"Saya akui bahawa saya telah membaca karya ini dan pada pandangan saya karya ini adalah memadai dari segi skop dan kualiti untuk tujuan penganugerahan Ijazah Sarjana Muda Kejuruteraan Mekanikal (Termal-Bendalir)"

Tandatangan 

Nama Penyelia : Professor Madya Dr. Mohd Ridzuan Nordin

Tarikh : APRIL 2007

A STUDY ON THE INFLUENCE OF FUEL ADDITIVES ON ENGINE EXHAUST EMISSION

SIM POH LI

Laporan ini diserahkan kepada Fakulti Kejuruteraan Mekanikal
sebagai memenuhi sebahagian daripada syarat penganugerahan
Ijazah Sarjana Muda Kejuruteraaan Mekanikal (Termal - Bendalir)

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April 2007

"Saya akui laporan ini adalah hasil kerja saya sendiri kecuali ringkasan dan petikan yang tiap-tiap satunya saya jelaskan sumbernya"

Tandatangan : .....

Nama Penulis : SIM POH LI

Tarikh : APRIL 2007

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ABSTRACT

The addition of additive into fuels for internal combustion engines is a common practice. They were added for various purposes such as to help clean engine deposits and to enhance engine combustion process. The expected benefits of using additives were to reduce the emission of unwanted components and to enhance the power output from the engine. This research is intended in particular to elucidate the effect of additives when blended with petrol on exhaust emission. The effect of various concentrations of STP and Waxco Tech additives at different engine speed on exhaust emission were studied. Presence of CO, HCs, NO, CO_2 and excess O_2 were monitored. The concentrations by volume of additive in petrol studied were 0%, 0.5%, 1.0%, 1.5% and 2.0%. Presence of additive was generally found to reduce HCs emission, signifying improvement in combustion of the fuel, while increasing the emission of NO. Emission of NO was lowest when the concentrations of additives were between 0.5 – 1.0%. This is inline with the recommended concentration of 0.5% for the use of the additives. STP additive was found to be better than Waxco Tech additive. It was also observed that the emission of NO increases at higher engine speed. The effect of additive is similar to that of increasing engine speed suggesting that the combustion of petrol in the presence of additives result in higher combustion temperatures. This study establishes the positive effect of blending additives with petrol. It also establishes that the recommended concentration should be observed because if higher concentrations are used the emission of NO will increase substantially.

ABSTRAK

Pencampuran additif ke dalam petrol biasa dilakukan oleh pengguna. Tujuan penambahan tersebut adalah membershkan karbon yang termendap dalam enjin serta meningkatkan proses pembakaran enjin. Kesan positif penggunaan additif adalah pengurangan keluaran komponen yang tidak diingini dalam asap kenderaan serta meningkat kuasa enjin. Kajian ini menyelidik kesan pencampuran additif dengan petrol terhadap pengeluaran komponen gas dalam asap kenderaan. Dua additif, iaitu STP dan Waxco Tech dikaji pada kelajuan enjin yang berbeza. Komponen gas yang dipecukan adalah CO, HC, NO, CO_2 dan O_2. Kesan additif pada kepekatan berasaskan isipadu 0%, 0.5%, 1.0%, 1.5% dan 2.0% dikaji. Secara umumnya, kehadiran additif telah mengurangkan pengeluaran gas HC dalam asap enjin. Namum terdapat sedikit pengeluaran gas NO. Pengeluaran NO berada pada tahap minimum kepekatan 0.5 – 1.0% additif. Additif STP menghasilkan pengurangan gas ekzos lebih baik berbanding dengan Waxco Tech. Pengeluar produk telah mencadangkan kepekatan yang paling sesuai ialah 0.5% isipadu additif dalam pencampuran dengan petrol. Dalam pemerhatian didapati bahawa pengeluaran gas NO telah meningkat pada kelajuan enjin yang lebih tinggi. Dengan sedemian, kehadiran additif telah meningkatkan suhu proses pembakaran bahan api.

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SYMBOL LISTING

GREEK LETTER	DEFINATION
RPM	Revolution Per Minute
%	Percentage
>	More Than
<	Less Than
φ	Equivalent Ratio
λ	Lamda
K	Kelvin
km	Kilometer
km/h	Kilometer Per Hour
kph	Kilometer Per Hour
kW	Kilo Watt
PPM	Unit of Measurement Hydrocabon and Nitrogen Oxide
kJ/mole	Kilo Joule Per Mole
°C	Celsius
Gal	Gallons
g/kWh	Gram per kilowatt-hour

SUBSKRIP	DEFINITION
PM	Particulate Matter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
O_2	Oxygen
HC	Hydrocarbon
NO	Oxides of Nitrogen
SO_2	Sulfur Dioxide
CNG	Compressed Natural Gas
LPG	Autogas
CAA	Clean Air Act
EPA	Environmental Protection Agency
NGO	Non Government Association
UK	United Kingdom
RON	Research Octane Number
MON	Motor Octane Number
E	Ethanol
EA	Ethanol
RVP	Reed Vapour Pressure
TDC	Top Dead Center
POM	Polycyclic Organic Matter
THC	Total Hydrocarbon
DME	Dimethyl Ether
MMT	Methylcyclopentadienyl Manganese Tricarbonyl
UHC	Unburned-Hydrocarbon
PAH	Polycyclic Aromatic Hydrocarbons
HDE	Howard-DME-Ethanol
C_6H_5	Diphenyl (Phenyl Benzene)
HCCI	Homogeneous charge compression ignition
TOF-MS	Time of Flight Mass Spectrometry

