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COMBUSTION PHENOMENON IN CI ENGINE: A REVIEW

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ABSTRACT

The basic concept of internal combustion engine is a cylinder, which is closed at one end, is filled with a mixture of fuel and air. As the crankshaft turns it pushes cylinder. The piston is forced up and compresses the mixture in the top of the cylinder. The mixture is set alight and, as it burns, it creates a gas .pressure on the piston, forcing it down the cylinder. This paper gives a review of compression ignition engine.

KEYWORDS: CFD, Biodiesel, CI engines, ansys,

INTRODUCTION

Use of Biodiesel in CI Engines

According to Saurabh et al [1] Vegetable oils are a suitable alternative to diesel in compression ignition (CI) engines. The use of vegetable oils in a C I engine results in low CO, HC and smoke opacity emissions compared to a conventional diesel fuel. Biodiesel, a clean renewable fuel, has recently been considered as the best substitute for a diesel fuel because it can be used in any CI engine without the need for modification. Chemically, biodiesel is a mixture of methyl esters with long chain fatty acids and is typically made from non-toxic, biodiesel resources such as vegetable oils (Jatropha, Karanja, Thumba etc.), animal fats or even waste cooking oils (WCO).

Bio-diesel, which can be used as an alternative diesel fuel, is made from renewable biological sources such as vegetable oil and animal fats. It is biodegradable, non-toxic and possesses low emission profiles. Also, the uses of bio-fuels are environmentally beneficial. The name bio-diesel was introduced in the United States during 1992 by the National Soy Diesel Development Board (presently National Bio-diesel Board) which has pioneered the commercialization of biodiesel in the US [2].

Use of conventional diesel fuel causes serious problem of air pollution and effects on the environment leading to effect like green house, some factors in diesel fuel results in high emission in diesel engine. The stringent emission norms have been an important driving force to develop the CI engines more environment friendly. The main pollutants from diesel engines are carbon monoxide, hydrocarbons, nitrogen oxides and Smoke intensity. The problem of increasing demand for high brake power and the fast depletion of the fuels demand severe controls on power and a high level of fuel economy. That's Many innovative technologies are developed to tackle these problems [2, 3].

This recommends the intensive studies on the use of alternative fuels especially renewable ones like vegetable oils and alcohols. The use of vegetable oils as an alternative fuel for diesel engine is not a new concept. In fact early engines were demonstrated with vegetable oil. In a developing country like India where mass transportation plays an important role, the suitability of alternate fuels for a diesel fuel engine application has to be thoroughly investigated. Vegetable oils plays a prominent role in substituting diesel, since they are renewable and are easily produced in rural areas. Biodiesels such as Jatropha, Karanja, Sunflower and Rapeseed are some of the popular biodiesels currently considered as substitute for diesel. When biodiesel is used as a substitute for diesel, it is highly essential to understand the parameters that affect the combustion phenomenon which will in turn have direct impact on thermal efficiency and emission. In the present energy scenario lot of efforts is being focused on improving the thermal efficiency of IC engines with reduction in emissions. The problem of increasing demand for high brake power and the fast depletion of the fuels demand severe controls on power and a high level of fuel economy. Many innovative technologies are developed to tackle these problems [3, 4].

Some researchers states that the taguchi is most effective method for optimization of diesel engine performance parameters. For example, [5, 6] in this work consist an experimental study that involves an

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application of the Taguchi method and grey relational analysis to determine the optimum factor level to obtain optimum multiple performance characteristics of a diesel engine run with different low-percentage thumba biodiesel-diesel blends [7]. Taguchi method of optimization predicted optimum level of parameters within 9 trials and the 40 Turpentine blend found working satisfactorily at optimum setting. Lastly he proved that the blending of turpentine with diesel fuel up to 40% increases the engine Performance without much more effect on emission.

