CHAPTER I

INTRODUCTION

1.1 Background

Although gasoline engines have improved a lot, they are still not very efficient at turning chemical energy into mechanical power. Most of the energy in the gasoline (around 75%) is converted into heat, and only 25% of total energy produced in gasoline engine which converted into effective work. Therefore, it is the job of the cooling system to take care of that heat. In fact, the cooling system on a car driving down the freeway dissipates enough heat to heat two average-sized houses.

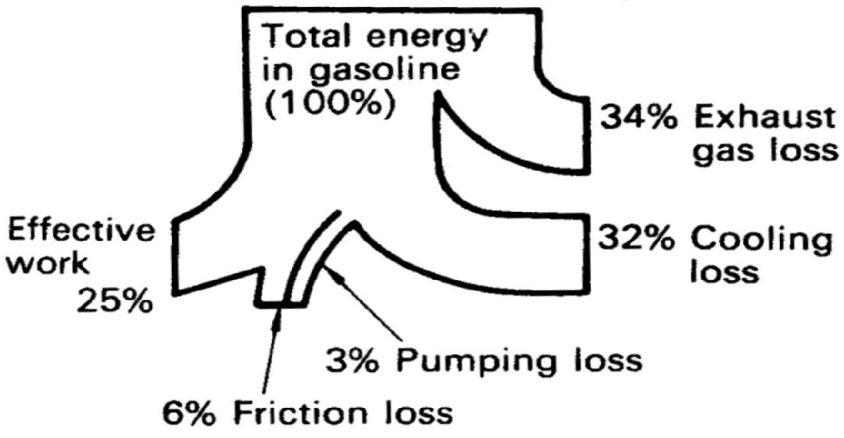

Figure 1.1 Heat Balance In Gasoline Engine

The primary work of the cooling system is to keep the engine from overheating by transferring this heat to the air, but the cooling system also has several other important works. The engine in car runs the best at a fairly high

temperature. When the engine is cold, components wear out faster, and the engine is less efficient and emits more pollution. So another important work of the cooling system is to allow the engine to heat up as quickly as possible, and then to keep the engine at a constant temperature.

Therefore, knowledge about the design and analysis of radiator car is very important to be studied by engineering students at university.

1.2 Car Cooling System

A car engine is made up of numerous internal moving parts that cannot be seen. When the engine is running, these parts move very quickly and create friction which then, creates heat. It is normal for a car engine to operate at a high temperature but extreme heat cannot be maintained and it must be moved on or the internal parts will be fatigue and the engine is worn. This is where the engine cooling system and the radiator come in. The purpose of the cooling system is to absorb excess heat generated by the engine.

1.2.1 Function

Specific functions of car cooling system are:

a. To reduce engine heat. Heat which produced by combustion process could reach 2500°C. This heat is enough to melt metal or other engine components, so if car is not equiped with cooling system could damage the engine.

b. Maintaining the most efficient working temperature of engine which is 82°C to 99°C. At working temperature components will expand so that clearance of components of the engine becomes precise. Besides, the works of the engine will become maximum and the exhaust gas emission will reduce.

c. Accelerate reaching working temperature to avoid excess worn of engine componets.

d. To warm up car cabin, especially in country which winter season occur.

1.2.2 Work

When the engine in low temperature, water circulate in around the engine only, since the thermostat still closed. Water gets pressure from water pump, but it can not force thermostat to open since thermostat works based on temperature changing.