EA	Additives of Ethanol
MTBE	Methyl *Tert*-Butyl Ether
vol.	Volume
FCC	Fluid Catalytic Cracking
PLG	*Premium Leaded Gasoline*
Pb	Plumbum
CR	Compression Ratio
CH_2O	Formaldehyde
H_2O_2	Hydrogen Peroxide
PCDD	Polychlorinated Dioxins
PCDF	Polychlorinated Dibenzofurans
DPM	Diesel Particulate Matter
NMHC	Non-Methane Hydrocarbons
CH_4	Methane

APPENDIXES

CHAPTER I

INTRODUCTION

1.1 Overview

Today there are many gasoline and diesel fuel additives available in the market to increase horsepower and improve engine operation, engine life, and fuel economy. They were also claimed to reduce emissions. There additives are the by-product of the refining process and the businessmen make it more profitable.

Basically, most bottled additives are fuel-soluble chemicals that can be added to gasoline to enhance certain performance characteristics. Deposit control additives that help eliminate carbon build-up on intake system parts and reduce the harmful effects of combustion chamber deposits are of particular interest today. Chemicals in these additives "pull" carbon deposits away from metal surfaces of combustion chambers, intake valves and fuel injectors and then burn them away in the combustion process.

Fuel additives are essentially any substance added to the fuel. Additives can reduce the total emissions of particulate matter (PM), with variable effects on carbon monoxide (CO), oxides of nitrogen (NOx), carbon dioxide (CO_2), and sulfur dioxide (SO_2). Different additives may affect the emissions of different gases differently. Generally the additive cause lesser smoke coming out from the exhaust engine. In the market, the fuel additives are normally used for extending the engine life and increase the engine power. Fuel additives for the exhaust engine are just two or three types in the market. (V Ganesan, 2004)

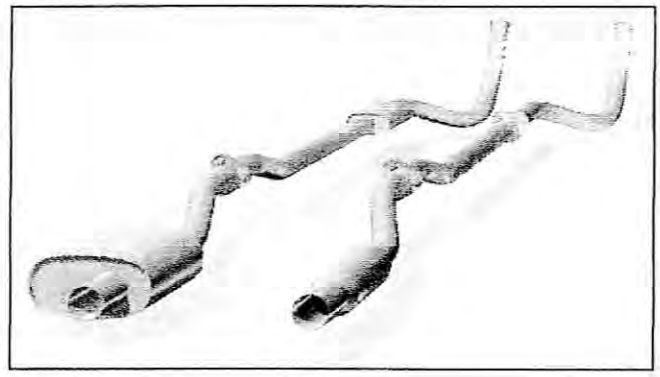

Figure 1.1: Exhaust Engine

It is interest to determine the influence of fuel additives on exhaust engine emissions. The compositions of emission from exhaust engine are reported for different engine speed (RPM). The exhaust engine emissions include hydrocarbon (HC), carbon monoxide (CO), oxides of nitrogen (NO), carbon dioxide (CO_2), and oxygen (O_2). The different engine speed will affect the composition of the exhaust engine emissions. The emission at different engine condition is studied will be determined. The effect of additive on the emission of gasoline fueled engine will be studied. The compositions of additive were varied from 0% to 2.0%.

1.2 Problem Statement

Nowadays, fuel additives are widely used in the market. The additives are used as the detergent, corrosion inhibitor, emulsifiers and stabilizer or antioxidants. For the detergent, it is prevention and clean up of carbon deposits and other contaminants created by the incomplete combustion or fuels and lubricant residues. The corrosion inhibitor is for the protection of the fuel system against corrosion to extend the life of the fuel system and prevents filter blocking. For the demulsifies, it will separate water if present so the water stays at the bottom of the tank and/or fuel filter. It can prevent damage to the fuel system and avoids bacterial growth. Besides that, the stabilizer/anti oxidant is for preventing darkening and further reactions causing sludge or other sediments in the fuel during the storage of the fuel. (Kenneth E. Bannister, 1996)

Exhaust engine emission could potentially harm the environment and human. Exposure to CO in the long term will cause the people heart ailment. NO_x could lead to formation the smog and acid rain, CO_2 will cause the greenhouse gas effect and increasing the global warming and the HC is toxic which can affect the human health. Since the exhaust engine emissions are harmful to human and the environment, some action should be taken to reduce engine exhaust emission. In the market, there is a number of fuel additives used to reduce the exhaust engine emissions. As a result, the research on the influence of additives to the exhaust engine emission is being done through this research. Two brands of additives were choosen for this study.

1.3 Objective

This study will investigate the effect of additive concentration in fuel on exhaust gas emission. The investigation will be done under different engine operating condition.

1.4 Scope of Research

The scope of the research is to study the influence of fuel additives on exhaust engine emissions. For this study, the STP and the Waxco Tech fuel additive were chosen for the experiment. STP is a well-known additive in Malaysia. It is favored by Malaysian. Based on the feedback from the Brother's accessories car salesman said that most of the customers use the STP brand. For the Waxco Tech additive, it can reduce intake and exhaust valve deposit and clean clogged fuel injector. The different volume percentage of fuel additive will cause different exhaust engine emissions.