INFLUENCE OF ETHANOL FUEL IN ENGINE EMISSION

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SUPERVISOR'S DECLERATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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Date:

STUDENT'S DECLERATION

I hereby declare that the work in the thesis is my own except for quotations and summaries which have been duly acknowledged. This thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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Dedicated to my beloved father and mother

Idris bin Zakaria
Amizah binti Ali

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ABSTRACT

This project is to determine the influence of ethanol fuel in engine emission. The main objective of this study is to compare the emission of carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC) and nitrogen oxide (NO_X) produce by gasoline with the emission of carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC) and nitrogen oxide (NO_X) produce by gasohol fuels which are ethanol 10% (ethanol 10% blended with gasoline 90%), ethanol 85% (ethanol 85% blended with gasoline 15%) and pure ethanol (ethanol 100%). The engine model use in this project is build up according to Mitsubishi's 4G92 which is use in Proton Wira. The simulation is conducted by using Gamma Technologies Software (GT-Power). The relation between the increasing of engine speed with the amount of emission and the amount of emission produced by each fuel is also discussed. Major finding shows that the emission of carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC) and nitrogen oxide (NO_X) decrease with the increase of blended ethanol in the fuel. Furthermore, although overall of the emission pattern results showed good agreement with previously published work even though the amount is different compare to the past studies but this is due to the engine parameters itself each engine have different parameter. The observation indicates that the emission of carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbon (HC) and nitrogen oxide (NO_X) produce by gasoline is the highest compare to the other fuel. In addition, the fuel that gives the cleanest emission is the pure ethanol (ethanol 100%).

ABSTRAK

Projek ini dijalankan untuk mengkaji minyak yang diadun bersama etanol mempegaruhi pembebasan gas beracun iaitu karbon monoxide (CO), karbon dioxide (CO_2), hydrokarbon (HC) and nitrogen oxide (NO_X) yang terhasil selepas proses pembakaran di dalam enjin. Objektif utama dalam kajian ini adalah untuk mengkaji perbezaan terhadap pembebasan gas beracun yang terhasil jika menggunakan minyak petrol dan pembebasan gas beracun jika menggunakan minyak petrol yang diadun dengan etanol. Di dalam kajian ini jumlah etanol yang diadunkan ke dalam mintak petrol adalah mengikut sukatan yang telah ditetapkan iaitu etanol 10% (etanol 10% diadun dengan petrol 90%), etanol 85% (etanol 85% diadun dengan petrol 15%) and etanol asli (etanol 100%).Di dalam kajian ini analisis yang dijalankan dengan menggunakan kaedah simulasi dengan menggunakan perisian using *Gamma Technologies Software (GT-Power)*. Kajian yang dijalankan . Selain itu, keseluruhan keputusan menunjukkan pengurangan dalam pembebasan gas beracun dengan penggunaan minyak petrol yang diadun dengan etanol menunjukkan kesamaan dengan eksperimen sebelum ini, namun jumlah pengurangan tidak sama seperti kajian-kajian lepas kerana setiap enjin mempunyai setting yang berbeza. Daripada pemerhatian menunjukkan dengan penambahan etanol ke dalam minyak petrol kadar pembebasan gas beracun semakin berkurangan. Tambahan lagi, dengan penggunaan etanol asli kadar pembebasan gas beracun adalah di tahap yang paling rendah.

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CO	Carbon Monoxide
CO_2	Carbon dioxide
HC	Hydrocarbon
NO_X	Nitrogen Oxide

LIST OF ABBREVIATIONS

E0	Gasoline
E10	Ethanol 10% blended with gasoline 90%
E85	Ethanol 85% blended with gasoline 15%
E100	Ethanol 100%

CHAPTER 1

INTRODUCTION

1.1 Introduction

Air pollution is a hot topic nowadays. Air pollution is defined when the air contains gases, dust, fumes or odour in harmful amounts. That is, amounts which could be harmful to the health or comfort of humans and animals or which could cause damage to plants and materials. Air pollutions are cause from release of carbon dioxide (CO_2), nitrogen oxide (NO), nitrogen dioxide (NO_2), chlorofluorocarbon (CFC) and smog. Carbon dioxide and nitrogen oxide are gases that are release from vehicles. From day to day the number of vehicles being produced by the factories increases. Every year we can see many new models being introduced. This means that the number of vehicles on the road also increases. The increasing number of vehicles on the road means that there are lots of emission gases being released. Emission is a hot topic now in the automotive industries. This is because the gas that being released from the vehicles is very dangerous. Emission gas is dangerous because it affect everything such as the environment and also human health. What is emission actually?

