

**INVESTIGATION ON THE PERFORMANCE GASOLINE BLENDED WITH
HYDROGEN PEROXIDE AS FUEL FOR PETROL ENGINE**

MUHAMMAD THAZALY BIN ZAKARIA

**This report is submitted
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DECLARATION

I declare that this project report entitled “Investigation On The Performance Gasoline Blended With Hydrogen Peroxide As Fuel For Petrol Engine” is the result of my own work except as cited in the references.

Signature :

Name : Muhammad Thazaly Bin Zakaria

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) with Honours.

Signature :

Name of Supervisor : Dr. Adnan Bin Roseli

Date :

DEDICATION

To my beloved mother, Puan Siti Hawa Binti Abdul Aziz

ABSTRACT

This report represents an experimental investigation on the performance gasoline blended with hydrogen peroxide as fuel for petrol engine. The main objective of this investigation was to identify the effects of hydrogen peroxide on engine performance when blended with gasoline. Literature reviews showed that previous studies had demonstrated better engine performance parameters with hydrogen peroxide blend. Test fuels was set with 5% and 10% of hydrogen peroxide in the fuel blends. An experiment was done to identify those fuel blend's chemical properties. For engine performance testing, each test fuel was tested at various engine speeds and loads. Data from those experiments were analysed into engine performance parameters. Then, the results of hydrogen peroxide-gasoline blend was compared with gasoline alone in terms of combustion analysis and engine performance analysis. The results showed blending off hydrogen peroxide with gasoline did improved performance of the engine when compared to gasoline alone.

ABSTRAK

Laporan ini mewakili peyiasatan ke atas prestasi petrol yang dicampur dengan hidrogen peroksida sebagai bahan bakar untuk enjin petrol. Objektif utama penyiasatan ini adalah untuk mengenal pasti kesan-kesan hidrogen peroksida pada prestasi enjin apabila dicampur dengan petrol. Kajian kesusasteraan menunjukkan bahawa kajian sebelum ini telah menunjukkan prestasi enjin yang lebih baik dengan campuran hidrogen peroksida. Bahan api ujikaji telah ditetapkan dengan 5% dan 10% kandungan hidrogen peroksida dalam campuran bahan api. Eksperimen dilakukan untuk mengenal pasti sifat-sifat kimia campuran bahan api tersebut. Untuk ujian prestasi enjin, setiap bahan api ujikaji diuji pada pelbagai kelajuan dan beban. Data-data dari eksperimen tersebut dianalisis ke dalam bentuk prestasi enjin. Kemudian, hasil analisis pembakaran dan analisis prestasi enjin untuk gabungan campuran hidrogen peroksida-petrol dibandingkan dengan petrol sahaja. Hasil dari perbandingan tersebut menunjukkan campuran hidrogen peroksida dengan petrol meningkatkan prestasi enjin berbanding dengan petrol sahaja.

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LIST OF ABBREVIATIONS

TDC	Top Dead Centre
BDC	Bottom Dead Centre
DAQ	Data Acquisition System
MEP	Mean Effective Pressure
IMEP	Indicated Mean Effective Pressure
BMEP	Brake Mean Effective Pressure
ITE	Indicated Thermal Efficiency
SFC	Specific Fuel Consumption
ISFC	Indicated Specific Fuel Consumption
BSFC	Brake Specific Fuel Consumption
SOC	Start Of Combustion
H ₂ O ₂	Hydrogen Peroxide

LIST OF SYMBOLS

τ	=	Torque
n	=	Number of revolution per cycle
N	=	Engine speed
m_a	=	Mass of air
m_f	=	Mass of fuel
Q_{in}	=	Heat energy input
W_i	=	Indicated work per revolution cycle
W_b	=	Brake work per revolution cycle
\dot{W}_i	=	Indicated power
\dot{W}_b	=	Brake power
η_m	=	Mechanical efficiency
η_{th}	=	Thermal efficiency
$\eta_{b.th}$	=	Brake thermal efficiency
ϕ	=	Equivalence air-fuel ratio
η_v	=	Volumetric efficiency
V_d	=	Displacement volume
ρ_a	=	Air density
A_p	=	Area of piston face

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CHAPTER 1

INTRODUCTION

1.1 Background of Project

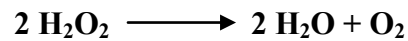
Decreasing supplies of fossil fuels and steadily rising concentrations of atmospheric carbon dioxide concentrations and levels of atmospheric pollutants are some of major challenges to the modern society (Kumar & Rao, 2013). An attempt to replace fossil fuels with cleaner and renewable sources of energy is proposed to overcome these problem. The biomass-based fuels were indicated to be the best option according to the conducted research because they do not require changes in the existing technologies in use. Probably then, the best alcohol that can be an alternative to petroleum is ethanol.

