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UNIVERSITI MALAYSIA PAHANG
FACULTY OF MECHANICAL ENGINEERING

We certify that the project entitled "EXHASUT GAS CALORIMETER FOR FOUR STROKE GASOLINE ENGINE SIMULATION" is written by MOHD FIRDAUZ BIN A.SAMAD. We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering with Automotive.

Examiner: Signature:

EXHAUST GAS CALORIMETER FOR FOUR STROKE GASOLINE ENGINE SIMULATION

MOHD FIRDAUZ BIN A.SAMAD

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

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UNIVERSITI MALAYSIA PAHANG

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive.

Signature:
Name of Supervisor: EN. MOHD FADZIL BIN ABDUL RAHIM
Position: LECTURER OF FACULTY OF MECHANICAL ENGINEERING
Date:

STUDENT'S DECLARATION

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

Signature:
Name: MOHD FIRDAUZ BIN A.SAMAD
ID Number: MH06026
Date:

Dedicated to my dearest and beloved parents, family and friends for their everlasting love, guidance and support in the whole journey of my life

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ABSTRACT

This paper investigates about the rate of heat losses from through exhaust gas using exhaust gas calorimeter. A four stroke gasoline engine Magma 4G15 is used as a reference in this study. The engine simulation has been done using one dimensional GT-Power software and the simulation are at the various engine speed. The engine speed is varied for five different cases staring from 1000, 2500, 3000, 4500 and 6000 rpm at wide open throttle. The simulations are conducted with the purpose to test the applicability of exhaust gas calorimeter model in order to quantify the heat losses through exhaust gas. The model considered the calorimeter system components such as water reservoir, pipe for water in and out as a cold fluid and pipe connected from exhaust tail pipe to the calorimeter for the hot fluid. It is important to evaluate energy losses in the engine in order to increase the engine performance. The result showed that the rate of heat losses through the exhaust gas is increased with the increasing of engine speed. This is due to the fact that when the engine speed increase, the throttle opening will also increase in order to allow more mass of air entering the cylinder during combustion. Consequently, the mass of fuel also will be increased and affect the exhaust gas temperature.

ABSTRAK

Kertas ini menyiasat tentang kadar kehilangan haba daripada gas ekzos menggunakan gas ekzos calorimeter. Enjin gasolin 4 lejang, magma 4G15 telah di gunakan sebagai rujukan di dalam kajian ini. Simulasi enjin ini telah dilakukan menggunakan perisian GT-Power dan simulasi dilakukan dengan mempelbagaikan kelajuan enjin. Kelajuan enjin dipelbagaikan di dalam lima kes yang berbeza bermula dari 1000, 2500, 3000, 4500, dan 6000 putaran per minit pada pendikitan maksimum. Simulasi telah dijalankan untuk menguji kebolehan model calorimeter gas ekzos untuk mengukur kadar kehilanagan haba melalui gas ekzos. Model tersebut mengambil kira sistem kalorimeter komponen seperti bekas peyimpan air, paip untuk masukan dan keluaran air sebagai bendalir sejuk serta paip yang disambungkan dari paip ekzos ke kalorimeter untuk bendalir panas. Adalah amat penting untuk menilai kehilangan tenaga di dalam enjin untuk meningkatkan prestasi enjin tersebut. Keputusan menunjukkan tenaga yang terbebas melalui gas ekzos berkadar terus dengan kelajuan enjin.Ini disebabkan apabila kelajuan enjin ditingkatkan,pembukaan pendikit juga akan bertambah untuk membenarkan lebih banyak jisim udara memasuki silinder semasa pembakaran. Seterusnya, jisim minyak juga akan bertambah dan memberi kesan kepada suhu gas ekzos tersebut.

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LIST OF SYMBOLS

C_p	Specific heat
M_a	Mass flow rate of air
m_f	Mass flow rate of fuel
Q	Rate of heat
ΔT	Temperature difference
Q_{HV}	Fuel heating value

LIST OF ABBREVIATIONS

ATDC	After top dead centre
ABDC	After bottom dead centre
BBDC	Before bottom dead centre
BTDC	Before top dead centre
OHV	Overhead valve
SOHC	Single overhead cam
AFR	Air fuel ratio
rpm	revolution per minute

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The engine designer always interested in methods through which engine performance can be improved. So it should be noted that the large proportion of the available energy is lost in a non-usable form such as heat losses. Any method which can be employed to prevent the excessive heat loss and cause this energy to leave the engine is a usable form will tend to increase engine performance. Higher coolant temperatures, for instance, provide a smaller temperature gradient around combustion chamber walls and a reduction in heat loss, but are limited by the possibility of damage to engine parts.

