SURVEY ON CARBON DIOXIDE EMISSION FROM INTERNAL COMBUSTION ENGINE

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Report submitted in partial fulfillment of the requirements
for the award of Bachelor of Mechanical Engineering with Automotive Engineering

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project report 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 with Automotive Engineering.

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STUDENT'S DECLARATION

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

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ABSTRACT

This research is conducted to study about the carbon dioxide emission from passenger car. Passenger car is one of the largest shares of internal combustion engine vehicle on the road today. Therefore, they are also responsible for a large proportion of the environmental pollution such as the greenhouse gas emission. On this study four different ages of cars will be tested experimentally for their carbon dioxide emission using the universal emission analyzer machine. From the experiment result, carbon dioxide emission index is then being proposed. Using the data from the Pahang Road and Transport Department (JPJ), the carbon dioxide emission index for different car age in Pahang state is then being determined. This research also will determine some of the solutions to reduce the carbon dioxide emission from internal combustion engine. From this research it is clear that the age of the car play a significant role of carbon dioxide emitted. Generally, the older the car emits more carbon dioxide compare to the newer car for the same time of use. There are some possible solutions to reduce this emission as being proposed by some other researcher. Policy implementation and alternative fuel vehicles are just some of these possible solutions.

ABSTRAK

Kajian ini dilaksanakan bagi mengkaji mengenai pencemaran karbon dioksida daripada kenderaan penumpang. Kenderaan penumpang adalah salah satu penyumbang terbesar terhadap jumlah kenderaan enjin pembakaran dalam di jalan raya hari ini. Oleh itu, ianya juga bertanggungjawab terhadap sebahagian besar pencemaran alam sekitar seperti pencemaran gas rumah hijau. Dalam kajian ini, empat kereta yang berlainan umur akan diuji secara eksperimen terhadap pencemaran karbon dioksidanya menggunakan mesin analisis pencemaran semesta. Daripada keputusan eksperimen, indeks pencemaran karbon dioksida kemudiannya dicadangkan. Menggunakan data daripada Jabatan Pengangkutan Jalan Pahang (JPJ), indeks pencemaran karbon dioksida untuk umur kereta yang berlainan di negeri Pahang kemudiannya ditentukan. Kajian ini juga akan menentukan beberapa penyelesaian untuk mengurangkan pencemaran karbon dioksida daripada enjin pembakaran dalam. Daripada kajian ini, adalah jelas bahawa umur kenderaan memainkan peranan yang penting dalam pembebasan karbon dioksida. Secara umum, kereta yang lebih lama membebaskan lebih banyak karbon dioksida dibandingkan dengan kereta yang lebih baru untuk jangka masa penggunaan yang sama. Terdapat beberapa penyelesaian yang mungkin untuk mengurangkan pencemaran ini seperti yang telah dicadangkan oleh pengkaji-pengkaji yang lain. Pelaksanaan polisi dan kenderaan bahan bakar alternative hanyalah sebahagian daripada penyelesaian yang mungkin ini.

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%	Percentage
^{o}C	Degree Celsius

LIST OF ABBREVIATIONS

JPJ	Jabatan Pengangkutan Jalan
MIN	Minute
OECD	Organization for Economic Cooperation and Development
PSI	Pounds per square inch
RPM	Revolution per minute
UK	United Kingdom
USA	United State of America

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Transport nowadays played an increasingly important for social and economic activity on every country, linking people with each other and with goods and services. This sector is the most rapidly growing sector in terms of energy, particularly oil consumption. The demand for passenger transport are affected by many factors, including lifestyles, income, labor structure, cost of travel, time available for travel and urban development pattern [1].

Transport sector has a large share of the total energy use globally which is about 21% in 1999 [2]. This sector relies almost entirely on the oil for the operation where most of the energy is produce by the principle of internal combustion engine [3]. This sector especially the road transport grows rapidly over the years [2]. As the world transport sector grows also the world carbon dioxide emission. Car travel particularly is the largest share of carbon dioxide emission from road transport [4]. From the 2004 global emission data, transport sector contribute for 24% of the carbon dioxide emission [3]. This is not a good sign for the global climate as excessive carbon dioxide in the atmosphere will cause the greenhouse effect that will produce the global warming [5].

This study analyzes the carbon dioxide emission from cars of different years of usage. The cars were ranging from very old car to newer car. The study also will propose the carbon dioxide emission index to determine the level of the carbon dioxide emission of each car. Some of relevant solutions to reduce the carbon dioxide emission from internal combustion engine also will be proposed in this study.

