NUMERICAL SIMULATION ON THE PERFORMANCES AND EMISSIONS OF THE DIRECT INJECTION COMPRESSION IGNITION ENGINE

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NUMERICAL SIMULATION ON THE PERFORMANCES AND EMISSIONS OF THE DIRECT INJECTION COMPRESSION IGNITION ENGINE

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DECLARATION

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NOMENCLATURES

ATDC	After Top Dead Center
ABDC	After Bottom Dead Center
A/F	Air-Fuel Ratio
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CA720	Crank Angle at 720°
CFD	Computational Fluid Dynamics
CR	Compression Ratio
DICI	Direct Injection Compression Ignition
EVO	Exhaust Valve Opened
HRR	Heat Release Rate
ICE	Internal Combustion Engine
IVC	Inlet Valve Closed
IVO	Inlet Valve Opened
NOx	Nitric Oxide and Nitrogen Dioxide
PISO	Pressure-Implicit with Splitting of Operators
P-V	Pressure versus Volume
SI	Spark Ignition
TDC	Top Dead Center
TKE	Turbulent Kinetic Energy
2D	Two dimensional
N	Engine Operating Speed in rev/second
Rs	Swirl Ratio
Ws	Angular Velocity of Rotating Flow at Swirl Axis

ABSTRAK

Dalam usaha untuk meningkatkan kecekapan enjin diesel, banyak kerja dan kajian telah dilakukan. Dalam projek ini, kesan daripada kelajuan enjin dan penentuan masa suntikan pada tingkah laku fizikal dalam proses silinder dalam enjin diesel akan dikaji. Kajian ini menekankan tekanan puncak, kadar pembebasan haba, suhu, tenaga kinetik bergelora dan pecahan jisim NOx dalam silinder. Kajian menggunakan kaedah eksperimen memerlukan banyak pelaburan tenaga kerja, kos, masa dan peranti teknologi tinggi. Oleh itu, perisian simulasi seperti ANSYS Fluent boleh digunakan untuk menjalankan kajian mengenai persembahan dan pelepasan enjin diesel. Simulasi boleh dijalankan berulang kali dengan menukar kelajuan enjin (2000rpm, 2500 rpm dan 3000 rpm) dan masa suntikan (CA10 BTDC, CA15 BTDC dan CA17 BTDC) menggunakan eddy model pelesapan. Input tersebut mempengaruhi CA, sudut semburan pemasaan injap, halaju suntikan massa disuntik akan kekal. Kes garis asas telah dijalankan pada 2500 rpm dengan masa suntikan CA15 BTDC. Semua parameter enjin diambil dari model enjin yang sebenar 4TNV98CT-GGE. Di samping itu, keputusan simulasi dijalankan sedar bahawa kelajuan enjin rendah mendapatkan tekanan silinder puncak, HRR dan suhu yang lebih tinggi. Oleh kerana suhu udara yang tinggi, pecahan jisim NOx juga mendapat jumlah yang lebih tinggi kerana ia amat sensitif kepada suhu udara. Keputusan simulasi dijalankan menunjukan bahawa kelajuan enjin rendah memberi tekanan silinder puncak, HRR dan suhu yang lebih tinggi. Oleh kerana suhu udara yang tinggi, pecahan jisim NOx juga mendapat jumlah yang lebih tinggi. Keputusan simulasi dijalankan menunjukan bahawa kelajuan enjin rendah memberi tekanan silinder puncak, HRR dan suhu yang lebih tinggi. Oleh kerana suhu udara yang tinggi, pecahan jisim NOx juga mendapat jumlah yang lebih tinggi kerana ia amat sensitif kepada suhu udara.

Keputusan juga menunjukkan bahawa pemasaan suntikan lewat, lebih rendah tekanan puncak, HRR dan suhu disebabkan pembakaran kurang. Selain itu, kontur tekanan statik, suhu statik, halaju magnitud juga boleh diperiksa menggunakan perisian berangka. Di samping itu, trend yang jelas telah ditunjukkan oleh tekanan silinder puncak, HRR, suhu, pecahan jisim NOx. Pada kelajuan enjin 2000rpm atau masa suntikan CA17 BTDC, tekanan puncak dan puncak HRR adalah yang tertinggi untuk enjin diesel ini yang 4864833Pa dan 75J /Degree masing-masing. Semakin tinggi puncak HRR, semakin tinggi output kuasa.