Emission is the gas produced by vehicles from the combustion of gasoline fuel. Emission is also known as exhaust gas. Exhaust gas is define as flue gas which occurs as a result of the combustion of fuels such as natural gas, gasoline/petrol, diesel, fuel oil or coal. It is discharged into the atmosphere through an exhaust pipe or flue gas stack. The chemical formula is shown below:

Fuel + Air => Hydrocarbons + Nitrogen Oxides + Carbon Dioxide + Carbon Monoxide + water

From the equation gasoline (CH_4) when added with oxygen (O_2) and through combustion process it will produced carbon dioxide (CO_2), water (H_2O), carbon monoxide (CO), hydrocarbon (CH_X), and nitrogen oxide (NO_X). All of these released gases except and H_2O are every dangerous. These gases can cause major damage to the environment and also human health.

In order to reduce the quantity of these gases being released into the air, many researches have been done and lots of solutions have been discovered. Among the solution are by making electric powered car, where there is no gasoline fuel is used. Beside that solar car is among one of the solution on how to control the emission rate, but the fact is that solar car is not practical enough to be produced as a conventional car. The other solution on how to reduce the quantity of emission gas being produce is by using biofuel. What is biofuel actually? Biofuel is actually fuels made from biomass. Biofuels include ethanol, biodiesel and methanol. They are manufactured from vegetable oils, waste cooking oils, animal fats or tall oil (a by-product of the pulp and paper industry).

Ethanol is one of the biofuel available. Ethanol is one of the elements in alcohol family. Ethanol can be used as a fuel for vehicles. Ethanol fuel is ethanol (ethyl alcohol), the same type of alcohol found in alcoholic beverages. It can be used as a fuel, mainly as a biofuel alternative to gasoline, and is widely used in cars in Brazil. In some part of the world, people depends more on ethanol as a fuel other than gasoline. This is because ethanol can easily be manufacture and process. Crops, sugarcane and corn are the most popular raw material to produce ethanol. This is a renewable resource (can be produced, unlike petroleum which cannot be produced and in time will be gone). Ethanol fuel can help reducing the quantity of dangerous gases in the exhaust gas from escaping into the air. So this project is to investigate whether ethanol can really reduce the amount of dangerous in exhaust gas.

1.2 OBJECTIVE

In this project, the aim is to investigate the influence on ethanol fuel on engine emission whether it will reduce or increase the emission. So the objectives of this project are:

- Compare the amount of emission produce by using 100% gasoline and by using gasoline blended with ethanol (E10, E85, E100).
- Calculate the reduction (%) of emission between gasoline fuel with E10, E85, and E100.
- Determine which fuel give cleaner emission.

1.3 PROBLEM STATEMENT

Many car manufacturers and individual has been researching how to reduce the rate of emission that been produced by vehicles. High rate of emission will damage our environment such as pollute the air, increase in world temperature, make ozone layer thinner and many more. So to overcome this problem biofuel or alternative fuel was introduced. Ethanol is one of the biofuel that is can be renewed and also one of the cheapest fuels available. In some countries gasoline is added with 85% of ethanol. By using alternative fuel it can lower the percentage of emission release by vehicles.

This project will be conducted by using Gamma Technology Power Software (GT Power). The engine model that is going to be used is from the Mitsubishi 4G92 engine. All of the specification of the engine will be place in the software. This engine was once use in the Protons car. The test will be done by using fully gasoline which means 100% gasoline will be used in the engine and from the simulation result we can get the graph for the emission using gasoline 100%. This result will used as the reference to the other test which use 100% ethanol, 10% ethanol and 85% ethanol.

1.4` SCOPE

The scope for this project is to reduce the emission of CO_2, CO, HC and NO_X produce by vehicles with the influence of ethanol fuel. The focus of this project is:

- Comparison of amount of emission produce when using gasoline with gasoline blended with ethanol at the operating condition.
- The relation on the amount of emission with the increment of rpm.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION

Pollutant or emissions are a major problem nowadays. Spark-ignition and diesel-ignition are a major source of urban air pollutant. From Oxford dictionary emission can be define as things that are sent, given off and discharge (A.S. Horney). In this case emission can be defined as the gases that are discharge after combustion process from vehicles. Emission or also known as exhaust gas is flue gas which occurs as a result of the combustion of fuels such as natural gas, gasoline/petrol, diesel, fuel oil or coal. After combustion process inside the engine, there are gases that will be discharge that are carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxide (NO_X) and hydrocarbon (HC). Exhaust emissions occur during two modes:

- Cold Start -Emission is high if we start or drive the car the first few minutes because of the emissions control equipment is not in its optimal operating temperature (U.S. EPA, 1994).
- Running Exhaust Emissions - Pollutants are emitted from the vehicle's tailpipe during driving and idling after the vehicle is warmed up (U.S. EPA, 1994).

