# Review Paper on Experimental Investigation on Different Injection Pressure and Injector Holes Number in Stationary 4-Stroke Single Cylinder Diesel Engine Performance Using Bio Diesel Oil-Diesel Blends

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***Abstract***— The consumption of diesel is 4-5 times higher than petrol in India. Due to the shortage of petroleum products and its increasing cost, efforts are on to develop alternative fuels especially, to the diesel oil for full or partial replacement. Use of bio diesel in the diesel engine without modification that time performance of the engine is decrease because biodiesel viscosity and density effect the atomization so overall performance decrease. There are various factors that influence the performance of engine such as compression ratio, atomization of fuel, fuel injection pressure, and quality of fuel etc. Fuel injection pressure and nozzle holes number play an important role in better atomization of injected fuel allows for a more complete burn and helps to reduce pollution. In present work a single cylinder 5HP diesel engine is used to investigate the performance characteristics of bio diesel oil with diesel blends. We will jointly work on different injection pressure and injector nozzle holes number for improve the performance the engine.

**Keywords:** Injection Pressure, Injector Nozzle Holes Number and Size, Bio Diesel Blends.

## I. INTRODUCTION

### A. Diesel fuel injector

Diesel engine plays a dominant role in the field of power, propulsion and energy. The diesel engine is a type of internal combustion engine ,more specifically it is a compression ignition engine ,in which the fuel ignited solely by the high temperature created by compression of the air-fuel mixture. The engine operates using the diesel cycle. The fuel injection system is the most vital component in the working of CI engine. The engine performance, power output, economy etc is greatly dependent on the effectiveness of the fuel injection system. The injection system has to perform the important duty of initiating and controlling the combustion process. When the fuel is injected in to the combustion chamber towards the end of compression stroke, it is atomized into very fine droplets by injector nozzle which is given below.

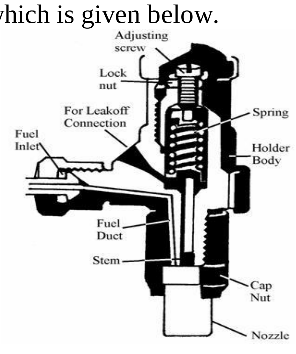


Fig. 1: Diesel fuel injector

The injector assembly consists of.

- A needle valve
- A compression spring
- A nozzle
- An injector body

When the fuel is supplied by the injection pump it exerts sufficient force against the spring to lift the nozzle valve, fuel is sprayed into the combustion chamber in a finely atomized particles. After fuel from the delivery pump gets exhausted; the spring pressure pushes the nozzle-valve back on its seat. For proper lubrication between nozzle valve and its guide a small quantity of fuel is allowed to leak through the clearance between them and then drained back to fuel tank through leak of connection.

## II. LITERATURE REVIEW

### A. Papers based on injector nozzle holes size and number

Mr. Lijo P Varghese et al. (2013) [1], have focused their work on analysis of the effect of nozzle hole diameter on CI engine performance using *karanja* oil-diesel blends.An experimental study was carried out to find out the effect of fuel injector nozzle hole diameter on diesel engine performance using *Karanja* oil-diesel blends. These performance parameters were measured using three different size nozzles. One nozzle with holes of 0.25 mm, 0.25 mm and 0.15 mm, second nozzle with all three holes of 0.4 mm size, third nozzle with all three holes of 0.6 mm size. the conclusion of this paper that if we were increase holes and size of the nozzle, the thermal efficiency was decreased but performance increase as fuel bio diesel oil but in same case for diesel fuel that fuel consumption was increased.

Cenk Sayin et al. (2013) [2], have analyzed by experimental study the Influence of injector hole number on the performance and emissions of a DI diesel engine fuelled with biodiesel -diesel fuel blends. In diesel engines, fuel atomization process strongly affects the combustion and emissions. Injector hole number (INHN) particular Influence on the performance and emissions because both parameters take important Influence on the spray parameters like droplet size and penetration length and thus on the combustion process.The injector nozzle hole size and number included 340*2 (340 µm diameter holes with 2 holes in the nozzle), 240*4, 200*6, and 170*8. If we used biodiesel fuel in diesel engine that time brake specific fuel consumption (BSFC) increase than diesel fuel for four hole nozzle but CO, SO, HC decrease and $CO_2$ increase due to the improved combustion and NOx emission also increase due to higher temperature generate in engine.

