 100% of H_20_2 will not be tested. In this experiment, we will use almost 30% of the hydrogen peroxide and blend with the gasoline.

1.3 OBJECTIVE

The objectives of this project are as follows:

1. To study the optimum ratio of gasoline blended with hydrogen peroxide with respect to the fuel temperature.
2. To investigate the effect of fuel temperature on petrol engine with hydrogen peroxide-gasoline blend.
3. To study the optimum fuel temperature for better performance.

1.4 SCOPE OF PROJECT

The scope of this project will be covering the performance of the engine. The parameters that will involve in this project are peak pressure, heat release rate, indicated thermal efficiency indicated work, and indicated specific fuel consumption. All these results will show in several test fuel temperatures from 50° to 60° of fuel blend. The experiment will be run with the 4-stroke single cylinder engine and give the different loads to look the different in the result. In this experiment, gasoline is use from RON 95 Caltex and 50% purity hydrogen peroxide will use. There will be various ratios of fuel blend will be made as to look the different of parameters result. In addition, this experiment is use to get the optimum performance of engine result from the several ratios of fuel blend with the respect of the fuel temperature.

CHAPTER 2

LITERATURE REVIEW

2.1 Theoretical Background Engine Performance

There are a few of parameter that have to be considered in the experiment that involve with the performance of engine. Mostly, all the data is collect from the Data Acquisition System (DAS) that adjusted from Dyno Machine. These include the mechanical output parameters of work, torque and power, the input requirements of air, fuel and combustion, efficiencies and emission measurement of engine exhaust (Heywood, 1988; Pulkrabek, 2004)

2.1.1 Brake Power

Outputs of the engine are measured by developing the power into a brake dynamometer in the output shaft. Dynamometers measure the speed and the torque of the shaft. Power is defined as the rate of work of the engine. The brake power is expressed as Eq. (2.4) (Pulkrabek, 2004)

$$y = mx + c \tag{2.1}$$

$$\dot{W} = \dot{2}\pi n\tau \tag{2.2}$$

$$\dot{W} = (\frac{1}{2n})\dot{(}mep)A_p\bar{U}_p \tag{2.3}$$

$$\dot{W} = \dot{(}mep)A_p\bar{U}_p/4 \tag{2.4}$$

Where N is the shaft speed in rev/s, T is the torque in Nm

2.1.2 Mechanical Efficiency

This tells us how much of the indicated power is converted into brake power. The difference between them us due to frictional between the moving parts and the energy taken to run the auxiliary equipment as the fuel pump, water pump, oil pump and alternator.

$$H_{mech} = \text{B.P./I.P} \tag{2.5}$$

2.1.3 Brake Specific Fuel Consumption

Brake specific fuel consumption (BSFC) is a measure of the fuel efficiency of any prime mover that burns fuel and produces rotational, or shaft, power. It is typically used for comparing the efficiency of internal combustion engines with a shaft output. It is the rate of fuel consumption divided by the power produced.

$$bsfc = \dot{m}_f / \dot{W}_b \tag{2.6}$$

Where $\dot{m}_f$= rate of fuel flow into engine

The literal meaning of BSFC is how much fuel is consumed in one hour to produce one kilowatt brake power. Brake Specific Fuel Consumption as a function of engine speed. Fuel Consumption decreases as engine speed increases due to shorter time for heat loss during each cycle. At higher engine speeds fuel consumption again increases because of high friction losses. As compression ratio is increased fuel consumption decreases due to greater thermal efficiency.