ABSTRACT

In order to improve the efficiency of the diesel engine, a lot of works and studies had been done. In this project, the effects of engine speeds and the injection timings on the physical behaviour in cylinder process in a diesel engine will be investigated. This study stresses on the peak pressure, heat release rate, temperature, turbulent kinetic energy and mass fraction of NOx in the cylinder. Research works employing experimental methods need extensive investment in terms of man power, cost, time and high technology device. Thus, the simulation software i.e. ANSYS Fluent, can be used to carry out a study on the performances and emissions of a diesel engine. The simulation can be conducted repeatly by chainging the engine speeds (2000rpm, 2500rpm and 3000rpm) and injection timings (CA10 BTDC, CA15 BTDC and CA17 BTDC) using eddy dissipation model. Parameters such as CA, spray angle valve timing, injection velocity and injected mass are fixed in this study. The base line case was running at 2500rpm with injection timing of CA15 BTDC. All the engine parameters were taken from the actual engine model of 4TNV98CT-GGE. In addition, simulations results showed that lower engine speed give rise to higher peak cylinder pressure, HRR and temperature. Due to the high air temperature, the mass fraction of NOx is also higher due to the high air temperature.

The results also show that a delay injection time would yield lower the peak pressure, HRR and temperature because of the less combustion. Moreover, the contours of static pressure, static temperature, velocity magnitude can also be examined using the numerical software. In addition, this study shows clear trends of peak cylinder pressure, HRR, temperature, mass fraction of NOx. At engine speed of 2000rpm or injection timing of CA17 BTDC, the peak pressure and peak HRR are the highest for this diesel engine which are 4864833Pa and 75J/Degree respectively. A HRR peak will yield higher power output.

CHAPTER 1
INTRODUCTION

1.1 Research background

The internal combustion engine (ICE) is a device that can generate heat energy by burning of fossil fuel in a combustion chamber, specifically piston. Throughout the combustion process, some of the pollutants will be released to atmosphere and it will definitely cause pollution and damage to environment and human beings. The performance of engine may depend on several factors such as the engine operating condition, engine design, fuel properties and so forth. Usually ICE can be categorized into diesel engine, gasoline engine and turbine. Direct injection compression ignition diesel engine will be focused on this research project. Figure 1-1 below shows the cylinder of the direct injection type of engine.

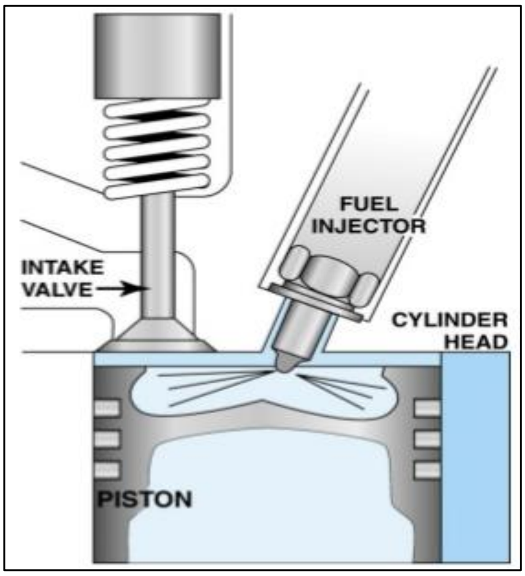

Figure 1-1: Diagram of diesel engine with fuel injector [1].

Recently, diesel engines face the challenge of alternative energy resources and global warming [2]. Under diesel engine, direct injection compression ignition diesel engine are used in tiny, medium and large duty applications due to its simplicity and high fuel conversion efficiency [3]. For example, diesel engines are extensively used for vehicles and power plant [4]. The development of this kind of engine have been going on throughout the years, especially for the transportation field, especially heavy-load mobile, agriculture and industry. Those engines operating using fossil fuel can cause pollution to the environment.

Figure 1-2: Emissions from heavy vehicles [5].

Due to the strict emission rules and regulations of the government, various authorities are competiting with each other to develop a clean engine that can run with minimal pollutant emissions and higher engine performance in automotive sector [4]. Many researchers continue to perform engine analysis in different ways with minimal cost [6]. Modification of existing engines are also incorporated extensively by many researchers rather than developing a new engine. However, the process of developing a new engine or modifying the existing engine will take a very long time to complete. In terms of financial, it will involve a lot of investment too [3].