A study was done by Melo, et al (2012) and the main propose is to study combustion effects on existing internal combustion engines with no modifications to existing injection and ignition systems, when the engine is applied with various fuel mixtures including gasoline, ethanol, and oxy-hydrogen gas, stabilized hydrogen peroxide, and offer the optimal fuel mixture (Kumar & Rao, 2013).

Hydrogen peroxide-gasoline blended is now considered as the alternative fuel for internal combustion engine. Unfortunately, not many investigation has been carried out yet. Hydrogen peroxide is a strong oxidizing agent and a weak acid in water solution. Since it is an oxidizing agent, it oxygenates hence adds oxygen to the reaction when it burns (Brain, 2002). Although it does not boost the octane number of gasoline like MTBE

did in the past, ideally hydrogen peroxide reduces the amount of unburned hydrocarbons and carbons monoxide in the exhaust. In case of performance, addition of oxygen will cause a leaner combustion and reduce the unburned hydrocarbon. This will affect the performance of engine.

Hydrogen peroxide is known as the simplest form of peroxide compound which consists of an oxygen-oxygen single bond. It is a colourless liquid with a sharp odour also a weak acid and strong oxidizing agent. The specific gravity of hydrogen peroxide is 1.135. Hydrogen peroxide is soluble in water and it is a polar solution. So it is slightly unstable and will decompose at a reasonably slow rate.



During the decomposition of hydrogen peroxide, one volume of hydrogen peroxide is able to release 10 volumes of oxygen. Due to this characteristic, hydrogen peroxide is currently utilized as rocket propellant fuel.

A research was conducted and found that brake thermal efficiency, $\eta_{b.th}$ of diesel engine increased when hydrogen peroxide is blended with the fuel. This lead to the finding that additional oxygen molecule released by hydrogen peroxide has led to better combustion (Nagaprasad & Madhu, 2012).

Before that, effects of alcohol-gasoline blends such as ethanol-gasoline blends on the performance engine have been investigated by many researchers. Palmer (1986) showed when 10% of ethanol with constant concentration is added to gasoline, the engine power improved by 5%. Next, Cowart et al. (1995) proved that the engine torque and power increased by 4% respectively when blended fuels were used. Al-Hasan (2003) found that by using ethanol as fuel additive to unleaded gasoline, engine performance can be boost. Also, increment by about 8.3%, 9.0%, 7% and 5.7% mean average values in brake power, brake thermal efficiency, volumetric efficiency and fuel consumption respectively was noticed. Then, he concluded that the best results of the engine performance is when 20% ethanol fuel blend was used.

Engine performance is evaluated by some parameters. The parameters are work done, torque, power, fuel consumption and engine efficiencies. Engine torque measured with dynamometer is known as brake torque, τ_b while power delivered by the engine and absorbed by the dynamometer is known as brake power, \dot{W}_b . Brake mean effective pressure (BMEP) can be determine from dynamometer or water pump pressure. Fuel consumption is defined as the flow rate or mass flow of fuel per unit time while specific fuel consumption is the rate of fuel flow per unit power output. There are indicated specific fuel consumption (ISFC) and brake specific fuel consumption (BSFC). Then, the thermal efficiency, η_{th} of engine is the conversion of the heat energy stored in the liquid fuel into mechanical energy. While mechanical efficiency, η_m is the ratio of brake power, \dot{W}_b delivered by the engine to the indicated power, \dot{W}_i produced in cylinders (Pulkrabek, 2004).

Based on early literatures, the use of hydrogen peroxide-gasoline blended fuels is not very clearly whether it improved or unimproved the engine performance compared to gasoline alone. In this project, the performance of petrol engine using the hydrogen peroxide-gasoline blend will be investigated and the results will be compared when using gasoline alone.