In the figure below we can see the summary of the mechanism of how nitrogen oxide (NO_X), hydrocarbon (HC) and carbon monoxide (CO), occur:

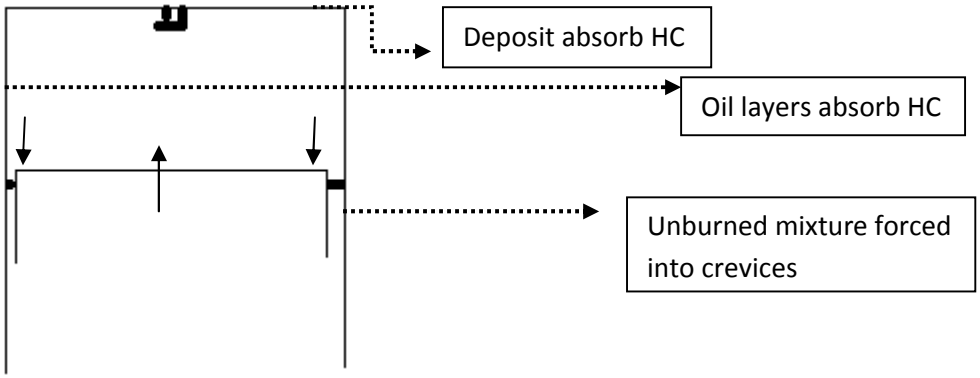


Figure 2.1(a): Compression Stage

Source: Heywood 1988

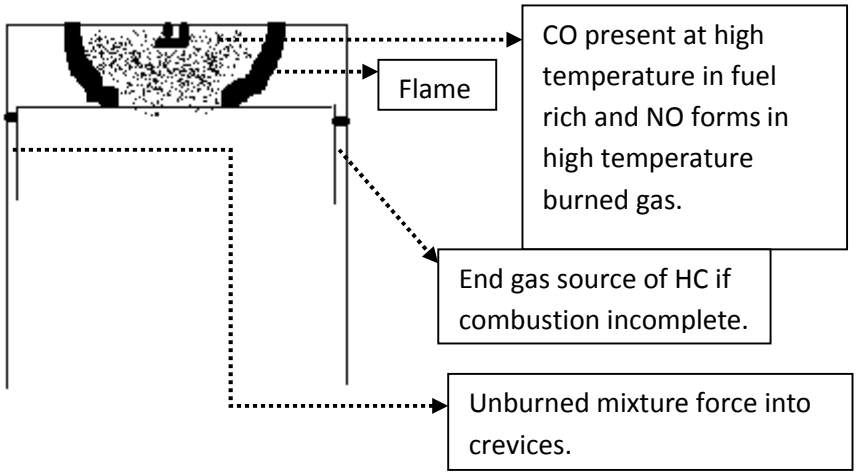


Figure 2.1(b): Combustion Stage

Source: Heywood 1988

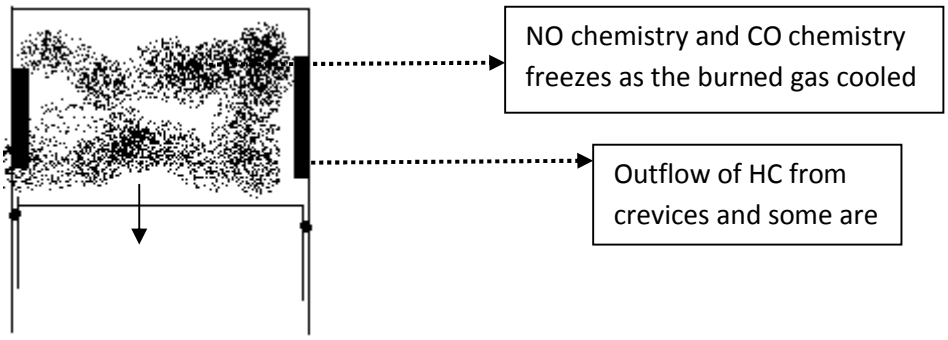


Figure 2.1(c): Expansion Stage

Source: Heywood 1988

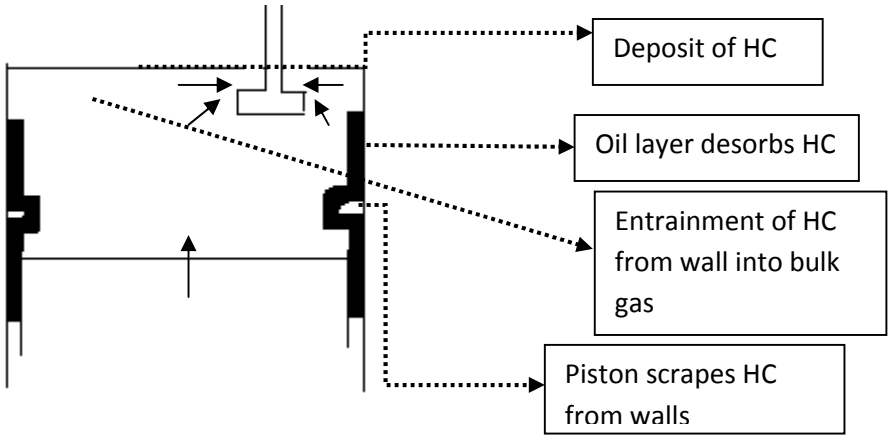


Figure 2.1(d): Exhaust Stage

Source: Heywood 1988

From the figure above, its shows the schematic diagram of the formation of emission gases during the four stages which are compression, combustion, expansion and exhaust. From the figure we can summarized that nitrogen oxide form throughout high temperature due to the chemical reaction between N atom and O_2 atom. Nitrogen Oxide increases if the burning rates increase. During expansion NO will freeze. During the combustion period carbon monoxide CO is form and by the time expansion process

happens carbon monoxide will oxidize, this will cause carbon monoxide freeze due to the decrease of temperature. Hydrocarbons are form from incomplete combustion due to bulk quenching of the flame.

2.2. EMISSION GASSES AND ITS EFFECT

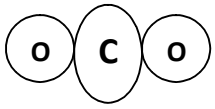
As we know, vehicle emission will discharge certain kinds of gases. From the equation below we can see the gases that are being release after the combustion process in the engine:

Fuel + Air => Hydrocarbons + Nitrogen Oxides + Carbon Dioxide + Carbon Monoxide + water

Beside water which is also being discharge all of the other gases in the equation above will harm living things and the environment. These gases which are carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxide (NO_X) and hydrocarbon (HC) can give effects to both living things and also the environment. These gases can cause cancer, greenhouse gas and more seriously can cause death.