In this era of advanced technology, most of the leading manufacturers around the world employ computer simulations method due to the availability of fast digital computing from powerful computers. This is because it can shorten the research and development period if compared with experimental method. Not only that, diversified diesel engine can be developed and tested to seek for improvement by investing lesser resources and money. Next, the optimisation of the engine design can also be done using numerical simulation [3]. Numerical simulation come with the insights on the interaction inside the combustion chamber as well as tackle the governing equations like turbulence, mass, momentum, energy and so forth in the engine analysis [6]. In addition, parametric studies can also be fulfilled using numerical simulation instead of hardware development [7].

In addition to that, the pollutant emissions from the combustion process are the factor that lead to serious urban air pollutions. Nitric oxide, nitrogen dioxide, carbon monoxide, unburned hydrocarbon and particulates are the common pollutants released by internal combustion engine. The source of formation of those pollutants are originated from the exhaust gases. Figure 1-3 shows the composition of diesel exhaust gas. In diesel engine exhaust, the concentration of NOx is more than those from spark ignition engine. NOx is the main source of pollutants in diesel engine. Besides, diesel engines are a significant source of particulate emissions. Conversely, diesel engine are not the significant source of carbon monoxide [8]. Usually carbon monoxide will be emitted due to the incomplete combustion of fuel. Actually, NOx produced from internal combustion engine can cause the formation of smog and haze that frequent seen over the cities. NOx will be dissociated and formed ozone when it is exposed to sunlight which is considered as the pollutant at the ground level. Furthermore, NOx will also react with volatile organic compound to form hazard molecules. This pollutant can be inhaled by human beings and cause undesirable events in the lung like breathing problem and respiratory diseases. From the environmental perspective, the reaction of rain with the NOx can lead to acid rain problems. Next, those pollutants may be deposited on the piston wall. This problem can affect the performance of the engine and then shorten its lifespan.

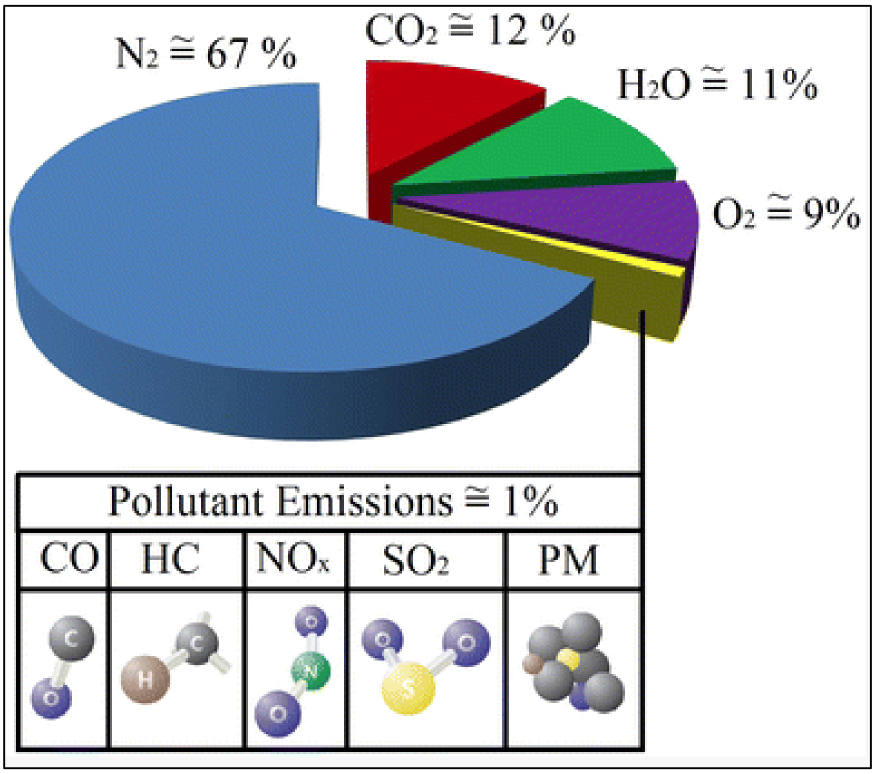

Figure 1-3: Composition of diesel exhaust gas [9].

Ahmadi R and Hosseini S.M. [10] investigated the influences of hydrogen-diesel fuel on the emissions on a diesel engine which is running at 1600rpm. They found out that the pollutants like HC and CO can be reduced by more than 50% by using hydrogen-diesel fuel.