1.2 Problem Statement

Everyday amount of gasoline is consumed in cars, light trucks, motorcycles, small aircraft, boats, watercraft, also in landscaping and construction equipment. Major problem with gasoline when it is burned, it produces substances like carbon monoxide, nitrogen oxides, unburned hydrocarbons and some particular matter. These substances contribute to air pollution.

On performance matters, usage of gasoline alone does not improve the engine performance. Alternative fuels beside are needed petroleum, so blending of gasoline with some additives like ethanol and methanol was discovered. These blend give a leaner combustion thus better performance and lesser fuel consumption. However currently, the new alternative fuel is begin to arise. It is hydrogen peroxide-gasoline blend.

Lately, consumers began to question if the hydrogen peroxide is the best blending with gasoline which could boost engine performance. Besides the price of hydrogen peroxide in the market is considerably expensive.

Hence, for this project, blending off hydrogen peroxide with gasoline as fuel for petrol engine with different percentage of hydrogen peroxide should be boosting the engine performance in order to overcome those problem.

1.3 Objective

The objectives of this project are as follows:

1. To study the effects of hydrogen peroxide on engine performance parameter.
2. To compare the results between hydrogen peroxide-gasoline blends with gasoline alone.
3. To study which blend percentage that give best performance to the engine.
4. To study the percentage of hydrogen peroxide for optimum performance.

1.4 Scope of Project

The scopes of this project are experimental data and analysed results such as calculations, table, graph and effects of different composition of blends on engine performance are presented in this report. The emission of engine at different blends is not covered.

1.5 General Methodology

Throughout this project, several of methodologies will be carried out in order to achieve those objectives. The first methodology will be literature review. Journals, articles, technical papers or any materials regarding this project need to be gathered as much as possible and then be reviewed. Outcomes from literature reviews will be a help regarding this project. As example, with the literature reviews, outcome of this project can be predicted before carrying out the experiment.

Experiments are the next methodology that will be carried out in this project. Several experiments like chemical properties determination and engine performance testing experiment will be carried out at the respective laboratories. For engine performance testing, the setup is shown in **Figure 1**. In order to study the effect of blending off hydrogen peroxide with gasoline to engine performance, the percentage of hydrogen peroxide in the fuel blend will be varied. Other parameters like engine specification, gasoline properties, air and fuel temperature will be constant in this project. Generator will be used to supply load. Experimental data will be collected through data acquisition system.

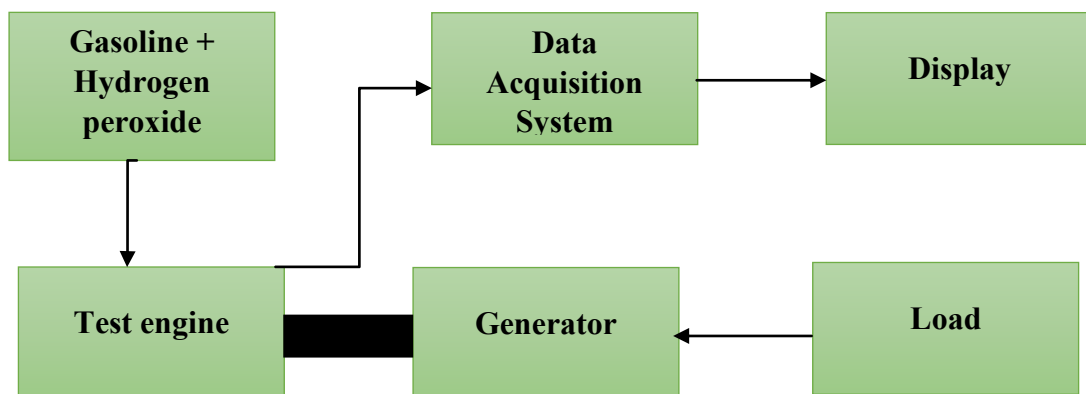


Figure 1: Schematic diagram of engine testing

Data analysis are the methodology that will be presented up after conducting the experiments. Based on each fuel blends tested on the engine, the raw data will be calculated, tabulated and analysed based on various performance parameters. Result at the end of the analysis will be concluded according to the objectives of this project.

Last but not least, the last methodology that will be report writing. A thesis, progress reports and draft reports on this project will be produced and submitted along the project's duration. Report writing is important such as progress report means to show and update project's progress while draft report is to ensure that the mistakes are corrected before submitting the thesis.