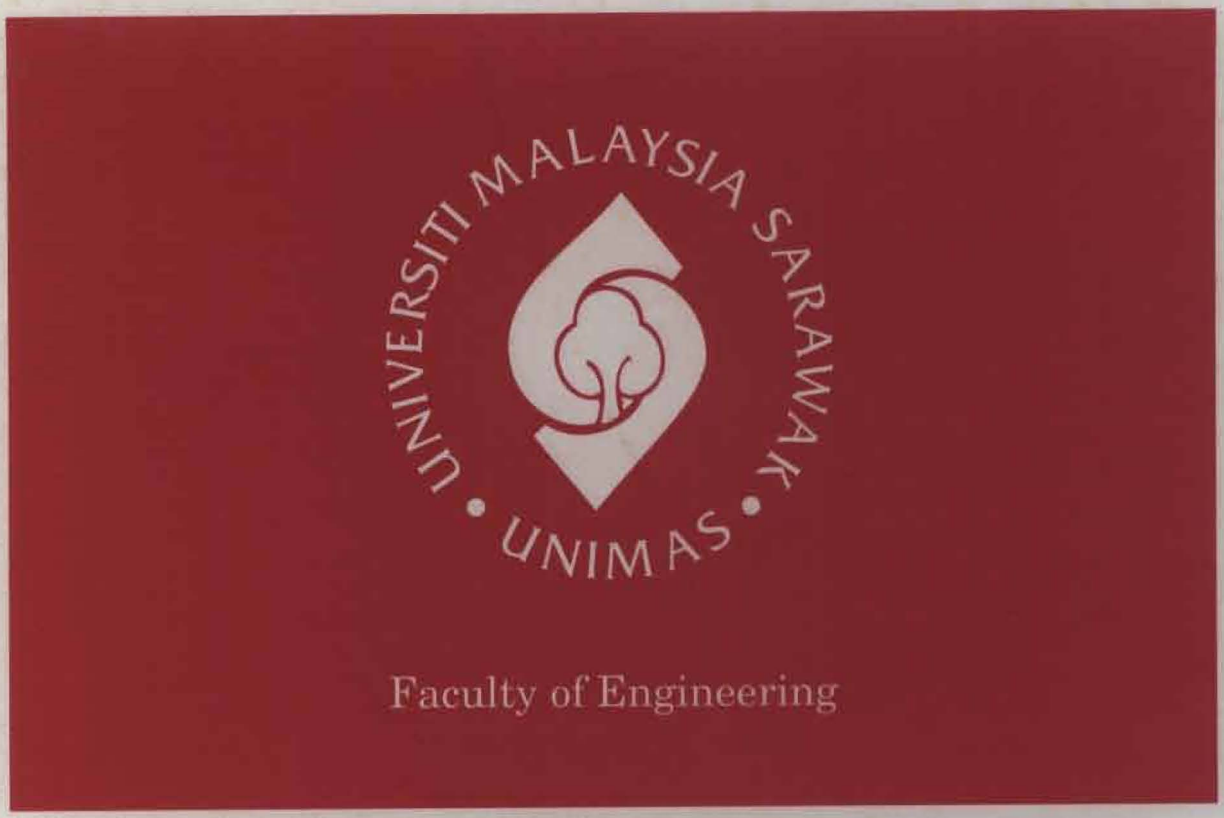

A STUDY ON THE GASOLINE QUALITY AND PERFORMANCE

Chung King Long

Bachelor of Engineering with Honours
(Mechanical and Manufacturing Systems)
2004

UNIVERSITI MALAYSIA SARAWAK

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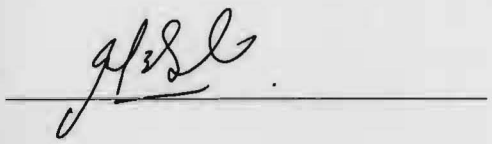

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A STUDY ON THE GASOLINE QUALITY AND PERFORMANCE

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ABSTRACT

The study of a comparison of gasoline quality by three local vehicle fuel suppliers namely SHELL, Esso and Petronas are present in this report. The objective of this report can be divided into three categories of analysis, which are post combustion emission level analysis, idling speed fuel consumption rate analysis and cold start-warm up duration analysis. The post combustion emission level analysis only limited to two type of post combustion of exhaust product namely carbon monoxide (CO) and hydrocarbon (HC). The exhaust product generated from gasoline consumption supplied by these three supplier has been analyst and experimental work also have been carry out to determine the percentage of carbon monoxide (CO) and hydrocarbon (HC) in part-per-million (ppm). The result from experimental work is use to make a comparison of fuel quality.