There are several factors that affects the amount of formation of NOx. Most of the factors are related to the injection system. That leads researchers to study the nozzle geometry and optimization of injection system. This is due to the reason that the combustion processes in diesel engine are characterized by auto-ignition as well as non-homogeneous diffusion [4]. Those factors under injection system include injection pressure, injection rate and injection timing. For the injection pressure, Sugiyama et al. [11] researched the effect of injection pressure to the performance of diesel engine in two cases. Both cases were injected at two different pressures which was 150MPa and 50MPa respectively. The results revealed that when the injection pressure increases, the maximum pressure inside the piston increases and the lesser time is needed to reach the maximum pressure. For the injection rate, split injection with smaller quantity of fuel at the first phase proved that can limit the rate of heat release and minimize the formation of NOx. However, the previous work mostly focused on the injection pressure and injection. Thus, the effect of the fuel injection timing will be studied in this project.

1.2 Problem statement

Diesel engines are extensively been applied in most power-generation stations and heavy-duty mobile such as ferry, trucks and cranes. This is because they are able to provide greater indicated mean effective pressures and higher efficiencies because of the higher compression ratios. Nowadays, governments around the world are encouraging their citizens to support renewable energy and limiting the usage of precious fossil fuel. The by-products emitted during the fuel combustion such as nitric oxide, nitrogen dioxide, carbon monoxide, unburnt hydrocarbon can cause serious pollution to environment. In addition, it also can affect the lifespan of the engine itself. The weak performances of the engine are usually due to the engine design and its injection system. So, research and development related to diesel engine are continously being studied by many scientists. Due to the high cost and time-consuming of experiments studies, the modern tool of numerical simution can replace the conventional experimental method. By using the computational fluid dynamics simulation, different models of combustion process can be created easily in a short time. The trend of various factors such as engine speed and injection timing towards the diesel engine performances and pollutants can then be investigated. Furthemore, the ideal operating condition for the diesel engine can also be determined in order to offer a sustainable environment.

1.3 Project objective

The objectives of this project are:

- To develop a simulation model on the performances and emissions of a diesel engine that imitate 4TNV98CT-GGE engine model using ANSYS Fluent.
- To investigate the trend of performances and emissions on a diesel engine at higher engine operating speeds at 2000rpm, 2500rpm and 3000rpm.
- To study the trend of performances and emissions on a diesel engine by varying the fuel injection timing for 10, 15 and 17 degree crank angle before top dead center.
- To examine the contours of static pressure, static temperature and velocity magnitude in a direct injection compression ignition engine diesel engine.

1.4 Scope of project

The scope of project includes the study of the in-cylinder phenomena using the modern tool which is the ANSYS Fluent. This study is focused on the direct injection compression ignition diesel engine. The parameters of the diesel engine are imitating a commercial diesel engine model under the brand of YANMAR. This is because the specification and parameters of this kind of engine is very common. For the baseline case, the simulation will be running at the engine speed of 2500rpm. In addition, the fuel injection process will start at 15 degree crank angle before top dead center with the duration of 21.5 degree crank angle. This is an account of the fact that most of the researches on the diesel engine now are using low speed condition which is below 2000rpm to perform the simulation. However, this research project will only stress on the performances of the engine at medium speed condition which is at 2000rpm, 2500rpm and 3000rpm. Thus, the trend of the performances and pollutant emissions such as peak pressure, apparent heat release rate, peak temperature, velociy magnitude, turbulent kinetics energy and mass fraction of NOx will be determined according to the several engine speeds. Besides, the second part of the project is also same as the first part which the engine performances and pollutant emissions will be determined by varying the fuel injection timing with CA10, CA15 and CA17 BTDC. The engine operating conditions such as compression ratio, amount of injected fuel, minimum valve lift, fuel used, injection velocity and boundary conditions will remain the same for all simulations under this project. This project will focus on the same timing for inlet valve closed (CA570) and exhaust valve opened (CA833). Thus, only the compression stroke and power stroke will be discussed in this project. This project will not cover the simulation of different fuels, injection timing after top dead center, soot emission, formation of carbon monoxide, particulate matters and unburnt hydrocarbon.