1.2 PROBLEM STATEMENT

Internal combustion engine vehicles are responsible for the vast majority of environmental pollution in this world today. The greenhouse gas emissions from internal combustion engine are expected to rise in the future as the increasing of vehicles usages around the world.

1.3 OBJECTIVE

The objectives of this project are:

1) To study the carbon dioxide emission from passenger car, and
2) To determine the solutions to reduce carbon dioxide emission from internal combustion engine.

1.4 SCOPE OF STUDY

The scopes of the project are as follows:

1) Investigation on passenger cars in Pahang State.
2) Investigation on four types of cars according to years of usage.
3) Measurement of carbon dioxide emission using multigas analyzer machine.
4) Comparison of carbon dioxide emission from various cars.

1.5 ORGANIZATION OF THE REPORT

This thesis consists of five chapters including chapter 1. Chapter 1 is the overview of the project. Chapter 2 reviews some of the related literature with this project. Chapter 3 is about the procedures and principal that involve in making the thesis. Chapter 4 contains the result of this study and also related discussion about the result and the study. The last chapter, chapter 5 is about the conclusion and recommendation.

CHAPTER 2

LITERATURE REVIEW

2.1 INTERNAL COMBUSTION ENGINE

The main purpose of internal combustion engine is the production of mechanical power from the chemical energy contained in the fuel. In internal combustion engines, as differ from external combustion engines, this energy is released by burning or oxidizing the fuel inside the engine. The fuel-air mixture before combustion and the burned products after combustion are the actual working fluids. The work transfers which provide the desired power output occur directly between these working fluids and the mechanical components of the engine. The internal combustion engines can be classified into two major categories; first the spark ignition or gasoline engines and second the compression-ignition or diesel engines. Because of their simplicity, ruggedness and high power to weight ratio, these two types of engine have found wide application in transportation and power generation [6].

2.2 FOUR STROKE ENGINE

Today internal combustion engine in cars, trucks, motorcycles, aircrafts and many others, most commonly use four stroke cycles. The four strokes refer to intake, compression, combustion (power) and exhaust strokes that occur during two crankshaft rotations per working cycle of the Gasoline engine and Diesel engine [7].

2.2.1 Intake Stroke

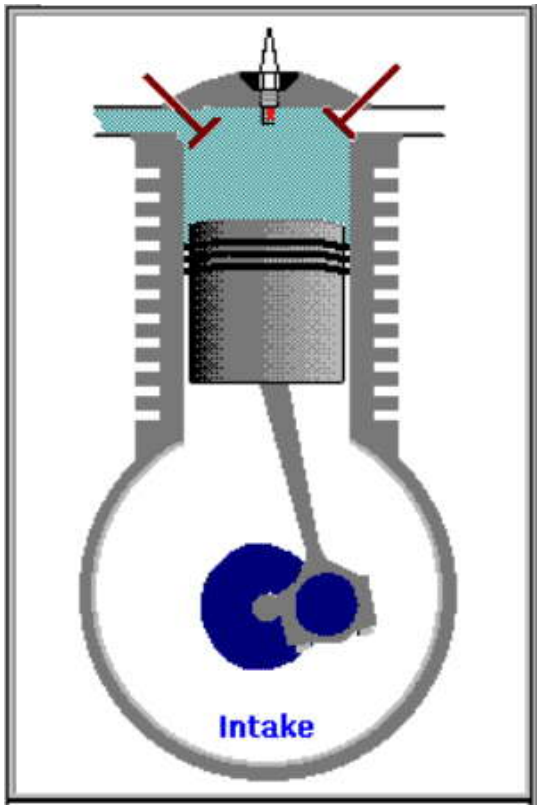

Figure 2.1: Intake stroke

On the intake stroke show in Figure 2.1, the intake valve has opened. The piston is moving down, and a mixture of air and vaporized fuel is being pushed by atmospheric pressure into the cylinder through the intake valve port.