ABSTRAK

Analisa-analisa berkaitan dengan kualiti tiga jenis jenama petrol yang terdapat di pasaran tempatan iaitu SHELL (Super), Petronas (Primax) dan Esso (Synergy F1) telah dipersembahkan dalam laporan projek ini. Tiga jenis analisa yang menggunakan tiga jenis jenama petrol telah dijalankan untuk tujuan tersebut iaitu analisa terhadap tahap pencemaran ekzos kereta, analisa penggunaan petrol oleh enjin kereta pada kelajuan pepura dan analisa terhadap jangka masa diperlukan untuk enjin mencapai suhu kerja dari keadaan sejuk. Analisa pertama hanya diterhadkan kepada gas Karbon Monoksida dan Hidrokarbon. Kesemua keputusan analisa adalah sebagai bandingan tentang kualiti petrol antara ketiga-tiga jenis jenama.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Automotive traffic generates a lot of air pollutants, some metallic contaminants and causes troubles, not only for the roadside environment but also for the terrestrial and aquatic ecosystems. The exhaust gases of vehicle engines contain mainly carbon monoxide and dioxide, nitrogen oxides, a few sulfur dioxides, a great number of hydrocarbons, or organic carbon derivatives, and some heavy metals particulate.

Some of these compounds are directly toxic for living organisms, when they occur in a closed environment such as inside the car, tunnels, subterranean car parks, or rooms; but they are harmless when emitted in open space, when natural diffusion conditions are sufficient to prevent high concentrations in the air.

Other emitted gases will interact with oxidants to form new labile compounds, which have a high phytotoxic activity at low concentrations (photochemical smog). These oxidants, obtained by photochemical reactions in the atmosphere, may be involved in the widespread dieback and decline of forests. Heavy metals contamination of soil, water and plant materials, near highways is well known, and there's a trend to accelerate the reduction of lead addition in the fuels.

The vicinity of heavy traffic roads is a source for important troubles to terrestrial and aquatic ecosystems. Some examples of these will be discussed for their direct or indirect effects on

animal, microbiological or plant life. The regular use of deicing salts, essentially sodium and calcium chlorides, in winter period, affects the resistance to drought stress of trees and crops, and increases the sensitivity of plants to parasitic diseases.

The compaction of soils near the road is involved in anaerobic conditions near the roots of trees, which will be followed by an important dieback. The risks for environment alterations could be prevented and reduced by clean motors, with a drastic reduction of gaseous pollutants. The lead problem will be progressively resolved by the new European standards of lead addition to fuels; but the lead already present in soils will remain a threat for some sensitive crops and forages.

Potentially toxic constituents of the exhaust gas have come to be widely known as exhaust emissions and, as is well known, legislation has been introduced in many countries imposing limits on what levels of such substances are acceptable in exhaust gases. The substances legislated against are: carbon monoxide, CO; unburned hydrocarbons, for which the abbreviation HC is used to denote all the hydrocarbons present; oxides of nitrogen, NO_x; and, principally for diesel engines, particles comprising mostly carbon. Subscript x is used because the exhaust contains two main oxides of nitrogen, NO and NO_2, of which the latter is the most significant as regards toxic and photochemical effects. Of the HC, only about 30-40% is actually unburned: the remainder comprises products of partial combustion.

1.2 The Greenhouse Effect

Although CO_2 is not among the toxic substances, and moreover, its proportion in the exhaust gas cannot be reduced, there are pressures to improve fuel economy and thus reduce the total quantity produced or, from a few extremists, even to ban the use of internal combustion engines

and coal burning power plants except perhaps for certain essential purposes. This is because suspicions have been aroused that it is at least partly responsible for the so-called greenhouse effect.

The evidence is mainly the increasing mean ambient temperature throughout the world, which might conceivably be due to the relative transparency to ultraviolet rays of the carbon dioxide that is being released into it. This is said to be allowing these rays to pass through the atmosphere to earth, where it is converted into heat.

1.3 The Precise Nature Of The Toxicity

Inhalation of air containing 0.3% by volume of CO, which is a colorless odorless gas, can cause death in half an hour. It is toxic because it is absorbed by the red corpuscles of the blood, inhibiting absorption of the oxygen necessary for sustaining life. Nitric oxide, NO, is also colorless and odorless and, in the presence of oxygen, is rapidly converted into NO_2. This is a reddish brown gas with a sharp odor, and it combines with water to form nitric acid HNO_3, and therefore can progressively destroy lung tissue. Unburned hydrocarbons can, in the presence of sunlight, form oxidants, which irritate the mucous membranes, and some are believed to be carcinogenic.