1.5 Thesis outline

This thesis is organized into six chapters:

- Chapter 1 begins with a general background relating to internal combustion engine and its simulation.
- Chapter 2 briefly reviews the literature and provides useful insights reported pertaining to the factors that related to the performance of diesel engine such as injection timing, engine speed, pollutants and so on.
- Chaper 3 briefly reviews the theory of the diesel engine such as the its components, operation and process during combustion.
- Chapter 4 describe the technique used in this study to simulate the diesel engine such as modelling of engine, meshing, decomposition and setup of simulation.
- Chapter 5 numerically explores the effects of varying engine speed and injection timing to the performances and emission of the diesel engine.
- Chapter 6 emphasizes the contributions of the thesis and provides suggestions for future investigations.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The chapter will first discuss the factors that will affect the performance of the engine. Those factors include engine operating speed and fuel injection timing. Then, the in-cylinder condition will be analyzed using the simulation. Apparent heat release rate, peak pressure, peak temperature as well as the pollutants parameter will be reviewed. The method and settings of the numeriacal simulation also will be discussed.

2.2 Fuel injection timing

In diesel engine, fuel injection timing is a major parameter that will affect engine combustion process [12]. Nader Raeiea, Sajjad Emamib and Omid Karimi Sadaghiyania studied about the effect of injection timing on the propulsion and power in a diesel engine using multi-dimensional CFD code AVL-FIRE. They performed the simulation on a diesel engine which was MT4.244 engine by varying the injection timing at 6°BTDC, 3°BTDC, TDC, 3°ATDC and 5.5°ATDC. They found out that early fuel injection contributes higher NOx emissions than late injection [11].

Srinath Pai et al. [13] also studied the injection timing and injection affect the performance of a diesel engine called Kirloskar Make (TV1Model). The experiment was investigated for the combination of different injection pressures and injection timings (15.5°BTDC, 20.5°BTDC, 23°BTDC and 25.5°BTDC) at the engine speed of 1500 rpm. They concluded that injection pressure with proper injection timing can improve the engine performance and minimize those emission like NOx. 15.5°BTDC produced lowest amount of NOx emission among them at a constant injection pressure.

Diesel-RME (Rapeseed Methyl Ester) blends is used by Megaritis and Tsolakis [14] in order to study on the performance and emissions of a diesel engine. From their study, the exhaust gases were recirculated back to intake section and there will be retarded injection timing by 3° CA. They discovered that the brake specific fuel consumption was slightly elevated.

T H Lim and S. Bari, C W Yu studied the efficiency of direct injection diesel engine by advancing the injection timing by 4°CA. Both diesel and waste cooking oil were used as the fuel for combustion process. They revealed that the efficiency of the engine increased about 1.1% for diesel and 1.6% for waste cooking respectively [15].

Ganesan and Jayashankara studied the influences of injection timing and intake pressure to the engine performance. The diesel engine was running at low speed of 1000rpm. The simulation results revealed that retarded injection caused the decrease of mass fraction of NOx, tempereature, heat release and pressure [16].

The condition of mixing of air and fuel will vary and it depends on the injection timing. When the injection timing is changed, it will affect the ignition delay [17]. The pressure and temperature of the compressed air will be lower when the fuel injection occurs before the standard injection timing [18]. The penetration of the spray fuel can be enhanced by extending the ignition delay of the fuel. As a result, the good mixing of fuel and air can be prepared and then it can improve the burning process. So, the heat release will be increased when the combustion process begins. It is due to the suitability of the mixture of fuel and air [19]. Turbulence will be created inside cylinder if the injection timing is advanced. Besides, the existence of turbulence can help in mixing the fuel and air [17].

Fuel injection timing in a diesel engine is a dominant parameter that will affect the engine performance and emissions. Besides, fuel injection timing decides the commence of the combustion process together with the ignition delay. Early injection is defined as the fuel will be in lower pressure and temperature conditions. Henceforth, it will experience a longer ignition delay and vice versa. Rao et al. [3] stated that higher heat release can be achieved by advancing the fuel injection timing. Meanwhile, retarded injection timing will result in lower heat release. The advanced injection timing happened at (28° BTDC) and retarded injection timing at (18° BTDC).

2.3 Engine speed

Based on one of the simulation study in this field, the grid independence test are chosen at 1500rpm instead of 1800rpm and 2100rpm because it is a standard speed used condition of the single-cylinder direct injection diesel engine [20]. Usually the engine speed is categorized into three group which is low speed, medium speed and high speed. For the low speed, the speed is less than 1500rpm. It will have shallow, less swirl occurs in the combustion chamber. For the medium speed of the engine, the speed ranges from 1500rpm to 3000rpm. For the high speed, the speed is greater than 3000rpm.