Therefore it can be seen that the cooling system is necessarily designed so that it can remove an enormous fraction of all the energy/power that an internal combustion engine creates, which causes the "overall thermal efficiency" of any conventional automotive engine to have low thermal efficiency, even separate from all the mechanical losses related to the engine's operation. Generally indicate that a conventional internal combustion engine cannot have an overall efficiency of greater than around the low 30% range. There have been some experimental engines designed that have been measured at around 28%, but the most efficient production engines are around 25% and most vehicles on the highways now have engines which have around 21% overall efficiency.(Rajput, 2005).

Nonetheless, the use of higher compression ratios would increase the efficiency of conversion of the energy in the fuel into useful energy (mechanical). Even with such fuels, as pointed out earlier, there appears to be a limit to the advantage in increasing the compression ratio. Another solution would be to reduce the losses between the air cycle and the actual cycle, and thereby increase the proportion of energy which can be mechanically utilized in the engine system.

1.2 PROBLEM STATEMENT

As the heat content of a fuel is transformed into useful work, during the combustion process, many different losses take place. The net useful work delivered by an engine is the result obtained by deducting the total losses from the heat energy input. Thus, it is important to be able to evaluate these various losses of particular interest from the hot gas in the cylinder to the containing surfaces, since these directly affect the indicated power of the engine. Prior of that, a layout of energy balance test rig, especially for the exhaust gas calorimeter using GT Power has been proposed to in this study. The exhaust gas calorimeter is used to quantify the heat losses from the exhaust gas based on the temperature difference between two different fluids.

1.3 OBJECTIVES OF THE STUDY

1. To analyze the heat exhausted by the engine at varying engine speed.
2. To proposed a layout for the exhaust gas calorimeter using GT Power simulation.

1.4 SCOPES OF THE STUDY

This model of 4-cylinder gasoline engine is used to determine the heat losses of the engine through the exhaust gas. The heat losses are calculated based on the temperature from the exhaust gas calorimeter. The simulation is carried out at varying engine speed starting from 1000, 2500, 3000, 4500, until 6000 rpm.

The study is based on one dimensional GT-Power engine simulation. All the parameters value in the simulation is based on the carburetted gasoline engine, type Mitsubishi Magma 4G15, 12 valve, 1.5 litre engine with pent-roof combustion chamber.

1.5 FLOW CHART OF THE STUDY

The flow chart of the overall procedure of the study is shown in Figure 1.1

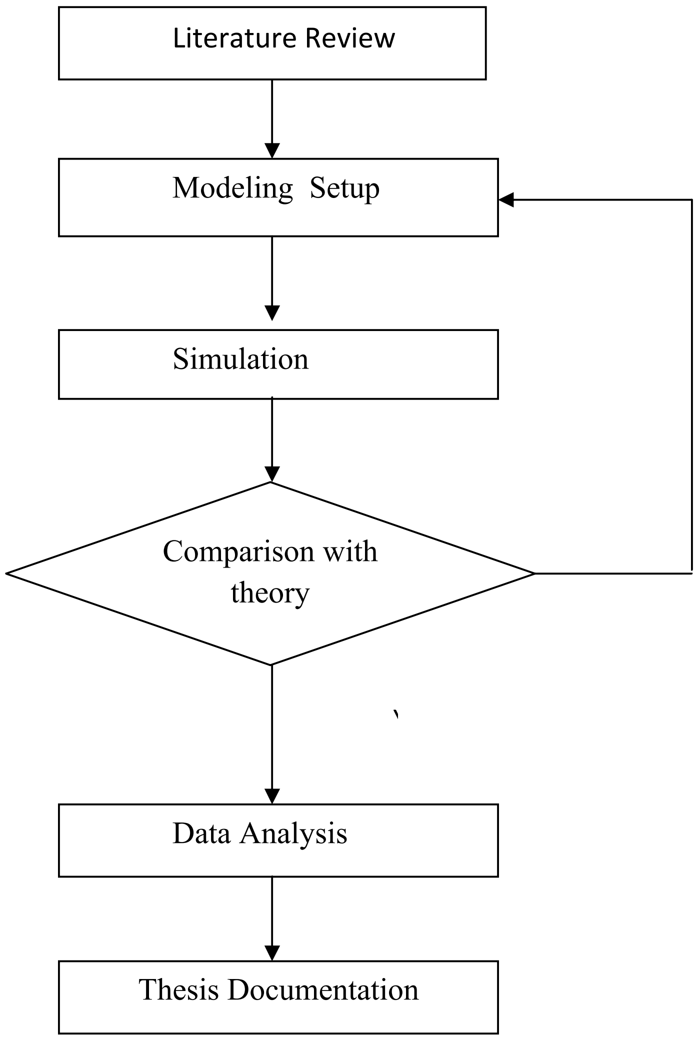

Figure 1.1: Flow chart of the overall procedure of the study