Faculty of Engineering Technology

EFFECT OF WATER MIST IN SPARK IGNITION ENGINE TOWARD EXHAUST GAS EMISSION

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This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Department of Mechanical Engineering Technology) (Hons.)

Faculty of Engineering Technology

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DECLARATION

I declare that this thesis entitled "Effect Of Water Mist In Spark Ignition Engine Toward Exhaust Gas Emission" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidate of any other degree.

Signature : ……..

Name : ……..

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APPROVAL

I hereby declare that I have read this report and in my opinion this report is suffient in term of scope and quality as a partial fulfilment of Bachelor of Mechanical Engineering Technology (Automotive Technology) (Hons).

Signature : ……..

Supevisor Name : ……..

Date : ……..

DEDICATION

I would like to thanks to everyone who involved in finishing my final year project. First of all, i would like to say thank you to my project supervisor En. Muhammad Zaidan Bin Abdul Manaf for the guidance and while finishing this project and also not forget to my previous supervisor Pn. Norhamizah Binti Miswan. All those teaching and effort were priceless to me. I would also like to thank my family who keep supporting morally all the way in completing this project. Specials thank to my friend that has help me in completing this final year project and several UTeM staff that giving the support amd help. Finally, I would like to thanks the researcher who publish their research paper which is my main source in completing this final year project.

ABSTRACT

This study investigates the effect of water addition in a spark ignition engine by analyzing the exhaust gas emission. Method of the study research is using experimental method. The concept of vapourize the water by using ultrasonic humidifier. The engine was using a Suzuki Belang R150 as the experiment engine. The gas analyzer brand EMS model 5002 for the exhaust gas analyzer. The experiment were conducted in a workshop at Faculty Engineering Technology. The ultrasonic humidifier were attach at the center of the motorcycle near the carburetor. Tools that used were humidity sensor and temperature sensor. The sensor were attached at the middle between the carburetor and the ultrasonic humidifier. The condition of the first experiment without water mist were, the air intake temperature is 35°C and the humidity is 61%. The second experiment which that with the mist maker, the air intake temperature is 27°C and the humidity is 99%. Both experiment have the ambient temperature of 35°C. The result were taken at 1,000 rpm to 10,000 rpm. With water mist addition the result of O2% emission have been reduce from 1.4% to 8.6% at various engine speed. The CO% emission with addition of water mist the reading from 1,000rpm to 5,000 rpm was a bit lower then without water mist, but from 6,000rpm to 10,000rpm was gradually increase. With water addition the result of CO2% emission have been reduce from 0.3% to 2.3% at various engine speed. With water mist addition the result of HC ppm emission have been increase from 19 ppm to 583 ppm at various engine speed. . With water mist addition the result of NOX ppm emission have been reduce from 3 ppm to 21 ppm at various engine speed. . With water mist addition the result of AFR emission have been increase from 5 to 20.73 at various engine speed. At the end of this research, the conclusion are, water mist addition can reduce O2, CO2, NOX emission but its also increase HC emission and leaner the AFR or air fuel ratio. Water mist addition does not have significant change toward CO.