Revansiddappa Byakod et al. (2012) [3] Compared Analysis of Performance and Emission Characteristics of Neem Oil Using 3 And 4 Holes Injection Nozzle on DI

 

Diesel Engine. They investigated on 5.2 kW diesel engine AV1 Single Cylinder water cooled, Kirloskar Make tested for blends of diesel with Castor and Neem Biodiesel. The viscosity of neem oil is reduced first by blending with diesel in 25/75%, 50/50%, 75/25%, and 100% on the volume basis, then analyzed and compared with diesel. They concluded that brake thermal efficiency, specific fuel consumption and indicated thermal efficiency are higher in 4 holes nozzle than 3 holes nozzle. The emission of CO and HC are higher in 4 holes nozzle than 3 holes nozzle.

USV Prasad et al. (2012) [4] performed their experiment for Influence of Fuel Injection Parameters of DI Diesel Engine Fuelled with Biodiesel and Diesel Blends. They experimented on 5HP single cylinder diesel engine at different injection pressure 190 bars, 200 bars and 210 bars with different blends and nozzle holes size and number. They concluded that injection pressure was increasing not only the fuel droplet size decreases but also increases the momentum of the droplets. Standard 3 holes nozzle and 210 bras injection pressure yielded lowest brake specific fuel consumption. Also, it was observed that for the same number of holes, small size hole nozzle at any given injection pressure yielded better performance. This is indicating the fact that smaller nozzle requires higher injection pressure to ensure complete combustion and to bring down fuel consumption.

*B.* Papers based on injection pressure

M.L.S Deva Kumar et.al. (2012) [5], have varied two parameters injection pressure and intake manifolds inclinations. They took Injection pressure 160 bars, 180 bars, and 200 bars at different intake manifolds inclinations $90^0$, $60^0$ and $30^0$. They concluded that if we increase the injection pressure of the engine that time good atomization, reduced delay period, good vaporization of fuel so increase overall performance of the engine. $60^0$ inclinations of intake manifold and 180 bars injection pressure gave best brake thermal efficiency, mechanical efficiency. $60^0$ inclinations of intake manifold and 200 bars injection pressure gave better volumetric efficiency.$90^0$inclinations of intake manifold and 180 bars injection pressure gave best indicated thermal efficiency.$30^0$ inclinations of intake manifold and 200 bars had less HC emission. $60^0$ inclinations of intake manifold and 180 bars had less NOx emission.$60^0$ inclinations of intake manifold and 160 bars had less $CO_2$ emission.

Cenk Sayin et al. (2011) [6], have investigated impact of compression ratio and injection parameters on the performance and emissions of a DI diesel engine fuelled with biodiesel-blended diesel fuel. This work investigates the influence of compression ratio (CR) and injection parameters such injection timing (IT) and injection pressure (IP) on the performance and emissions of a DI diesel engine using biodiesel (5%, 20%, 50%, and 100%) blended-diesel fuel. Tests were carried out using three different CRs (17, 18, and 19/1), ITs (15, 20, and 25 CA BTDC) and IPs (18, 20 and 22 MPa) at 20 N m engine load and 2200 rpm. Increasing CR enhances density of air charge in cylinder. The more density is the higher angles of spray cone results in increase of amount of air entrainment in the spray. Enough air in the fuel spray contributes to the completion of combustion. The ORG IT gave the best results of BSFC, BSEC and BTE compared to the other ITs. The increased IP gave the better results for BSFC, BSEC and BTE compared with the ORG IP and decreased IP.

S. Jindal and B.P. Nandwana et al. (2010) [7], they experimented investigated of the effect of compression ratio and injection pressure in a direct injection diesel engine running on Jatropha methyl ester. This study targets at finding the effects of the engine design parameters viz. compression ratio (CR) and fuel injection pressure (IP) jointly on the performance with regard to fuel consumption (BSFC), brake thermal efficiency (BTHE) and emissions of CO, $CO_2$ , HC, NO and Smoke opacity with JME( Jatropha methyl ester) as fuel. They found that the combined increase of compression ratio and injection pressure increases the BTHE and reduces BSFC while having lower emissions. For small sized direct injection constant speed engines used for agricultural applications (3.5 kW), the optimum combination was found as CR of 18 with IP of 250 bar.

