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A Review on Investigation Parameter of CI Engine by Using ANSYS Software

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A review on Investigation parameter of CI engine by using ANSYS software

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Abstract

The availability of crude oil on the planet is limited, and the price of crude oil is rising by the day. This situation is creating a challenge for the engine manufacturer to manufacture an engine that will create less pollution and be capable of meeting future demands. The diesel engines are manufactured by considering diesel as a working fuel. The same engine, with small modifications, can be employed if biodiesel is used as fuel. Engine performance can be improved by performing engine simulation. Several studies have been published on the fuel economy and attempted to reduce the pollution level by varying the input parameters of the engine and fuel, which required a huge amount of money and time. An alternative method to overcome these limitations is the use of computer simulation techniques, which requires less time and money. Using these powerful techniques, it is possible to check the effect of changes in input parameters such as compression ratio, intake pressure, speed, structural and operational parameters at low cost and very little time. The focus of the present study is to review the different available models used for modeling of CI engines.

Keywords: CI engine, numerical modelling, combustion, simulation

Introduction

Modeling Compression ignition engine depends on characteristics of fuel.

For the purpose of understanding the behaviour of the system it is neccessary to design a model of real system and conducting experiments on it.

Numerical model of a diesel engine can be regarded as an explanations of real engine operation, which combines mathematical relation between the relative components, can be use to simulate the dynamic process of diesel engine.

A clear overview of engine operation helpful to understand the modeling of a real diesel engine.

It surves as a tool for better understanding of combustion and it's effects on engine, so as to build up more strong real system.

The purpose of this project i.e. numerical modeling is to determine the effect of fueling a diesel engine with diesel and biodiesel fuel blends.

Objective of this project is concerning with numerical modeling and predictions of output.

Here,we analyzed the chemistry related to design of internal combustion engine with respect to its pressure ,volume and Temperature

Here, C++ can be used as a source of programming for attaining of objective, as it is more users friendly and more specific for getting optimum result.

Process of combustion in CI engine is different from SI engine

One or more jet of fuel are injected with high pressure of 110 to 200 bar by means of fuel pump to highly compressed and heated air.

Minute droplets quickly surrounded by an envelope of it's own vapor and after and interval , is inflamed at the surface of the envelop hot air temperature 450-550^{o}C and pressure 30-40 bar.

Fuel is not injected once, spread over 20-40 degree of crank travel.

Fuel air mixture are heterogeneous, if air will motionless small portions of fuel may burn.