Mudgal et al. [8] Work on the Prediction of Emissions from Biodiesel Fueled Transit Buses Using Artificial Neural Networks. Shivakumar et al. [9] Researcher had work on the Experimental investigation on the Performance parameters and Exhaust emissions from the four stroke C.I. engine operated on honge methyl ester. Back-propagation algorithm was used to train the network. In this work they selected the inputs for the ANN are blend percentage (B), load percentage (W), and the compression ratio (CR). The output parameters from the ANN are Brake thermal efficiency (BTE), Brake specific energy consumption, (BSEC), Exhaust gas Temperature and the emissions which include Oxides of nitrogen (NOx), Smoke (SN), Unburnt Hydrocarbon (UBHC), and Carbon Monoxide (CO). Lastly he had investigated the ANN results showed good correlation between the ANN predicted values and the desired values for various engine performance values and the exhaust emissions.

NUMERICAL SIMULATION OF MULTI-CHAMBER PISTON C.I ENGINE

The work of arhant and kartika [10] relates to the modification of the C.I engine design for inducing turbulence by squish and tumble flows to improve the combustibility of the combustible mixture. This modification includes the formation of multi-chambers on the piston crown. It consists of three small chambers at 120^0 apart. The C.I engine with multi-chamber piston at motoring condition has been analyzed through C.F.D using fluent software and the results obtained are compared with the base C.I engine.

Suresh babu et al [11] imported from ICEM CFD to ANSYS FLUENT and their counters are plotted. They found that pressure and temperature distribution at the top of cylinder near inlet and exhaust valves is not uniform, which is resulting in un-burnt fuel particles coming out through exhaust valve due to abnormal combustion. Design modifications have to be done in order to make the pressure and temperature distribution along the top of the cylinder near inlet and exhaust valve should be uniform. By this we can reduce the un-burnt fuel and decrease the environmental pollution. In this way the efficiency of the engine can be increased.

Umakant and Vivek [12] described the development and use of sub models for combustion analysis in direct injection (DI) diesel engine. In their study the Computational Fluid dynamics (CFD) code FLUENT is used to model complex combustion phenomenon in compression ignition(CI) engine. The experiments were accomplished on single cylinder and DI engine, with full load condition at constant speed of 1500 rpm. Combustion parameters cylinder pressure, rate of pressure rise and heat release rate were obtained from experiment. The numerical modeling is solved by unsteady first order implicit, taking into account the effect of turbulence. For modeling turbulence Renormalization Group Theory (RNG) k ε model is used.

Each after treatment system design should be done in such a way that considering the complete system objectives. Energy efficient exhaust system development requires minimum fuel consumption and maximum utilization of exhaust energy for reduction of the exhaust emissions and also for effective waste energy recovery system such as in turbocharger, heat pipe etc. from C.I. Engine. Traditional manifold optimization has been based on tests on Exhaust system. This trial & error method can be effective but is very expensive & time consuming. Beside this method cannot provide any information about the actual flow structure inside the system. Rajesh and Dhananjay [13] obtained this vital information using 3-D CFD analysis. The design engineers can study the flow structures & understand whether a particular system performs correctly or not.

CONCLUSION

This review paper gives an insight into the importance and effects of combustion parameters. Strength of modern computer for computational analysis is increasing day by day. It is easy to perform complicated analysis for saving time and money. There is a strong necessity of research and innovation in combustion chamber design as with advent of new technologies in engine. Study of combustion parameters is of prime importance and that too in CI engines because their applications are varied and widespread. CFD is a very efficient tool

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for the research in diesel engine. CFD could be very effective to analyse and predict the behaviour of parameter like diesel combustion, pressure, temperature and emission.

FUTURE SCOPE

As we saw through this article, how important combustion process and combustion Parameters are, current studies should provide basis for research work in future & helps in save the time & money There is lot of possibility in the analysis of an IC engine by using Computational fluid Dynamics software to improved combustion efficiency in CI engines.

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