Review on the performance parameter of 4 stroke diesel engine by inspecting fuel injection pressure and timing using bio diesel

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Abstract
Now it has become increasingly obvious that continued reliance on fossil fuel energy resources is unsustainable, owning to both depleting world resources and the green house gas emissions associated with their use. Therefore, there are vigorous research initiatives aimed at developing alternative renewable and potentially carbon neutral Biofuels as alternative energy resources. This review paper analyzes the previous researches concerning the consequences of proposed effective strategies including the variation in engine operating parameters like fuel injection timing and injection pressure for enhancing combustion characteristics of biodiesel implementation. This study focuses its light on the advancement and retardation methods of injection timing and injection pressure to treat the engine combustion indicators such as brake thermal efficiency, brake specific fuel consumption, in-cylinder pressure, peak cylinder pressure, heat release rate, ignition delay period and combustion duration, finally a comparative evaluation has been developed and the relevant reasons for the variation of combustion characteristics have been conversed. The review concludes that the advancement in injection timing and higher injection pressure are best in amplifying the combustion phenomena of biodiesel fuelling.

Keywords: Biofuel, Injection Pressure, Injection Timing.

1 Introduction
Studies about the practice of renewable energy sources oxygenated biodiesel as the substitute for diesel fuel have been escalated in high rate due to overemphasizing demand and diminishing supply of fossil fuels caused by rapid rate of industrialization and increasing vehicle population in the recent decades. In the year 2011, it was reported that India was ranked fourth in energy consumption in the world. To meet this growing energy needs, alternative fuels are receiving more consideration. Biodiesel derived from vegetable oils, used cooking oils, animal fats, plastic oils, etc., are used as alternative fuels in diesel engines. Biodiesel have been recommended as a vehicular fuel because of their similar physiochemical properties when compared to diesel fuel. Due to the benefits like renewability, feasibility, availability, higher combustion efficiency and lower emission; biodiesel has been suggested as the superior renewable source. Over the past few decades, various biodiesel for diesel engines have been explored and studied on the performance, emission and combustion characteristics by many researchers. They investigated that the effect of operating parameters like injection timing and injection pressure on the engine combustion characteristic is quite significant. Injection timing and injection pressure influences major impacts on the performance characteristics of biodiesel fuelled engines. Injection timing plays an important role in the emission characteristics of biodiesel fuelled diesel engine. A substantial number of research studies from highly rated journals in the scientific indexes were selected and surveyed preferentially since the year 1999–2017, on the basis of effects of operating parameters variation on diesel engine combustion characteristics literatures. Therefore it is important to review the effect of injection timing and injection pressure on the combustion characteristics of a variety of biodiesels for the effective combustion in diesel engines.

2 Biodiesel production approach and latest technologies.
Fatty acid (FA) composition of oil from feedstock is an important parameter to select the suitable process of biodiesel production technique. FA distribution and unsaturation degree of oil affects the behavior of biodiesel. Viscosity is one of the important characteristics of fuel to be fuelled in engine. Oil extracted from feedstocks could not be used directly in engines due to their higher viscosity that may leads to poor atomization of fuel spray and inappropriate fuel injection, which resulted in deprived performance. Substantial efforts have been made by several researchers to develop the vegetable oils to suit the physio-chemical properties and performance of diesel fuels. As discussed earlier, the issues related to substitution of methyl or ethyl esters for diesel fuel could be changed by various general approaches and latest intensification technologies, as follows.
2.1. Direct blending and micro-emulsification
Direct blending or dilution deals with the mixing of diesel directly with vegetable oil in an appropriate proportion. But some issues like free fatty acid content, acid value, higher viscosity and formation of gum leads to the complex application of fuel in the engine. Microemulsification is the process to reduce the higher viscous vegetable oil by the formation of micro-emulsions.

2.2. Catalytic cracking
Catalytic cracking is the process of conversion of vegetable oils in the deficiency of oxygen or air to the fuel having similar properties to diesel. The obtained fuel comprises the significant quantity of moisture, sediments, sulphur and carbon residues.

2.3. Thermal cracking
Thermal cracking or pyrolysis involves the production of fuel from non-edible oil in the presence of catalyst by means of heat. The fuel obtained from pyrolysis has been proposed as a suitable alternative fuel for diesel engine. The pyrolysed material comprises alkanes, alkadienes, aromatics, alkenes and carboxylic acids.