Stages of combustion of CI engine

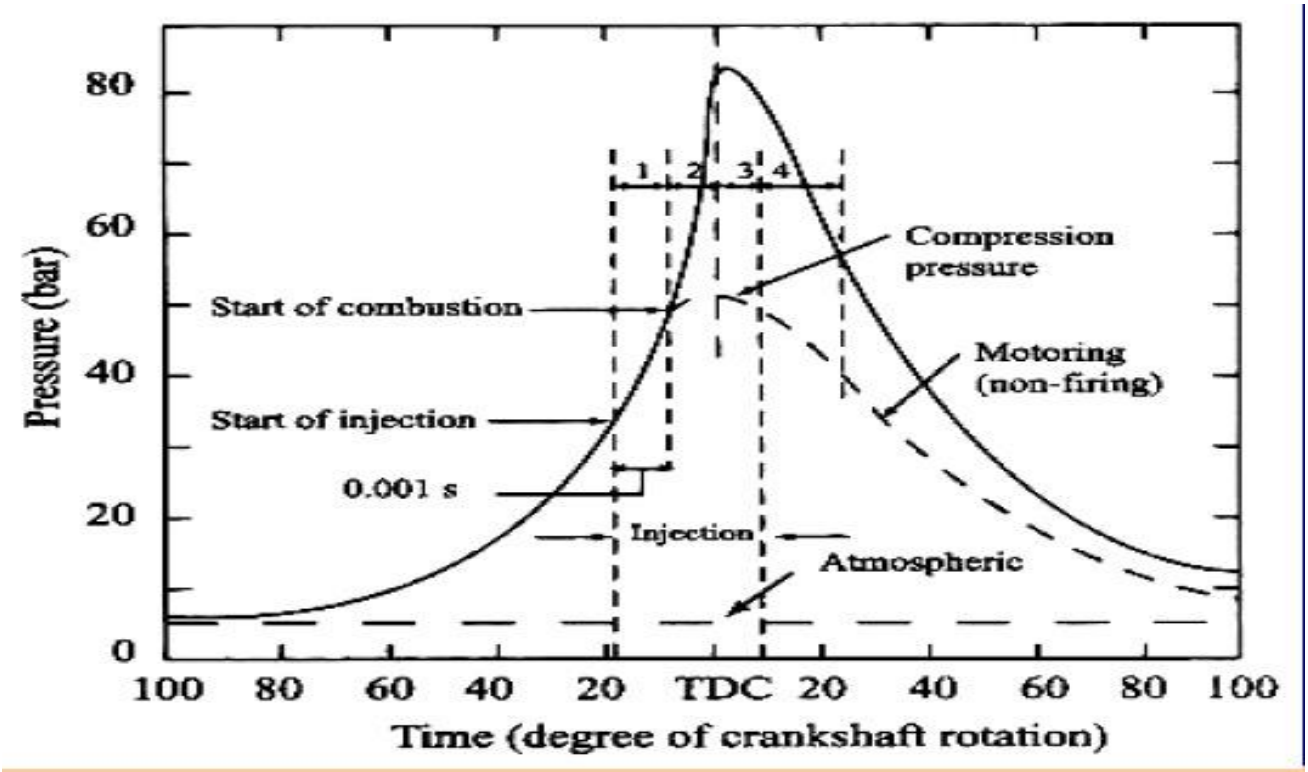
1.Ignition Delay Period

- Physical Delay
- Chemical Delay

2. Uncontrolled combustion

3. Controlled Combustion

4. After burning



1.Ignition Delay Period

Injection of fuel in otomize from is initiated into the combustion space containing compressed air.

Fuel open injection does not get burnt immediately instead some time is required for preparation before start of combustion.

Fuel droplets injected into high temperature air first get transformed in vapor.

Subsequently, if temperature inside its greater than self ignition temperature at respective pressure then ignition get set.

Thus, the delay in start of ignition may be said to occur due to 'physical delay' i.e. time consum in transformation from liquid droplets into gaseous form,and ' chemical delay ' i.e.time consume in preparation for settingup of chemicalreaction (combustion).

The duration of ignition delay depends upon fuel characteristics, compression ratio (i.e. pressure and temperature after compression) fuel injection ambient air temperature, speed of engine geometry of combustion chamber. Etc

Ignition delay is inevitable stage and in order to accommodate it, the fuel injection is advanced by about 20^{o} before TDC.

2. Uncontrolled Combustion

During the ignition delay period also the injection of is continue as it has begun at point 'a' and shall continue upto the point of cutoff.

For the duration in which preparation for ignition is made , the continuous fuel injection results in accumulation of fuel in combination space.

The moment when ignition just begins, if the sustained flame front is established then this accumulate fuel also gets burnt rapidly.

This burning of accumulated fuel accurs in such a manner that combustion process become uncontrolled resulting into steep pressure rise.

During this Uncontrolled combustion phase is the pressure rise is very abrupt then combustion is termed as abnormal combustion and may even lead to damage of engine part in extreme conditions.

During this Uncontrolled combustion phase about one third of total fuel heat is released.

3. Controlled Combustion

After the Uncontrolled combustion is over then the rate of burning match with rate of fuel injection and the combustion is termed as called controlled combustion.

This phase maximum of heat gets evolved in controlled manner.