ABSTRAK

Kajian ini menyiasat kesan penambahan air dalam enjin pencucuk lilin dengan menganalisis pelepasan gas ekzos. Kaedah penyelidikan kajian menggunakan kaedah eksperimen. Konsep vapourize air dengan menggunakan humidifier ultrasonik. Enjin menggunakan Suzuki Belang R150 sebagai enjin percubaan. Model penganalisis gas EMS model 5002 untuk penganalisis gas ekzos. Percubaan telah dijalankan di bengkel di Teknologi Kejuruteraan Fakulti. Humidifier ultrasonik dipasang di pusat motosikal berhampiran karburetor. Alat yang digunakan ialah sensor kelembapan dan sensor suhu. Sensor dipasang di tengah antara karburator dan humidifier ultrasonik. Keadaan eksperimen pertama tanpa kabut air adalah, suhu pengambilan udara adalah 35 ° C dan kelembapan adalah 61%. Percubaan kedua yang dengan pembuat kabus, suhu pengambilan udara adalah 27 ° C dan kelembapannya adalah 99%. Kedua-dua eksperimen ini mempunyai suhu sekitar 35 ° C Hasilnya diambil pada 1,000 rpm hingga 10,000 rpm. Dengan penambahan kabus air, hasil pelepasan O2% telah berkurang dari 1.4% hingga 8.6% pada pelbagai kelajuan enjin. Pelepasan CO% dengan penambahan kabus air bacaan dari 1,000rpm hingga 5,000 rpm sedikit lebih rendah kemudian tanpa kabus air, tetapi dari 6,000rpm hingga 10.000rpm secara beransur-ansur meningkat. Dengan penambahan air, hasil pelepasan CO2% telah dikurangkan dari 0.3% hingga 2.3% pada pelbagai kelajuan enjin. Dengan penambahan kabus air, hasil pelepasan HC ppm telah meningkat dari 19 ppm hingga 583 ppm pada pelbagai kelajuan enjin. . Dengan penambahan kabus air, hasil pelepasan NOX ppm telah dikurangkan dari 3 ppm hingga 21 ppm pada pelbagai kelajuan enjin. . Dengan penambahan kabus air, hasil pelepasan AFR telah meningkat dari 5 hingga 20.73 pada pelbagai kelajuan enjin. Pada akhir kajian ini, kesimpulannya, penambahan kabus air dapat mengurangkan pelepasan O2, CO2, NOX tetapi juga meningkatkan pelepasan HC dan menurunkan nisbah AFR atau bahan api udara. Penambahan kabus air tidak mempunyai perubahan ketara terhadap CO.

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LIST OF ABBREVIATION, SYMBOL AND NOMENCLATURE

O2	-	Oxygen
CO	-	Carbon Monoxide
CO2	-	Carbon Dioxide
HC	-	Hydrocarbon
NOX	-	Nitrogen Oxide
AFR	-	Air Fuel Ratio
MBT	-	Maximum Brake Torque
CFD	-	Computational Fluid Dynamic
WI	-	Water Injection
WM	-	Water mist
BTDC	-	Before Top Dead Center
ATDC	-	After Top Dead Center
ADI	-	Anti Detonate Injection

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In the olden days, the vehicle manufacturer did not think of air pollution. The use of the older vehicle is not the effective cause of the carbureted engine cause of mechanical system. It is not fuel efficiency and poor exhaust emissions. Later the carburetor is being replaced by fuel injection, because it is effective fuel uses and less emission. For the past 100 years, many advance techniques have been created to make a better life for humans. Air pollution is one of the most important human risk sources from road vehicle emission.(MassDEP 2012). Now days, due to air pollution, causing the environment is hurting badly, the electric vehicles and hybrid vehicle are the new technology to counter the air pollution. (Wu & Zhang 2017). The government asks to reduce the pollution of congestion and air pollution by changing the daily routine. The uses public transport can reduce the number of vehicles on the road and be less crowd. Changing the car to a bicycle is a way of reducing air pollution because it is a free emission transportation.(Johansson et al. 2017). Now everything should be in green technology because air pollution not only can cause problem to the environment but also to human health.

1.2 Problem Statement

According to all modern government regulations, automakers need to control the amount of carbon monoxide, hydrocarbons and nitrogen Oxides in vehicle exhaust. In 1966, emissions from American exhaust pipes were uncensored vehicles. The federal government of the United States, was required to control the hydrocarbons and CO amendments to the Federal Clean Air Act require reduction of CO emissions, hydrocarbons and nitrogen oxides in the 1970s. Three substances (CO, Nox, and hydrocarbons) have been identified as the main pollutants emitted from the SI engine. Nitrogen oxides produced during high temperature inside the cylinder. Carbon monoxide is produced as a result of a process rich in the equivalent sense, and fuel is high when oxygen is present.(Hightower 1976)

1.3 Objective

1. To study the effect of air intake temperature in an engine
2. To design an experiment to study the effect of water mist system.
3. To investigate the water mist effect toward exhaust gas emission spark ignition engine.

1.4 Scope

- The water mist system is used at a motorcycle engine which is carburetor and gasoline for the experiment.
- Focusing the analysis on the exhaust gas emission.

CHAPTER 2

LITERATURE REVIEW

2.0 Overview

This chapter is discussed on the literature review on this study. It consists of types of engine, fuel delivery system, water injection, types of spray characteristic, type of nozzle spray, type of pump, device concept, the effect of water injection towards exhaust emission, product design specification and previous research.