Most of the study of the performance of diesel engine are done at low speed range. For example, Upendra Rajak and Tikendra Nath Verma from National Institute of Technology, Manipur studied the effects of engine speed variations on direct injection diesel engine.They ran the simulation using FLUENT software by varying the engine speed from 1200rpm to 1800rpm. They concluded that 1500rpm was the better engine speed for the four strokes diesel engine because it acquired highest heat release rate [20].

Sindhu, R et al. [21] also studied the simulation of CI engine flow processes for prediction of performance and emissions with distinct fuels. They analyzed the emission of NOx and soot, in-cylinder pressure, thermal efficiency and heat release for a diesel engine with 16.5:1 compression ratio. They examined the effect of engine speed towards the performance and emission of the engine by constructing several models using C++ software. They also simulated the engine at speed of 1200rpm, 1500rpm and 1800rpm. They have compared the predicted values with the experimental value and realized that higher pressure and temeperature will happen at lower speed [3].

Mohamad Isa et al. [22] investigated regarding the temperature, pressure and soot density on diesel engine model in 2D using non-premixed combustion and the eddy dissipation model. Those engine parameters were refered from an actual diesel engine with model KM186 KIPOR diesel engine. The simulation was conducted at high speed 3000rpm to see the distribution of temperature, pressure and soot formation.

Since, most of the previous work are focusing at the performance of the diesel engine at low speed condition (below 2000rpm). Henceforth, the performance of the diesel engine and the pollutant emission of the diesel engine at medium speed condition (from 2000rpm to 3000rpm) will be investigated in this project.

2.4 Analysis of in-cylinder data

Thermodynamics or energy conservation-based models conjointly referred to as phenomenological models which use the energy and mass conservation equations to facilitate within the calculation of in-cylinder pressures and work done produced [3]. Heat release rate can be extracted from the pressure data. Apparent heat release rate is refered to an approximations to the actual quantities because the real quantities cannot be found exactly.

A model in C++ was developed using double-Weibe function to examine and model the heat release. It was shown that early fuel injection timing will produce higher levels of temperature and pressure in the cylinder. In addition, the brake mean effective pressure can be easily affected by equivalence ratio instead of engine speed [23]. The peak heat release rates for different engine speed will occur at different timing. For low engine speed, the peak heat release rate will be higher because there is more time available for combustion process if compared to high engine speed. In addition, the lower the engine speed, the further the peak heat release away from the TDC. The lower the engine speed, the higher the peak pressure and happens closer to TDC. This is due to the fact that low engine speed will have small ignition delay (in CA). These findings are based on a simulation model using C++. The engine used come with 110mm stroke, 220mm connecting rod length, 16.5 compression ratio and injection angle at 23° before TDC. However, some of the informations are not stated clearly like the period of injection, amount of injected mass and temperature boundary conditions. Thus, it is tough to imitate the exact similation model [3].

S. M. Jameel Basha1, P. Issac Prasad and K. Rajagopal studied about in-cylinder condition using numerical simulation in a direct injection diesel engine. The simulations were performed using different injection timings which were 9°BTDC, 18°BTDC and 25°BTDC. The injected mass of fuel in this case was remained the same. From their results, the turbulent kinetics energy was considered the lowest at the injection timings of 25°BTDC. Besides, the fuel injection at 18° BTDC acquired the highest pressure and temperature [24].

Based on a study using CONVERGE software, the values of peak pressure and temperature will increase and move towards TDC if the fuel injection happens early. This study varied the injection timing from 9° before TDC to 20° before TDC [25]. N. A. Mohamad Shafie and M. F. Muhamad Said studied about the cold flow analysis on ICE with mutliple piston bowl designs. The engine specifications were taken from an actual aspirated 1.6-liter engine. They found out that the peak turbulent kinetics energy for different piston bowl configurations were about $30m^2/s^2$ [6].

2.5 Pollutants emissions

NOx is referred as the combination of nitric oxide (NO) and nitrogen dioxide (NO_2). There are some differences between NO and NO_2. Nitric oxide is a odorless and colourless gas whereas nitrogen dioxide is bitter odor and reddish brown gas. However, both gases are considered as toxic which may cause danger to environment. Nitric oxide is formed during the post flame combustion process due to the high temperature [26]. The reactions governing the formation of NO and NO_2 from oxygen and nitrogen will be shown in Figure 2-1 below.