In controlled combustion phase has smooth pressure variations and maximum temperature is attained during this period.

It is seen that about two- third of total fuel heat is released during this phase.

4. After Burning

After controlled combustion, the residual if any gets burn and the combustion is termed as after burning.

This after burning may be there due to fuel particles residing in remote positions in combustion space where flame front could not reach.

After burning is spread over 60 – 70^{o} of crank angle rotation and occur even during expansion stroke.

Problem Identification

1) It is very difficult to calculate various parameters like pressure, volume, temperature and heat relrate ata every crank angle.
1. There is not any specific tool to calculate the above parameters.

Literature Review

1. Sagar P. Potdukhe et al., Modeling and Energy Analysis of a Diesel and Biodiesel Fuelled Engine, International Journal of Science and Research, Volume 4 Issue 5, May 2015

The focus of this study is to review the different available model used for modeling of CI engines.

The focus is on single zone model which further subdivided in many submodel i.e. heat release rate, heat transfer, ignition delay period, droplet evaporation, intake and exhaust flow and combustion model

2. Yi Ren et al., Numerical simulation of biodiesel fuel combustion and emission characteristics in a direct injection diesel engine, Front. Energy Power Eng. China 2010, 4(2): 252–261

The effects of the physical and chemical properties of biodiesel fuels on the combustion process in Direct Injection (DI) engine are investigated numerically by using multi-dimensional Computational Fluid Dynamics (CFD) simulation.

In this study, methyl butanoate (MB) and n-heptane are used as the surrogates for the biodiesel fuel.

3.Hariram V. et al., Application of zero-dimensional thermodynamic model for predicting combustion parameters of CI engine fuelled with biodiesel-diesel blends, Alexandria Engineering Journal, Volume 55, Issue 4, December 2016, Pages 3345-3354

A zero-dimensional mathematical model is developed to analyse the rise in in-cylinder pressure along with Wiebie's heat release correlations, ignition delay, gas dynamics model, heat transfer model and frictional model.

4. Sanjay Patil, Thermodynamic Modelling for Performance Analysis of Compression Ignition Engine Fuelled With Biodiesel and its Blends With

Diesel, Alexandria Engineering Journal, IJRTE, Volume-1 Issue-6, January 2013

The simulation model is used to analyze the performance, combustion and emission characteristics of single cylinder 3.5 kW rated power diesel engine fuelled with Diesel (D0), Palm Oil Methyl Ester (POME) and POME-diesel blends.

The model is also used to predict net heat release rate, exhaust gas temperature, NOx and soot.

5. H. Jeshvaghani et al., Performance analysis of Diesel engines fueled by biodiesel blends via thermodynamic simulation of an air-standard Diesel cycle, Int. J. Environ. Sci. Technol. (2014) 11:139–148

The effect of compression ratio, cut-off ratio and fuel type on output work and thermal efficiency is investigated through the model.

The fuels considered for the analysis are conventional diesel, rapeseed oil biodiesel and its blend (20 % biodiesel and 80 % diesel by volume).

Conclusion

1. The single zone, multizone, and multidimensional models of diesel engine combustion are discussed in this article. The single zone model has been proven to be a more effective tool for predicting engine parameters quickly, although the wiebe function parameter must be adjusted on a case-by-case basis.
2. Multizone models account for air entrainment and mixture inhomogeneities, overcoming the single zone model's limitation. Multi-dimensional models take into account both the engine geometry and the flow field's temporal and spatial fluctuation. These accurately estimate the spray behaviour and dynamics of the fuel spray.
3. The multizone model is used to investigate the influence of insulation on the cylinder wall, and it is found that increasing the degree of insulation produces an increase in NOx emission while also increasing soot production. Because of the harmful impact on the environment, this increase in emission and soot generation is not admirable. More insulation on the cylinder wall, on the other hand, improves engine efficiency. As a result, it is recommended that the degree of insulation be carefully chosen.

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