2.1 Type of Engine

2.1.1 Naturally Aspirated

The inhaled natural engine is an inner combustion engine that depends on the quantity of air best on atmospheric stress and does now not depend upon forced induction which include a turbocharger or supercharger. In a herbal inhaled engine, the air is absorbed to the air / gasoline combination in the cylinders through atmospheric strain performing towards a partial vacancy that occurs when the piston travels down towards the lower useless middle in the course of the stroke. Most motor vehicle engines, as well as many small motors used for non-motor purposes, are inhaled naturally. The advantages of a naturally aspirated engine is that it is easier to maintain. It has a lower production and development cost. It is also higher reliability since its build with less separate parts. Since the naturally aspirated engine is not a force induction, so it has a direct throttle response because of no turbo lag. The disadvantage of the lower efficiency, lower power to weight

ratio, small potential of producing power and greater power loss at higher elevation where have lower air pressure compared to forced induction.

Figure 2.1 above show a naturally aspirated engine

2.1.2 Forced induction

Forced induction is the procedure of handing over compressed air to the quantity of internal combustion engine. Induction vehicles are forced the use of a fuel compressor to growth stress, temperature and air density. Uses compelled induction within the car and aviation enterprise to growth engine energy and efficiency. Induced induction engines are basically two compressors in a series. The compression motor pressure stroke is the main feature of each engine. Additional feeding compressor to engine consumption causing forced induction air. A pressure compressor to feed the other will increase the compression

ratio of the total system. Called intake pressure stimulation. This especially helps the engine low, because they have to operate at a higher elevation to a lower air density. A higher compression engine benefit from maximizing the amount of useful energy is growing every unit of fuel. Therefore, the thermal efficiency of the engine is increased by analyzing the steam energy cycle of the second law of thermodynamics. Each compression motor is not higher because it is for any particular octane fuel that will explode prematurely with a higher compression ratio than normal. This is called a pre-ignition, or knocks the explosives and can cause severe engine damage. High compression in naturally aspirated engine can reach the verge of explosion is relatively simple. However, the forced induction motor may have a greater amount of pressure without bursting because the air can cool down after the first stage of compression radiator.

One main concerns is a factor called Nitrogen oxide, or the amount of nitrogen compounds / oxygen engine produces. This level of government regulated emissions such as commonly seen in the inspection station. High compression resulting in higher combustion temperatures. Increase combustion temperatures lead to greater Nox emissions, where forced induction can give a greater proportion of nitrogen oxides.(Pakale & Patel 2015)

Figure 2.2 above show a forced induction engine of turbocharged engine

2.2 Fuel Delivery System

2.2.1 Carburetor

Carburetor is the use of a mechanical device for mixing the air with fine spray of liquid fuels for internal combustion engines. Carburetor using Bernoulli's theory, wind speed is faster, stable pressure decreases and dynamic pressure is high. The carburetor is a tube which allows the air and fuel through the valve in the engine, mixing them together in a variety of different types of driving conditions. Pressure drops in the air creates an interesting effect sucks air in through the fuel pipe on the side.

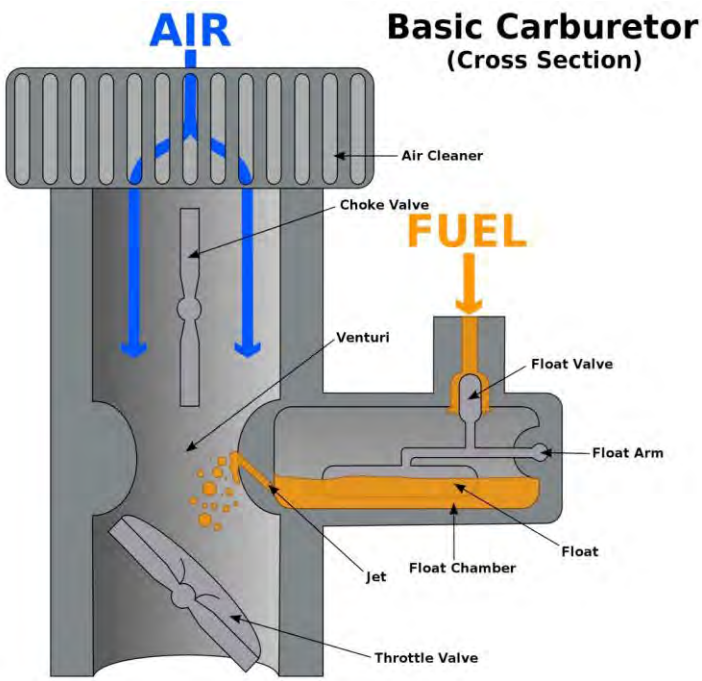

Figure 2.3 above show basic concept of carburetor

The air enters the carburetor through the engine air intake system. How much air enters the carburetor choke depending on the setting, the more open the choke valve cover is, the more air can enter. air is pushed through a narrow opening called a venturi. This creates a vacuum that draws fuel in through the jet fuel is very small, allowing

