UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ENGINE PERFORMANCE AND EXHAUST EMISSION ON COOLING SYSTEM

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

by

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DECLARATION

I hereby, declared this report entitled "Study Engine Performance and Exhaust Emission on Cooling System" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor Degree of Mechanical Engineering Technology (Automotive Technology) with Honours. The member of the supervisory is as follow:

…….

(Mr.Ahmad Zainal Taufik bin Zainal Ariffin)

ABSTRACT

This study was conducted to study the engine performance and exhaust emission on cooling system. Cooling system is the important roles to control the temperature of car engine. One of the important elements in the car cooling system is coolant. The usage of wrong cooling fluid can give negative impact to the car engine and shorten engine life. An efficient cooling system can prevent engine from overheating and assists the vehicle running at its optimal performance. Three main type of fluid were used in this study, which are fluid with coolant, without coolant and old coolant. This study used chassis dynamometer for record the operating horsepower, torque and exhaust gas emission.

ABSTRAK

Kajian ini dijalankan untuk mengkaji prestasi enjin dan pelepasan ekzos pada sistem penyejukan. Sistem penyejukan memainkan peranan penting untuk mengawal suhu enjin kereta. Salah satu elemen penting dalam system penyejukan kereta adalah penyejuk. Penggunaan cecair penyejuk yang salah boleh memberi kesan negatif kepada enjin kereta dan memendekkan hayat enjin. Sistem penyejukan yang cekap boleh menghalang enjin daripada terlalu panas dan membantu kenderaan berjalan pada prestasi optimum. Tiga jenis utama cecair telah digunakan dalam kajian ini, iaitu cecair dengan penyejuk, tanpa penyejuk dan penyejuk lama. Kajian ini menggunakan casis dynamometer untuk rekod kuasa kuda, tork dan gas ekzos pelepasan.

DEDICATIONS

I acknowledge my sincere indebtedness and gratitude to my parents and my family for their love, support and sacrifice throughout my whole life. Their sacrifice had inspired me from the day I born until what I have become today. From the day I have born, they have taught me about how to learn and write. Without them, I cannot achieve the success; I cannot find an appropriate word that could properly describe my appreciation for their devotion, support and faith in my ability to achieve what I have today. Lastly, I would like to thanks all people which contribute to my bachelor degree project directly or indirectly. I would like to acknowledge their comments and suggestions, which has crucial for the successful completion of this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

IAT		Inorganic Acid Technology
OAT		Organic Acid Technology
EG		Ethylene Glycol
PG		Propylene Glycol
CO		Carbon Monoxide
CO		Carbon Dioxide
HC		Hydrocarbon
O2		Oxygen
NOx		Nitrogen Oxide
H20		Water
ASTM		American Society for Testing Material
LLC		Long Life Coolant
ELC		Extended Life Coolant

CHAPTER 1
INTRODUCTION

1.0 Background Study

Automobile cooling system is a cooling the engine using the radiator through the cooling fins. The engine is not too warm or not to cold. Engine will maintain the system at a constant temperature. Low engine temperature, fuel consumptions will increase and the temperature is simply hot, the engine will damage. Cooling system has two type, liquid cooling system and air cooling system. The air cooling system basically use for motorcycle and the liquid cooling system use for radiator system. Both of function is agent cooling system. A normal car basically consist water jacket, radiator, thermostat, water pump, radiator cap, temperature switch, cooling fan, hoses and the most important is coolants.

A coolant is a function to prevent engine from overheating by using mixture of water and coolant. They also transfer the heat from another to another device. The coolants have ideal non-toxic, low cost, low viscosity and prevent corrosion of cooling system. Coolant is chemical liquid that prevent around the engine system. Coolant has a variety of color such as green, red, orange and blue. The color of coolant is used as to identify their fluid in the shop and the marketing decision. All coolant is water white before dye is added. There are has several additives like nitrates, silicates, disodium, and borates.