2.2.1. Carbon Dioxide (CO_2)

The chemical reactions of one carbon atom with two oxygen atoms will produce carbon dioxide (CO_2). Carbon dioxide first identified carbon dioxide in the 1750s. The molecular formula for carbon dioxide is CO_2. Below is the structure of Carbon Dioxide (CO_2) and also the properties for carbon dioxide (CO_2):



O=C=O

Figure 2.2: Molecular formula Carbon Dioxide

Table 2.1: Properties of Carbon Dioxide

Properties of Carbon Dioxide	
General formula	CO_2
Physical state	Gas
Odour	Odourless
Toxicity	In high Concentration is toxic to human
Solubility	Soluble in water when in liquid form
Boiling Point	-78.5 ^oC
Melting Point	-55.6 ^oC
Flammability	non-flammable
Polarity	Non-polar
Acidity	Faintly acidic

The properties table, carbon dioxide has a very low boiling temperature. This means that carbon dioxide that is produce from combustion process from vehicles is in gases state. Each vehicle release different amount of carbon dioxide emission due to the design of the engine. Carbon dioxide is the main factor that contributes to climate change. This is because carbon dioxide is a greenhouse gas. Greenhouse gas reacts as a blanket that traps the long wave given off by earth. At the same time the atoms in carbon dioxide will vibrate with the carbon atom in the middle. When the frequency of the radiation from the Earth's surface and the atmosphere coincides with the frequency of CO_2 vibration, the radiation is absorbed by CO_2, and converted to heat by collision with other air molecules, and then given back to the surface. This will result in the trapping of heat and less heat escape from earth (V. Ramanathan, 2009). This is why our planet is becoming hotter and hotter each day. Beside the temperature of earth increase, sea level also increases due to the melting of ice in the arctic.