When burned in engine cylinders, alcohol fuels and admixtures of alcohol and gasoline can produce small quantities of other toxic substances. These include principally benzene and 1.3 butadiene. The former is a carcinogen and is the simplest member, C_6H_6, of the aromatics.

Putting the emissions problem into overall perspective, however, one should point out that none of these so called toxic emissions has been shown to be seriously harmful to humans in the concentrations in which they exist in general in the atmosphere in for example the United

Kingdom. On the other hand, they do at least contribute towards conditions of discomfort experienced in certain areas such as the valley in which Los Angeles is situated, where an inversion layer in the atmosphere traps the contaminants beneath it and brilliant sunlight accelerates certain chemical reactions. However, the automobile is neither the only nor necessarily even the main culprit: huge quantities of the same pollutants are emitted also from other sources, such as furnaces for power generation, metal processing etc.

1.4 Project Objectives

The objective of this project is to do the studies and perform the comparison methods on gasoline qualities supplied by three local petrol suppliers namely SHELL (Super), Petronas (Primax) and Esso (Synergy F1). The project's objective can be divided into three categories as below:

1. Exhaust gas emission (CO and HC) level analysis
2. Idling speed fuel consumption rate at engine operating temperature
3. Cold start to warm up duration

CHAPTER 2

LITERATURE REVIEW

2.1 Automobiles Emissions and Environment

The characteristic features of pollution due to road traffic is wide spreading such that the whole population will affected, including children, invalids, old people and also pregnant women.

On the other hand, the durations of exposure may vary within wide limits. Thus the traffic can be continuous in some areas and very intermittent in others while the displacement of people can vary to a great extent. These pollutants can be prevented from dispersing because of local configurations or unfavorable weather conditions.

Furthermore it should be noted how certain pollutants can accumulate in the body in the absence of the long periods free from exposure that are required for them to be eliminated and how it is impossible to protect people suffering from some particular sensitivity or illness from the effects of pollution.

For pollutants in the form of a gas the dispersion is very rapid when the usual weather conditions and the exposure decreases with distance from the automobiles exhaust systems. Thus the people exposed to the greatest levels of pollution are first of all the drivers of the motor vehicles, and then those who making use of two-wheeled vehicles and finally the pedestrians.

Pollutants in the form of particles on the other hand settle very quickly and the level of atmospheric pollution falls very rapidly on moving away from the vehicles.

However the particles land on the ground and water and can accordingly find their ways into food. this giving rise to pollution at a distance, which can affect people's living in country areas.

2.2 Factor That Effect the Gasoline Car Engine's Emission Level

Various factors directly affected the post combustion's emission level of Carbon Monoxide and Hydrocarbon in a particular internal combustion engine. Among them are:

- Piston ring blow-by
- Exhaust piping system's impurities
- Ignition system condition
- Pre combustion air-fuel ratio
- Engine operating temperature
- Cylinder head design
- Gasoline qualities

2.2.1 Piston Ring Blow-by

Blow-by occurs when hot combustion gasses leak past the rings and into the crankcase. This is due to the piston compression ring cannot seal properly during power and compression stroke. Besides the obvious loss of power and efficiency, carbons build up and lubricating oil introduced in combustion chamber will greatly increase the exhaust emission level. The compression ratio will reduced and cause inefficient of combustion. At this condition, exhaust gasses not only contain high level of CO and HC, but also contain various type of lubricating oil's element such as addictive.

2.2.2 Exhaust Piping System's Impurities

Carbon and unburned gasoline will reside in the car exhaust piping system such as silencer and catalytic converter. Because car manufacturer tend to reduce the exhaust sound level to meet the regulation by using silencer and piping design but these action normally resulted impurities built-up inside the exhaust system. These impurities will influence the car emission level as they emitted unpredictable during engine operation. The level of exhaust impurities is directly proportional to the length of service of particular vehicle.

2.2.3 Ignition System Condition

The ignition system refers to the spark plug, ignition coil, spark plug cable, distributor and alternator. The system function is to provide correct ignition timing and adequate spark to allow the well mix air-fuel to combust properly. If one of these part fail or not in required standard, the emission level will increase due to miss fire or incomplete combustion.

2.2.4 Pre Combustion Air-fuel Ratio

Car owners want their engine operated in Stoichiometric air-fuel ratio because this ratio provided the best power and zero emission for the gasoline internal combustion engine. But normally we seldom achieved this target even by utilized today's technologies such as closed-loop electronic fuel injection system (EFI) and cylinder head design such as variable timing electronic control system (VTEC). If the engine cannot achieve this ratio, then emission will produce from the combustion.