1.1 Project Title

A study engine performance and exhaust emission on cooling system

1.2 Problem Statement

There are various opinions and brands have given by engineers, mechanics, foreman and service centre that concerned type of liquid should be used in car cooling system. There are so many parts which will affect the performance of the engine. One of the parts is the coolant. Coolant is one of the variables for an engine car performance. There are so many type of coolant which differentiates between the type and materials. Therefore, this study with coolant engine is maintaining regularly parts are used and the car is used of coolant. This situation will drop the performance of engine and effectiveness of car cooling system.

1.3 Project Objective

Based on the background and problem statement stated above, the objectives of this project are stated below:

1. To study the performance of an engine which consists of horsepower and torque.
2. To study the exhaust gas emission.
3. To make comparison coolant, without coolant and old coolant.

CHAPTER 2
LITERATURE REVIEW

2.0 Car Cooling System

Cooling system is a system that in charge of cooling the engine by discharging heat through the cooling balances, so that the engine is not very hot or not very chilly. This system will keep up the engine at a steady temperature for productive capacity of the engine. In the event that the engine temperature is too low, fuel utilization will rise; and the temperature is excessively hot for a really long time, the engine will damage (Ofria, 2006).

There are two sorts of auto cooling system, the air cooling system and fluid cooling system (Pang et al., 2011). Air cooling system is a system that utilization air as a cooling agent. It is generally utilized as a part of single barrel motors, for example, motorcycles; while fluid cooling system is known as the radiator system, a system that utilizations fluid as a cooling agent and is utilized as a part of a multi-cylinder engine, for example, cars and trucks. Radiator is the vital parts in the auto cooling system (Senthilkumar et al., 2010). It guarantees the engine not overheating (Ross, 2006).

A typical conventional car cooling system comprises of eight vital segments which incorporates the engine water jacket, indoor regulator, water pump, radiator, radiator cap, temperature switch, cooling fan (radiator fan), and hoses (Schappell, 2011).

2.1 The Circulation of Car Cooling System

Liquid cooling system using liquid and a mixture of chemicals as a cooling agent.(Pang et al., 2011). The cooling system works begin with the system itself, using water pump to send liquid passages from the cooling system to the engine block and heads. The liquid collects the heat that produced by the engine then flows through the thermostat, and the upper hose of the radiator (Ofria, 2006).

The hot liquid flows into the radiator and the fine pieces of radiator structure (fin). Air passes through this piece of space, and it will remove the heat. In this way, the liquid will experience a reduction of heat (Senthilkumar et al., 2010). Most of the new cooling system has a suction fan (radiator fan) that will suck or push air into the radiator so that the level of speed is more efficient and effective cooling (Salah et al., 2010).

Once the liquid is cooled, it returns to the engine by the lower radiator hose and back to the water pump. This cycle will continue to collect more heat from the engine until the engine is stopped (Ofria, 2006).

2.2 Antifreeze / Coolant

The coolant that courses through the engine and related pipes must have the capacity to withstand temperatures well beneath zero without solidifying. It should likewise have the capacity to handle engine temperatures in overabundance of 250 degrees without bubbling. A difficult request for any liquid, yet that is not all. The liquid should likewise contain rust inhibitors and grease.

The coolant vehicle is a mixture of ethylene glycol (antifreeze) and water. The suggested ratio is fifty-fifty. At the end of the day, one section radiator fluid and one section is water. This is the base prescribed for use in car engines. Less

antifreeze and the breaking point would be too low. In specific atmospheres where the temperatures can go well beneath zero, it is passable to have as much as 75% radiator fluid and 25% water, however close to that. Unadulterated liquid catalyst won't work legitimately and can bring about a boil over.

Antifreeze is toxic and should to be avoided from people and creatures, which are pulled in by the sweet taste. Ethylene Glycol, if ingested, will form calcium oxalate crystal in the kidneys which can bring death.