2.2.2 Compression Stroke

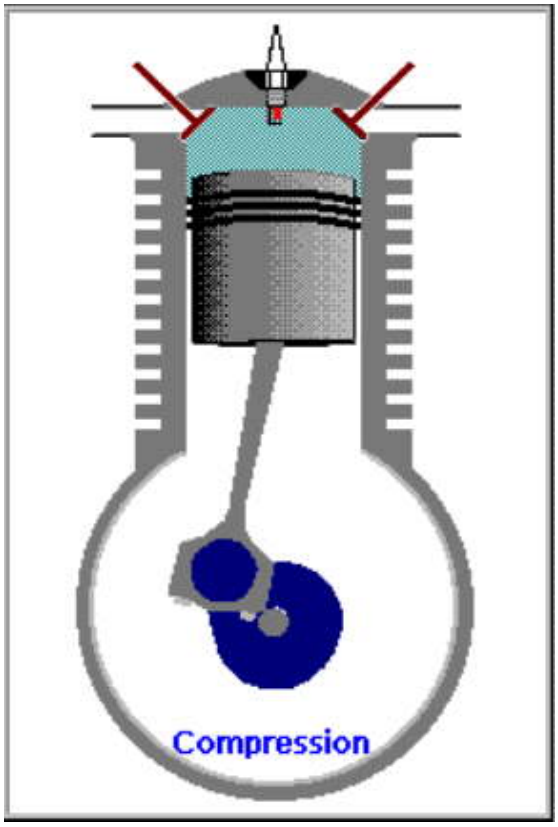

Figure 2.2: Compression stroke

Figure 2.2 illustrates the state of compression stroke. After the piston reaches the lower limit of its travel, it begins to move upward. As this happens, the intake valve closes. The exhaust valve is also closed, so the cylinder is sealed. As the piston moves upward, the air/fuel mixture is compressed. On some small high compression engines, by the time the piston reaches the top of its travel, the mixture is compressed to as little as one-tenth its original volume. Thus, the compression of the air/fuel mixture increases the pressure in the cylinder. The compression process also creates the air/fuel mixture to increase in temperature.

2.2.3 Power Stroke

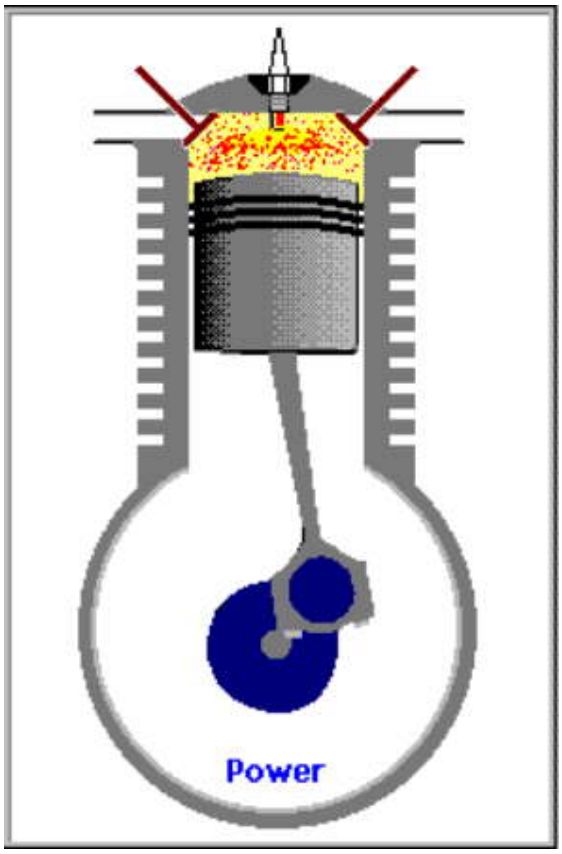

Figure 2.3: Power stroke

As the piston reaches the top of its travel on the compression stroke, an electric spark is produced at the spark plug as shown in the Figure 2.3 above. The ignition system delivers a high voltage surge of electricity to the spark plug to create the spark. The spark ignites the air/fuel mixture. The mixture burns rapidly and cylinder pressure increases to as much as (600psi). All of this pressure against the piston forces it down in the cylinder. The power impulse is transmitted down through the piston, through the piston rod (connecting rod), and to the crankshaft. The crankshaft is rotated due to the force.