Xiangang Wang et al. (2011) [8], they studied that Effects of ultra-high injection pressure and micro-hole nozzle on flame structure and soot formation of impinging diesel spray. The effects of ultra-high injection pressure ($P_{injection}$=300 MPa) and micro-hole nozzle (d=0.08 mm) on flame structure and soot formation of impinging diesel spray were studied with a high speed video camera in a constant volume combustion vessel. In this experiment Three Injection pressures of 100, 200 and 300 MPa and two injector nozzles with diameters of 0.16 and 0.08 mm were used. The soot formation is too weak to be detected with the micro-hole nozzle at injection pressures of 200 and 300 MPa. With eliminating the impact of injection rate on soot level, both ultra-high injection pressure and micro-hole nozzle have an obvious effect on soot reduction. Liquid length of the 0.16 mm nozzle is longer than the impingement distance and liquid length of the 0.08 mm nozzle is shorter than the impingement distance. Liquid impingement upon the wall is responsible for the deteriorated soot level of impinging flame compared to that of free flame with the conventional nozzle.

M. Pandian et al. (2011) [9], this study aimed that the effect of injection system parameters on performance and emission characteristics of a twin cylinder compression ignition direct injection engine fuelled with pongamia biodiesel–diesel blend using response surface methodology. In this experiment injection pressure, injection timing and nozzle tip protrusion were on the performance and emission characteristics of a twin cylinder water cooled naturally aspirated CIDI engine. Biodiesel, derived from pongamia seeds through transesterification process, blended with diesel was used as fuel in this work. The results depicted that the BSEC, CO, HC and smoke opacity were lesser, and BTE and $NO_x$ were higher at 2.5 mm nozzle tip protrusion, 225 bar of injection pressure and at $30^0$BTDC of injection timing. An injection pressure of 225 bar, injection timing of $21^0$ BTDC and 2.5 mm nozzle tip protrusion were found to be optimal values for the pongamia biodiesel blended diesel fuel operation in the test engine of 7.5 kW at 1500 rpm.

*C.* Papers based on experiment the performance of engine as bio diesel oil blends diesel fuel

Dharmendra Yadav et al.(2012) [10], had measured the performance of the parameters of single cylinder four stroke

 

DI diesel engine operating on Neem oil biodiesel and its blends. The main objective of this study is to investigate the performance of Neem oil methyl ester on a single cylinder, four stroke, direct injection, and 8 HP capacity diesel engine. The Experimental research has been performed to analyze the performance of different blends 20% (BD20), 50% (BD50), and 100% (BD100) of Neem oil biodiesel. It is investigated that the Neem oil biodiesel 20% blend showed very close performance when compared to plain diesel and hence can be used as an alternative fuel for conventional diesel in the future.

S. Jindal (2010) [11], found Effect of engine parameters on NOx emissions with Jatropha biodiesel as fuel. He experimented that lower blends of biodiesel and diesel works well in the existing engines without any modifications. Use of the higher blends is restricted due to loss of efficiency and long term problems in the engine. For using higher blends of biodiesel, the engine operating parameters must be changed for recovery of power and efficiency. But these changes may affect the emissions.

K.V.Radha (2011) [12], have experimentally investigated the properties of Neem oil and found that ester of this oil can be used as environment friendly alternative fuel for diesel engine creating a greener environment in the future. Neem (Azadirachta indica) belonging to Meliaceae family is one of the most suitable and valuable tree species found in India. It can grow on wide range of soils up to pH 10 which makes it one of the most versatile and important trees in Indian sub-continent. Due to its multifarious uses, it has been cultivated by Indian farmers since vedic period and it has now become part of Indian culture. In India, it occurs throughout the country and can grow well in every agro-climatic zone except in high and cold regions and dam sites. In fact in India, Neem trees are often found growing scattered in the farmers' fields and on the boundaries of fields without affecting the crops.

## III. Conclusions

So many researchers have worked on improving the performance of the diesel engine when they used bio diesel oil as alternative fuel without modification of engine. they concluded that the performance of engine was decreases because of viscosity and density of bio diesel oil which is higher than diesel fuel so not properly atomization of fuel which was affect the performance because performance is mostly dependent on fuel atomization and complete burn of fuel mixture after that they focused on different fuel injection parameters like compression ratio, injection pressure, spray cone angle, nozzle geometry, spray tip penetration, injection timing, temperature, and droplet size which are improved the performance of the engine as bio diesel oil fuel.

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