2.2.5 Engine Operating Temperature

In order for a typical internal combustion engine to operate in its optimum performance, suitable temperature is needed for combustion chamber and its wall. The temperature is range from 80-100 °C depend on cylinder head design and whether the car has turbo/super charger or not. Engine cooling system design and its efficiency play vital role in this aspect.

2.2.6 Cylinder Head Design

The intake and exhaust valve for a particular car need to have variable lift and timing to cope with engine speed in order to allow sufficient combustion time and amount of fresh air drawn into the combustion chamber and allow exhaust gas get rid from combustion chamber as fast as possible. These conditions can be achieved through current technologies such as Honda's VTEC and Mitsubishi's MIVEC system. If engine cannot obtain such characteristic during high speed or load, emission level will increase.

2.2.7 Gasoline Qualities

These is the most important factor effected the emission level of particular gasoline car engine. Former leaded gasoline even though can eliminate the engine knocking problem but it also emitted lead particle into atmosphere and then consume by human during briefing process. To solve these problems, reformulated and unleaded gasoline has been introduced and improves combustion efficiency and quality. Good quality gasoline also promotes sound exhaust emission level and reduces toxic exhaust by product. The additives presented during gasoline blending process mostly are intended to control the volatility level. Both gasoline with high and low volatility feature yield advantages and disadvantages when utilized in particular internal combustion engines operation.

2.3 Air Quality Guidelines in Malaysia

Table 1 lists the Recommended Malaysian Air Quality Guidelines (Ambient Standards) and compares them with the National Ambient Air Quality Standards (NAAQS) currently enforced in the United States. The Malaysian guidelines are fairly consistent with the United States' standards.

Table 1: Ambient Air Quality Standards-Malaysia & United States [1]

Country	**Malaysia**		**United State**	
Measurement	**ppm**	**gram/m^3**	**ppm**	**gram/m^3**
Carbon Monoxide (CO)				
8-hr avg	9	10	9	10
1-hr avg	30	35	35	40
Nitrogen Dioxide (NO_2)				
Annual	0.17	320	0.053	100
Ozone (O_3)				
8-hr avg	0.06	120	0.08	157
1-hr avg	0.10	200	0.12	235
Lead (Pb)				
Quarterly Avg	1.5		1.5	
Total Suspended Particles (TSP)				
Annual	90		–	

24-hr	260		–	
Particulate Matter<10μm				
Annual	50		50	
24-hr avg	150		150	
Particulate Matter<2.5μm				
Annual	–		15	
24-hr avg	–		65	
Sulfur Dioxide (SO_2)				
Annual	0.04	105	0.03	80
24-hr avg	–	–	0.14	365
3-hr avg	–	–	0.50	1300
1-hr avg	0.13	350	–	–
10-min avg	0.19	500	–	–

2.4 Petroleum Products

Petroleum products are refined from crude petroleum that is pumped from wells in many parts of the world. Crude petroleum is, in turn, refined in many refineries in the world. Refineries are of several types, but the most important process involves the "cracking" and distillation of the crude into a wide range of products that form the backbone of the world's energy and petrochemical industries. The lighter petroleum fuels or "fractions" (benzene,

kerosene and diesel) are the most widely used petroleum fuels for energy production in off-grid situations.

Petroleum products, after biomass (wood, and agricultural and animal wastes/residues), provide more energy in rural, off-grid situations than all other forms of energy combined. Kerosene is one of the most important sources of lighting energy in the developing world. Kerosene is also an important energy source for refrigeration and freezing in clinics, hospitals and a host of commercial applications (refrigerators in hotels, restaurants, bars, etc.). Liquefied petroleum gas/LPG is used to a limited extent for lighting and cooking in off-grid areas, but is also used for refrigeration and freezing in clinics, hospitals, schools and a range of commercial applications (refrigeration for butcheries, hotels, bars, etc.).

Gasoline (petrol or benzene [not the chemical benzine, but the petroleum fraction benzene]) is widely used for small (less than 3 kVA) generators, or gensets to produce electricity for commercial establishments, institutions and households. Diesel (or gas oil, the heaviest of these distillates or fractions) is the most widely used off-grid electricity generation and water pumping fuel source in the world. Diesel gensets are found all over the developing world, and serve as back-ups in most urban and grid-connected settings for essential services (such as hospital operating theatres, important telecommunications complexes, etc.).

Diesel fuel is the most widely available petroleum fuel in the world, and there are very few areas in the world, no matter how isolated, where diesel is unavailable, particularly given its paramount importance for transportation. This widespread availability makes diesel generation one of the easiest and cheapest forms of off-grid electricity generation. Moreover, the fact that diesel gensets are sized to meet some of the smallest loads (less than 3 kVA) to some of the largest (over 1.5 MW), makes it a very attractive and widespread source of off-grid electricity and pumping.