2.2.4 Exhaust stroke

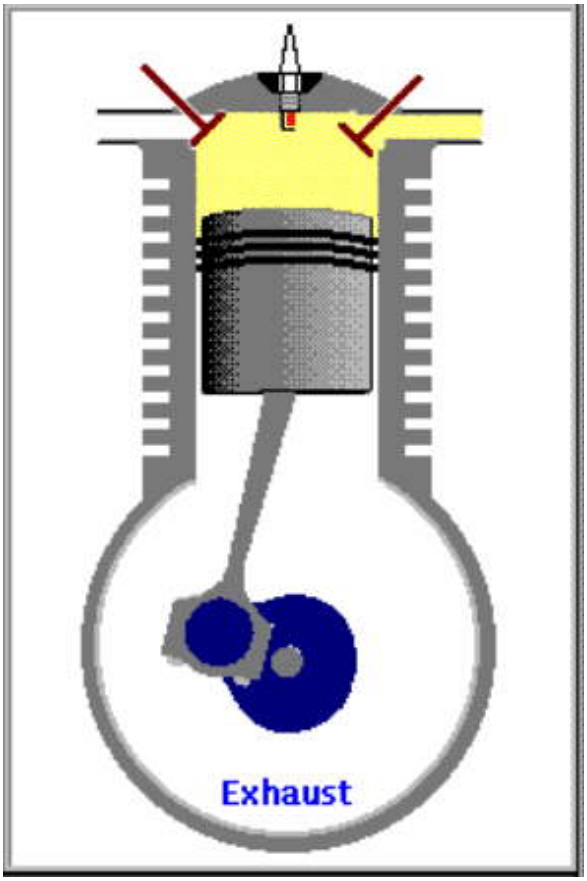

Figure 2.4: Exhaust stroke

Figure 2.4 above shows the exhaust stoke process. As the piston reaches the bottom of its travel, the exhaust valve opens. Now, as the piston moves up on the exhaust stroke, it forces the burned gases out of the cylinder through the exhaust port. When the piston reaches the top of its travel, the exhaust valve closes, and the intake valve opens. The cycle repeats again with the intake stroke. The four strokes are continuously repeated during the operation of the engine [8].

2.3 FORMATION OF CARBON DIOXIDE FROM FUEL COMBUSTION

Combustion or burning is a complex sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the production of heat or both heat and light in the form of either a glow or flames. It can be classified into two types which are the complete and incomplete combustion process. Both of this two will produce the carbon dioxide as one of their products [9].

2.3.1 Complete Combustion Process

In complete combustion, the reactant will burn in oxygen, producing a limited number of products. When a hydrocarbon (fuel) burns in oxygen, the reaction will only yield carbon dioxide and water. When a hydrocarbon or any fuel burns in air, the combustion products will also include nitrogen. When elements such as carbon, nitrogen, sulfur, and iron are burned, they will yield the most common oxides. Carbon will yield carbon dioxide. Nitrogen will yield nitrogen dioxide. Sulfur will yield sulfur dioxide. Iron will yield iron (III) oxide. It should be noted that complete combustion is almost impossible to achieve. In reality, as actual combustion reactions come to equilibrium, a wide variety of major and minor species will be present. For example, the combustion of methane in air will yield, in addition to the major products of carbon dioxide and water, the minor product carbon monoxide and nitrogen oxides, which are products of a side reaction (oxidation of nitrogen).

2.3.2 Incomplete Combustion Process

Incomplete combustion occurs when there is not enough oxygen to allow the fuel (usually a hydrocarbon) to react completely with the oxygen to produce carbon dioxide and water, also when the combustion is quenched by a heat sink such as a solid surface or flame trap. When a hydrocarbon burns in air, the reaction will yield carbon dioxide, water, carbon monoxide, pure carbon (soot or ash) and various other compounds such as nitrogen oxides.

2.3.3 Chemical Equation of Combustion Process

The general chemical equation for stoichiometric burning of hydrocarbon (fuel) in oxygen as follows:

$$C_aH_b + (a + b/4)\ O_2 \rightarrow aCO_2 + (b/2)\ H_2O \quad (2.1)$$

The simple word equation for the combustion of hydrocarbon in oxygen is:

$$\text{Fuel} + \text{Oxygen} \rightarrow \text{Heat} + \text{Water} + \text{Carbon Dioxide} \quad (2.2)$$

2.4 RELATION OF CARBON DIOXIDE AND GLOBAL WARMING

The terms global warming refers to the measured increase in the earth average temperature. The carbon dioxide (CO_2) is supposed to responsible for the global warming by the phenomena called the greenhouse effect. The existence of the greenhouse effect was first proposed by Arrhenius in 1896. According to the hypothesis, specific gases in the atmosphere of the earth, in the first place water vapor, but also carbon dioxide, methane, di-nitrogen oxide, ozone, and halogenated hydrocarbons, permit the transmission of the sun's radiation (short wave-lengths) but not that of the long wavelength infrared radiation reflected by the surface of the earth. Without this naturally occurring effect, the average temperature of the earth's surface would be -18 ºC as compared to its real value of 15 ºC. This natural greenhouse effect is beneficial, since it forms the basis for the great variety of plant and animal life on earth. But when it is too strong or too weak, life cannot exist [5]. CO_2 level are predicted to increase over the next century from 369 parts per million to between 540 and 970 parts per million. This will cause the increasing of average global temperature of between 1.4 to 5.8 ºC, that will lead to increase in extreme weather event and rise in sea level as it exceed the level required for stability that currently estimated to be in the region of 400 to 450 parts per million [10].

2.5 ROLE OF TRANSPORTATION TOWARDS CARBON DIOXIDE EMISSION