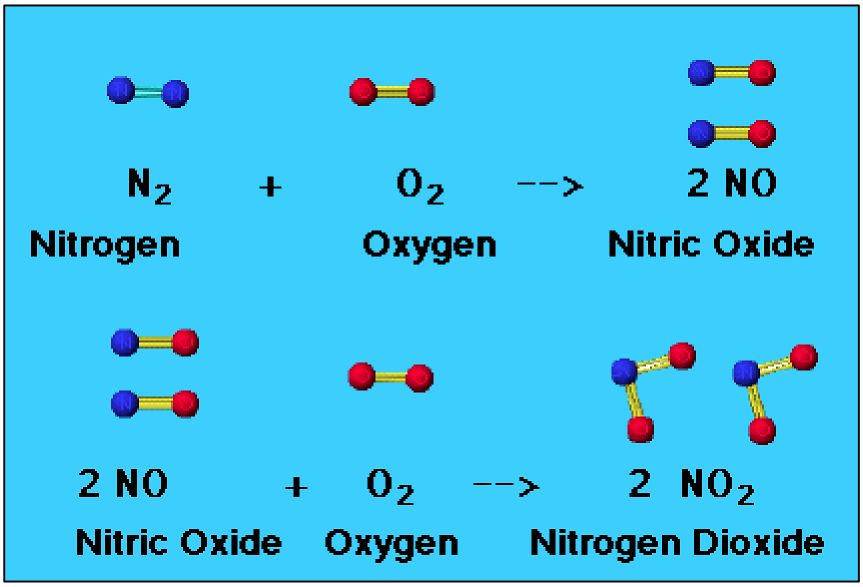

Figure 2-1: Formation of nitric oxide and nitrogen dioxide [27].

The main source of NO is due to the oxidation process of the atmosphere nitrogen. The another source of NO is from the fuel itself. If the fuel itself come with significant amount of nitrogen, then the oxidation process of the fuel can cause the emission of NO. Usually, diesel fuels contain more nitorgen than gasoline.

When the temperature in the cylinder increases, the concentration of NO will decrease. This is because there will less time for the oxygen to react with nitrogen in the cylinder. So, the lower the enigne speed, the smaller the peak pressure and temperature, then the lower the NO content in the cylinder. Not only that, retarded injection timing can also contribute to the reduction of NO as the temperature in cylinder is lower [3]. In early injection, the emission of NOx will increase because of the high temperature. Besides, the efficiency of combustion will increase and then reduce the soot emission. This is because more time is available for mixing fuel and air inside the cylinder [25].

Sindhu, R et al. [21] studied on the reduction of NOx emissions using split injections on a diesel engine with compression ratio of 16.5:1. The experiment was conducted on a direct injection diesel engine which operate at injection timing at 16°BTDC and constant speed at 1500 rpm. The split injection was divided into two pulses. The first pulse will inject about 25% of the fuel, then the remaining fuel will be injected during second pulse which have the gap of 8°CA. They observed that the premixed phase of the combustion will become slower if using split injection method. Besides, NOx emission can be tremendously reduced using the split injection with smaller amount on the first phase [21].

2.6 Numerical simulation

In order to minimize the computational cost, meshing can be performed for a sector which is 60 degree of the bowl shape piston geometrical symmetry [20]. The k-Turbulence model was selected for the numerical simulation [10]. Combustion simulation for a sector is focused on the compression and power stroke. The initialization settings must be set properly in order to obtain the result close to reality. This is because this type of simulation do not simulate the whole engine combustion process. For full cycle simulation, the simulation can provide full picture of the engine process like from intake stroke to exhaust stroke. It consists of the modelling of air flow, injection of fuel, mixing of fuel and air, combustion of fuel as well as formation of pollutants from exhaust gases. However, this type of simulation is deemed difficult and time-consuming due to the complex setting of the simulation [6].

2.6.1 Governing equations

There are three governing equations often relate to research of computational fluid dynamic which is momentum equations (Navier-Stokes equations), continuity equations and energy equations. They decide the thermal sciences and physics of fluid mechanics [28]. For the combustion model for diesel engine, the motion of fluid in cylinder is time dependent, compressible and turbulent flow. Besides, the high pressure spray of fuel will involve multiphase which is very complicated. In this case, the nature of the fuel and air are still governed by the continuity equations, Navier-Stokes equations and energy equations [7].