CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

A diesel engine also known as a compression-ignition engine is an internal combustion engine that uses the heat of the compression to initiate ignition to burn the fuel, which is injected into the combustion chamber. This is in contrast to spark-ignition engine such as a petrol engine (gasoline engine) or gas engine (using a gaseous fuel as opposed to gasoline), which uses a spark plug to ignite an air-fuel mixture.

The engine was developed by Rudolf Diesel in 1893. The diesel engine has the highest thermal efficiency of any regular internal or external combustion engine due to its very high compression ratio. Low speed diesel engines as used in ships and other applications where overall engine weight is relatively unimportant can have a thermal efficiency that exceed 50 percent. Diesel engine is manufactured in two-stroke and four-stroke versions. They were originally used as a more efficient replacement for stationary steam engines. Since the 1910s they have been used in submarines and ship. Use in locomotives, trucks, heavy equipment and electric generating plants followed later. In the 1930s, they slowly began to be used in a few automobiles. Since the 1970s, the use of diesel engine in larger on-road and off-road vehicles.

Nowadays, the depleting reserves of fossil fuel, increasing demand for diesel and uncertainty in their availability have been a matter of global concern. From the automotive view, to minimize the fuel consumption rate in the diesel engine is by improving the engine performance to reduce the energy lose in the combustion. In the diesel engine, combustion and emission characteristic are influenced by the fuel
atomization, nozzle geometry, injection pressure, shape of inlet port and other factors. In order to improve the fuel-air mixing, it is important to understand the fuel atomization and spray formation process. So far, to improve the combustion performance and particulate emissions, many researchers have investigated the characteristics of the spray behavior by experimental and theoretical approaches.

Generally, this study will be focus on the atomization and spray characteristics of diesel fuel, recently, most of the diesel engines applying direct injector method. The injected fuel into the combustion chamber undergoes atomization process. Atomization is the chemical reaction process between injected fuel and the compressed air in the combustion chamber, where the high pressure injected fuel breaking up into very fine mist or droplet. This process is important in order to produce the combustion ready mixture fuel. The smaller the droplet exiting the injector, the faster it will vaporize and ignite when it is injected into the engine cylinder. The effective atomization process will reduce the HC and $NO_x$ emission production. There are numerous factors that influence the atomization process, such as injection pressure, the temperature in the combustion chamber, the piston surface geometry and the nozzle injector geometry.

Under direct injection method, nozzle injector geometry plays an important role in producing an effective injection for atomization process. There are many type of nozzle injector used in diesel engine, but three standard type of nozzle that commonly used at the diesel vehicle by most heavy duty vehicle manufacturer is sac nozzle, micro-sac nozzle and valve covered orifice nozzle that also known as VCO-nozzle. The sac-nozzle has as sac volume space at the nozzle tip. After the injection process, a volume of fuel trapped in the tip of the injector. This volume of fuel would be wasted, leads to incomplete combustion and contribute in the HC and $NO_x$ emission. in order to reducing the pollution, the micro-sac nozzle have been introduces, both sac-nozzle and micro-sac nozzle have a similar design, but the sac volume space size of the micro-sac nozzle is smaller compares to the sac-nozzle. The sac volume hole size have been reduced depending on the requirement fuel after injection process. Although the volume of fuel trapped in the sac volume hole of the micro-sac nozzle is less than sac nozzle, incomplete combustion still occurs. Then the valve covered orifice has been used widely. This type of nozzle has removes the sac volume hole at the nozzle tip. For the
VCO-nozzle configuration there is almost no residual fuel to vaporize. In addition, control of injection timing and quantities are such improved with VCO-nozzle configuration, since no time is required to fill the sac volume. The major drawback is the unequal pressure distribution of fuel through individual nozzle holes when multi-hole nozzles are utilized. This is due to random oscillations of the needle in the transverse direction during needle lift and fall. This eccentricity of the needle transforms the axial symmetry of the flow around the needle and can result in asymmetry of the spray from each individual hole.

Spray characteristic of fuel injection is another factor in diesel combustion and pollutant emissions. An investigation into various spray characteristics from different holes of VCO-nozzle will be performed and compared. In this study the spray characteristic such as a spray tip penetration also known as spray penetration length and spray cone angle were measured from the simulation result by ANSYS Fluent software.

Spray Cone Angle is the angle that formed by the cone of fuel injection leaving a nozzle orifice. For any given flow rate, the wider the spray angle is the smaller the droplet size will be. Larger angle spray simply has more space to distribute the droplet and so there is less chance of recombination and a greater opportunity to atomize.

1.2 PROBLEM STATEMENT

The depleting reserves of fossil fuel, increasing demand for diesel and uncertainty in their availability have been a matter of global concern. From the automotive view, to minimize the fuel consumption rate in the diesel engine is by improving the engine performance and to reduce the energy lose in the combustion.

1.3 OBJECTIVES

Generally, the objectives to be achieved in this study are stated below:

i) To study the effect of the spray behavior based on the various temperature and pressure, single and double hole of valve covered orifice nozzle.