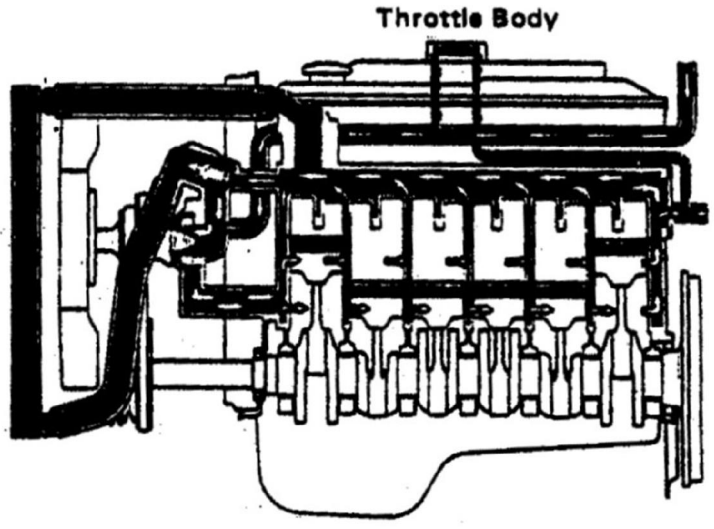

Figure 1.2 Cooling System When Thermostat Closed

To avoid excessive pressure of pumping process then cooling system is equiped with by pass valve on radiator cap.

When the engine in high temperature, thermostat is open so that hot water in water jacket (which already absorb heat from engine) flowing from engine to radiator that will be cooled by radiator, cooling fan, and air flow by forward movement of car. From radiator water (which already cooled) flow again to engine.

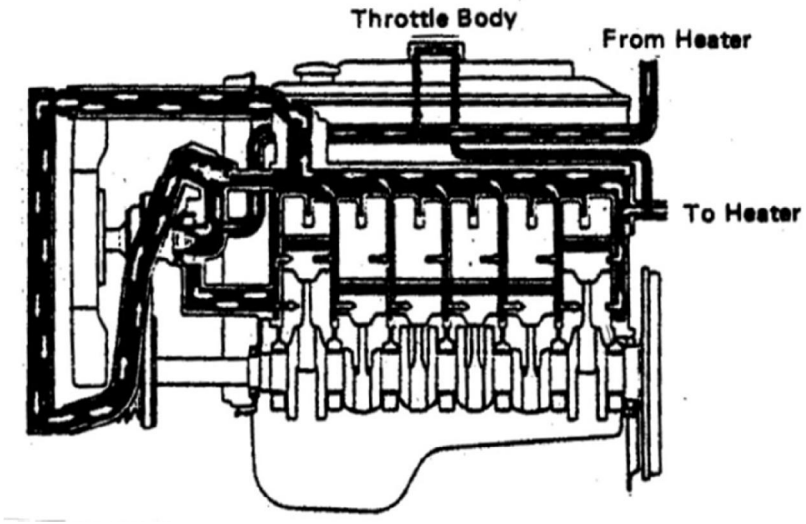

Figure 1.3 Cooling System When Thermostat Open

1.3 Objectives

Objective of this final project are:

1. To investigate heat transfer rate through radiator.
2. To create simple segment analysis which then compared to full radiator analysis.

1.4 Problem Limitations

Scope of work for this project is used as limitation which available to be discussed and analyzed. Limitations are as follows:

1. Radiator of Toyota Rush 1.5 M/T.
2. Analyzing of heat transfer in radiator when thermostat open.
3. Analyzing of heat transfer in radiator when fan starts.
4. Engine is on idle RPM (around 850 RPM).

1.5 Methodology

This car radiator heat transfer analysis done by several methods, namely:

1. Observation methods: by observing, analyzing and searching the data directly in the subject.
2. Literature methods: to obtain the basic of theory using equations or formulas from an existing reference.
3. Internet searching: to search the data components of car radiator, this can be accessed by internet.
4. Interview method: to obtain information and data by asking directly to the related resource.
5. Analysis: to process data to obtain result for completing objectives.

1.6 Systematic Writing

This final project consists of several chapters. In broad outline of each chapter contains the following:

Chapter I INTRODUCTION

This chapter contains background, car cooling system, objective, scope area, methodology and systematic writing.

Chapter II REVIEW OF LITERATURE

This chapter contains review of literature and theory of conduction, convection, radiation, fins, mass flow rate, friction, turbulent flow, laminar flow, and pump.

Chapter III COOLING SYSTEM OF TOYOTA RUSH 1.5 M/T

This chapter contains flow chart of research, four stroke internal combustion engine, combustion process, cooling system of Toyota Rush 1.5 M/T, and its main components.

Chapter IV CALCULATION ANALYSIS

This chapter contains calculation analysis of radiator.

Chapter V CONCLUSION

This chapter contains the conclusions and suggestions.