2.4. Transesterification
Biodiesel production from microalgae can be done using several well known industrial processes, the most common of which is base catalyzed transesterification with alcohol. The transesterification is the reversible reaction of fat or oil (which is composed of triglyceride) with an alcohol to form fatty acid alkyl ester and glycerol. Stoichiometrically, the reaction requires a 3:1 molar alcohol to oil ratio, but excess alcohol is (usually methyl alcohol is used) added to drive the equilibrium toward the product side. This large excess of methyl alcohol ensures that the reaction is driven in the direction of methyl esters, i.e. towards biodiesel. Yield of methyl esters exceeds 98% on a weight basis. The reaction occurs stepwise: triglycerides are first converted to diglycerides, then to monoglycerides and finally to glycerol. Transesterification can be done in number of ways such as using an alkali catalyst, acid catalyst, enzyme catalyst, heterogeneous catalyst or using alcohol in their supercritical state; however enzyme catalyst are rarely used as they are less effective. The alkali-catalyzed transesterification is about 4000 times faster than the acid catalyzed reaction. Consequently, alkalis such as sodium and potassium hydroxide are commonly used as commercial catalysts at a concentration of about 1% by weight of oil. Alkoxides such as sodium methoxide are even better catalysts than sodium hydroxide and are being increasingly used. Use of lipases offers important advantages.

3 Related Work
The literature review in this section will have a brief introduction on various approaches used making biodiesel, different injection pressure and injection timing.

Much research has been done on methods and technique for efficiently consuming the fuel and producing maximum possible efficiency. However there is futher need to polish the techniques to make the environment greener and healthier.

K.M Mrityunjaya Swamy[5] suggested that by increasing the injector opening pressure from the rated value for diesel (180bar) to 200 bar shows significant improvement in performance and emissions with alage oil methyl esters due to better spry formation. The injector opening pressure 220bar performance and emissions inferior than injector opening pressure 200 bar, this is due to that at higher pressure, the size of fuel droplets decreases and very high fine fuel spray will be injected, because of this, penetration of fuel spray reduces and momentum of fuel droplets will be reduced. Advancing the injection timing by 30 crank angle (i.e. 300bTDC) performance and emission characteristics have been improved significantly.

In [4], K. Vijayaraj proposed that 23°C bTDC with of 200 bar would be the optimum injection timing and injection pressure which gives better performance, combustion and lower emissions when compared to other injection timings and injection pressures. So, B25 MEMSO could be used as an alternative fuel for diesel engine with the static injection timing of 23°C bTDC with injection pressure of 200 bar without any engine modifications.

Akash Deep[1] proposed that the engine fuelled with 20% castor biodiesel and diesel blend (i.e. B20) performs better at its original configuration and therefore, do not require any change in engine design.

Avinash Kumar Agarwal[9] experimented concluded that Effects of fuel injection pressure and start of injection timings on CRDI engine performance, emissions and combustion characteristic of Karanja biodiesel (KOME) blends and baseline mineral diesel were investigated at a constant engine speed, in addition to comprehensive spray investigations. The fuel injection duration decreased slightly with increasing biodiesel content in the test blend. Fuel injection duration shortened and peak injection rate increased with increasing fuel injection pressure. Sauter mean diameter and arithmetic mean diameter of fuel spray droplet (D_{32} and D_{10}) decreased with reduction in biodiesel blending ratio due to relatively lower fuel density and viscosity.

Debabrata Barik[8] suggested that BDFM24.5 gave an optimum result for combustion, performance and emission characteristics, than those of other injection timing cases. The BSFC for BDFM24.5 is found to be higher by about 23.9% than that of KME, but it is 5.1% lower than that of BDFM23.0, at full load. About 6.6% increase in BTE was observed for BDFM24.5 in comparison with the BDFM23.0, at full load. BDFM24.5 gives a reduction in CO, HC and smoke emission of 17.1%, 18.2% and 2.1%, in comparison with BDFM23.0, at full load, respectively. The NO emission for BDFM24.5 was higher by about 5.5% than that of BDFM23.0, at full load.

4. Proposed Solution
This report is based on approach for getting higher efficiency and lower the pollution by controlling different
injection pressure and injection timing in diesel engine by using bio diesel.

To overcome this issue of lesser fuel efficiency and higher polluting gases, we have proposed that changing the injection timing and injection pressure and by using some percent of biofuel with diesel in diesel engine we can increase the efficiency of the engine and also decrease the polluting components like Nox, SO, CO, HC, etc.

5 Conclusion and Future Work

In this research, we proposed an unique way for changing the injection pressure and injection timing of the diesel engine by using bio diesel in it. The proposed solution will overcomes the drawbacks of less efficiency and more pollution due to the diesel engine.

In the future we aim to work on the experimental setup of diesel engine and applying the changes as per the requirement of the project and also do the analysis for the same and compare both the result. So this will give the exact idea for the increase of efficiency and decrease in pollution.

6 References