enough fuel to create the correct ratio for the explosion of the engine power of additional gas held in the float bowl when the bowl is full float "float" to the top and cover the area that the fuel flowing through, because the gas is released into the chamber, the float will drop to the level of gas and un-block the opening of the chamber, allowing the bowl to refill fuel. When the throttle valve is opened, the gas is released more quickly to make sure there is enough power to make the equipment more quickly. When the throttle is closed and the engine is idling, there are so-called secondary valve throttle valve idle outside.

2.2.2 Fuel Injection

fuel injection system is specified as typically electronically controlled to inject the right amount of atomized fuel into the cylinder or the intake air flow of the internal combustion engine. It is a type of delivery system in an internal combustion engine. It is a replacement for the carburetor past technology. In the past years, fuel is regulated through a carburetor, which is more useless in the use of fuel injection systems, which controls the amount of fuel to the measures appropriate for optimum performance and economy. The concept of fuel injection is to recalculate the amount of fuel required for the engine cylinder engine is the basis of various parameters. The function of the fuel injection is to optimize the fuel through a small nozzle under high pressure. Refer to the table below the basic concept of the fuel injection.

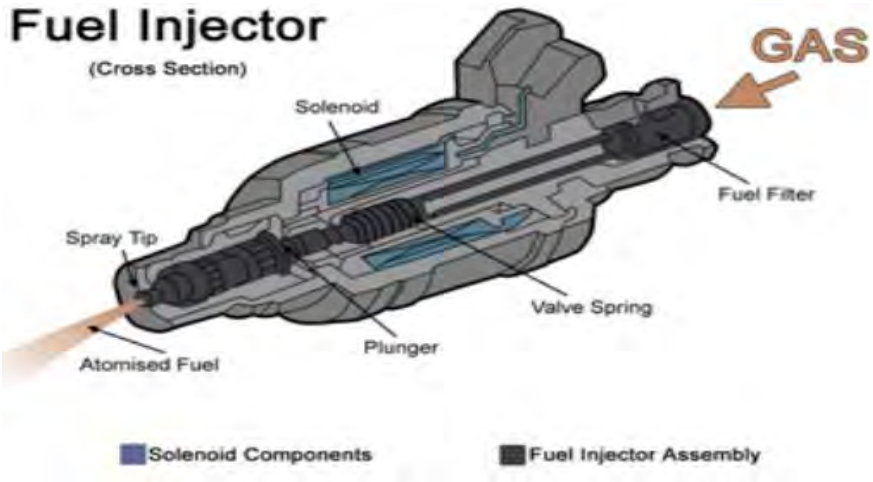

Figure 2.4 above show basic concept of fuel injection system (John,2007)

From the above figure, basic concept and component for fuel injector or fuel injection engine system. When the injector is activated, an electromagnet takes a rider, which opens the valve, causing the pressure fuel to be taken out of a small nozzle. Nozzle is designed to make fuel atoms so that it could possibly make the mist so that it can be easily burned. The amount of fuel supplied by the engine is determined by the amount of fuel needed to be open. It is called pulse width, and it is controlled by the ECU. The number of injector has increased in the multiplier so that they can spray the fuel directly onto the collection valves. In a pipe called fuel rail, all the injector pressure is pressurized on the fuel. To supply an appropriate amount of fuel, the engine control unit is fully equipped with sensors.

2.3 Water Injection

In an inside combustion motor, water infusion is more known as an anti-detonate injection (ADI), it can shower water into the discussion or fuel blend and approach discuss, or straight into the barrel to cool parts of the acceptance framework where the " hot spot "can create start rashly. Depending on the motor, the enhancement in execution and fuel effectiveness can be accomplished by water infusion. Water infusion can