2.3 Type of Coolant

While talking about coolant sorts, it is essential to comprehend the creation of a coolant. Coolants are comprised of three sections: water, a base, and added substances. Sort groupings are made regarding the base sort and the added substance sort. All monetarily accessible coolants utilize water as a part due to its characteristic capacity to exchange warm effectively. There are three distinctive base sorts that are financially utilized as a part of engine coolants: EG, PG, and Glycerine. EG, or ethylene glycol, based coolants are by a long shot the most widely recognized and record for around 90% of coolants sold in North America. EG based coolants are the most widely recognized as a result of their capacity to be utilized as a part of all atmospheres. The disadvantage of EG is that it is dangerous if ingested. PG, or propylene glycol, coolants are normally utilized by clients who are searching for non-dangerous coolant. PG is not as generally utilized as EG on the grounds that it is more costly and can't be utilized as a part of cold atmospheres. The last sort, Glycerine, is like PG in that it is non-harmful and is reasonable for direct atmospheres. Glycerine based coolants make up the littlest bit of the US advertise. (Lauren Lewis 2015)

2.4 Engine Coolant System

The engine block of liquid cooled contains paths or water jacket that the engine coolant goes through. The coolant travelling through the engine block expels heat from the engine. The coolant then conveys the warmth it expels back to the radiator through an arrangement of hoses. In the radiator, warmth is rejected from the coolant into the environment, with the assistance of wind stream through the radiator. The wind stream is helped by forward development of the vehicle and by a fan which draws air through the radiator, whether the vehicle is moving or stationary. An indoor regulator in the coolant system between the engine and the radiator opens when the engine warms up to around 195°F and permits the coolant to circle through the system with the guide of a water pump.

The radiator has a pressure cap that is set to around 15 psi above surrounding. The capacity of the radiator cap is to keep up the weight inside the cooling system at roughly two environments, or 15 psi above encompassing. This expanded weight permits the coolant in the radiator to achieve higher temperatures before bubbling. The pressure cap is equipped with a tube that associates with a recuperation supply where over-stream liquid from the radiator can stream if the pressure cap opens. The recuperation supply, thusly, has a flood deplete that permits liquid to run out onto the ground in the event that it packs.

The pressure cap on the radiator acts as a relief valve in case the pressure inside the radiator rises above the approximate two atmosphere set pressure. This can happen if the engine begins to overheat, such as when it is heavily overloaded for an extended period of time. The overheated coolant will then expand and potentially begin to boil, which in turn can cause pressure in the radiator and the pressure cap to open. (Wendell C. Hull, Ph.D. Eng. Sci., CFEI, CVFI, CFII)

2.5 Effective Engine and Coolant Operating Temperatures

Appropriate engine performance is subject to a specific sheltered and satisfactory working temperature run. A few variables that can prompt to antagonistic impacts while working outside this safe working reach can be isolated into high and low. Results of high engine temperatures are diminished oil thickness, prompting to engine parts, for example, cylinders not moving unreservedly and likely staying, bringing about loss of force, wear and inevitable seizure. High temperatures can prompt to blaze beat chamber gasket, and inevitable metal-to-metal contact. Loss of oil lubricant can likewise prompt to expanded oil utilization. Fuel vaporization is required for legitimate and complete fuel combustion, and at low engine temperatures, inadequate burning can come about, prompting to abundance fuel necessities for appropriate engine performance, because of inappropriate vaporization. Despicably vaporized fuel can cool engine surfaces in this way creating build-up of combustion gasses and water vapour during combustion, on cylinder walls, dilution of oil, residue arrangement, and the expulsion of oil film from cylinder wall surface – this can likewise bring about wear of cylinder bore. Dampness from combustion cans likewise mixture with the no smouldered hydrocarbon fuel forming acidic mixture which can bring about acidic erosion. This can prompt to engine harm. At high coolant temperature, water may bubble and vanish, prompting to likely oil film misfortune, and confined parts development since a specific grease temperature is required for legitimate oil stream. Harm to engine may likewise happen because of exorbitant coolant temperature, and by suggestion overheated motor as a consequence of explosion and pre-start. The most extreme conceivable coolant temperature is constrained by the coolants boiling point and the radiators heat transfer exchange limit, subject to the quantity of fins, radiator surface area, and thickness, and the quantity of coolant tubes (Tonye. K. Jack, Mohammed M. Ojapah).

2.6 Cooling System Maintenance and Repair

An engine that is overheating will rapidly self-destruct, so legitimate upkeep of the cooling system is vital to the life of the engine and the inconvenience free operation of the cooling system as a rule.

The most essential support thing is to flush and refill the coolant occasionally. The explanation behind this essential administration is that antifreeze has various added substances that are intended to counteract consumption in the cooling system. This consumption has a tendency to quicken when a few unique sorts of metal associate with each other. The erosion causes scale that in the long run develops and starts to obstruct the thin level tubes in the radiator and warmer center bringing on the engine to in the end overheat. The counter erosion chemicals in the radiator fluid keep this, however they have a constrained life expectancy.

More current radiator fluid details will keep going for a long time or 150,000 miles before requiring replacement. This antifreeze is generally red in shading and is alluded to as "Amplified Life" or "Long Life" antifreeze. GM has been utilizing this kind of coolant as a part of every one of their vehicles since 1996. The GM item is called "Dex-Cool".

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Search for a shop that can invert flush the cooling system. This requires uncommon equipment and the removal of thermostat in mind the end goal to carry out the job appropriately. This sort of flush is particularly vital if the old coolant looks brown or has scale or floating around in it.

On the off chance that you expel the thermostat for a reverse flush, always replace with a new thermostat.

2.7 Engine & Performance

Internal combustion engine is a heat engine where the combustion of a fuel happens with an oxidizer or air in a combustion chamber. The engine creates work utilizing the results of combustion as the working liquid as opposed to a heat transfer medium. To create work, the combustion is done in a way that produces high-pressure combustion items that can be extended through a turbine or piston (Richard C. Flagan 2012).

There are basically two types of I.C. ignition engines, spark plug and, compression of a fluid dependent type. Spark ignition engines take a mixture of fuel and air, compress it, and ignite it using a spark plug. Spark ignition engines use an air to fuel mixture that is compressed at high pressures. At this high pressure the mixture has to be near stoichiometric to be chemically inert and able to ignite. So the mixture in order to ignite needs not to be either with too much fuel or too much air but rather have an overall even amount. (Fernando Salazar, 1998). Engine performance can be define as curves of power output, revolution per minute, fuel or fluid consumption and ambient condition in which an engine operates(Tony Atkins et al., 2014). The engine will assume perform if this entire category is improved. There are few parameters that can be show the performance of the engine such as horsepower, thermal efficiency, air fuel ratio, specific fuel consumption, exhaust smoke and emission and torque.

2.8 Exhaust Emission

Gases from the exhaust are product of combustion of fuel and air. The gas later will be released into the air through the exhaust pipe. Some of the gases that being released from the exhaust are oxygen, nitrogen oxide, carbon dioxide, carbon monoxide, and hydrocarbons. Most of the gases are harmful to living life and the environment. The gases exhaust emission can be the parameter to the engine performance. The leaner operation can result in some improvements in engine performance parameters (Sayin et al., 2009).

2.8.1 Carbon Monoxide (CO) Emission

CO is a colourless, odourless, poisonous gas, and it must be restricted. CO results from incomplete combustion of fuel and is emitted directly from vehicle tailpipes. Nationally and, particularly in urban areas, the majority of CO emissions to ambient air come from mobile sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death. Besides the ideal combustion process that combines carbon (C) and oxygen (O2) to CO2, incomplete combustion of carbon leads to the formation of CO. The formation of CO takes place when the oxygen presents during combustion is insufficient to form CO2 (Canakci et al.,2009). A falling trend of CO emission can be assumed as the engine speed increases.