**EFFECT OF INJECTOR OPENING PRESSURE ON THE PERFORMANCE AND EMISSION CHARACTERISTICS OF DI DIESEL ENGINE RUNNING ON HONNE OIL AND DIESEL FUEL BLEND**

**S.Venkateswarlu1\*, Dr.G.Prasanthi2, Dr.M.Yohan3**

1 Lecturer, Mechanical Engineering Department, JNTUA College of Engineering, Ananthapuramu, Andhra Pradesh, India.

2Professor,Mechanical Engineering Department, JNTUA College of Engineering, Ananthapuramu, Andhra Pradesh, India.

3Professor,Mechanical Engineering Department, JNTUA College of Engineering, Ananthapuramu, Andhra Pradesh, India.

**ABSTRACT**

*Due to the increasing demand for fossil fuels and environmental threat, a number of renewable sources of energy have been studied worldwide. An attempt is made to assess the suitability of vegetable oil for diesel engine operation, without any modifications in its existing construction.*

*One of the important factors which influence the performance and emission of diesel engine is fuel injection pressure. In the present investigation is carried out in a constant speed, DI diesel engine with variable fuel injection pressure from 180bar to 220bar (In steps of 20 bar). The main objective of this work is to investigate the effect of injection pressures on a blend of 50% honne oil with 50% diesel fuel and compare with diesel on performance and emissions characteristics of the engine. The performance tests are conducted at 1500 rpm with loading of 20,40,60,80, and 100 percent of maximum load.*

***Keywords:* D.I.Diesel Engine, Performance, Emissions.**

**1. INTRODUCTION**

In the present situation there is an absolute scarcity of fuel. Hence popularizing the slogans such as “Save Oil”, introducing new fuel saving vehicles, etc. It is necessary to introduce alternate fuel to replace the existing fossil fuels as it has been predicted by experts that the existing resources of the fossil fuels will be exhausted in another 50 years. As the situation is deteriorating day-by-day especially in developing countries like India, and have to think of introducing alternate fuels. Apart from the scarcity, the cost also is increased at regular intervals. Depending on this, country’s economy is also affected. Continuous search for the alternate fuels has lead researchers to several areas. They are alcohols, H2, LPG, CNG, Biogas, Vegetable oils, etc. Out of these, Vegetable oils are becoming popular worldwide because it is renewable and they can be produced easily as the technology for extraction is well known. Alternate fuels which are extracted from Vegetable oils will positively reduce the usage of fossil fuels. There are various types of vegetable oils that can be used as alternate fuels. The different vegetable oils are: Jatropha oil, Cotton seed oil, Pine oil, Rubber seed oil, Rape seed oil, Rice bran oil, Honne oil, Orange peel oil. Out of these different vegetable oils, Honne oil is most important. Because the Calorific value of the Honne oil is almost equal to the calorific value of the Diesel. As Honne trees are available in abundance in India, one can easily extract oil from its seeds which can be successfully used as an alternate fuel to meet the requirements of fuel at the most economical rate. The oil extracted from Honne tree can be blended with Diesel and used in Diesel Engine. Several researchers have taken efforts to adopt suitable methods of using Honne oil which exhibits improved performance and reduced emissions.

**2. PROPERTIES OF HONNE OIL**

The Honne oil is extracted from the seed of the honne tree. The properties are shown in Table 1.

Table 1 Properties of hone oil

|  |  |  |
| --- | --- | --- |
| Properties | Diesel | Honne oil |
| Calorific Value(kj/kg) | 43000 | 39100 |
| Density at 150C(kg/m3) | 850 | 910 |
| Flash point (0C) | 52 | 224 |
| Kinematic viscosity at  40 0C  (CST) | 4.59 | 3.47 |

**3. SPECIFICATIONS OF DIESEL ENGINE**

The engine which is supplied by New Kirloskar Company the engine is single cylinder vertical type four stroke, water-coo1ed, and compression ignition engine. The engine is self-governed type whose specifications are given in Table 2 is used in the present work.

Table 2 Engine specifications

|  |  |
| --- | --- |
| **Item** | **Specification** |
| Engine | Kirloskar Engine, 4 stroke-stationary. |
| Type | water-cooled |
| Injection | direct injection (DI) |
| Maximum speed | 1500rpm |
| Number of Cylinder | One |
| Bore | 85 mm |
| Stroke | 110 mm |
| Compression Ratio | 16.5:1 |
| Maximum HP | 5 HP |
| Injection timing | 250 before TDC |
| Injection pressure | 200 bar |

**4. EXPERIMENTAL SET UP:**

The experimental set up consists of engine, an alternator, top load system, fuel tank along with immersion heater, exhaust gas measuring digital device and manometer

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Fig 1Experimental set up



2. Line diagram of experimental setup

**3.4 VARIOUS PARTS OF EXPERMENTAL SETUP:**

1. ANIL ENGINE 2. ALTERNATOR 3. DIESEL TANK 4. AIR FILTER 5. THREE WAY VALVE

6. EXHAUST PIPE 7. PROBE 8. EXHAUST GAS ANALYSER 9. ALTERNATIVE FUEL TANK

10. BURETTE 11. THREE WAY VALVE 12. CONTROL PANEL

**5. Experimental Procedure**

Before starting the engine, the fuel injector is separated from the fuel system. it is clamped on the fuel injection pressure tested and operates the tester pump. Observe the pressure reading from the dial. At which the injector starts spraying. In order to achieve the required pressure by adjusting the screw provided at the top of the injector .This procedure is repeated for obtaining the various required pressures.

As first said, diesel alone is allowed to run the engine for about 30 min, so that it gets warmed up and steady running conditions are attained. Before starting the engine, the lubricating oil level in the engine is checked and it is also ensured that all moving and rotating parts are lubricated

**6. RESULTS AND DISCUSSION**

Based on the experimental data the graphs are drawn. These graphs show the variation in brake thermal efficiency, Brake specific fuel consumption (BSFC), Hydrocarbon (HC), Carbon monoxide (CO), Nitrogen oxides Carbon dioxide(CO2) emissions at various injection pressures.

**6.1 SPECIFIC FUEL CONSUMPTION**

From Figure 3 it may be observed that as injection pressure increases brake specific fuel consumption decreases. The injector was set for different opening pressures namely 180 bar, 200 bar and 220 bar and the engine was tested. A glance on the figure reveals that BSFC decreases with increase in injection pressure and at 180 , 200 and 220 bar Honne oil- Diesel blend shows the decrease in BSFC. This may be due to good atomization at higher injection pressure which helps in faster rate of heat release.

Fig 3 Specific fuel consumption (Diesel) Vs Load

**6.2 BRAKE THERMAL EFFICIENCY**

The variation of brake thermal efficiency with respect to load for Honne oil-Diesel blends at various pressures is shown in fig4. For all the readings of diesel fuels and blends at various injection pressures the brake thermal efficiency increases with respect to various loads. The brake thermal efficiency values at full load are 17.63% , 18.05% and 18.27% for B50 at 180 , 200 and 220 bar. The brake thermal efficiency values at full load are of 15.17% ,15.51% and 15.76% for Diesel at 180, 200 and 220 bar are decrease to the brake thermal efficiencies of diesel at various loads.

Fig 4 Brake thermal efficiency (Diesel) Vs Load

**6.3 HYDROCARBON EMISSION**

Figure 5. shows the variation of hydrocarbon (HC) emission with fuel injection pressure for diesel mode and B50 mode at full load condition. It may be observed from the figure that HC emission for B50 mode of operation is lesser compared to diesel mode of operation at all fuel injection pressure conditions considered. This may be due to the charge in temperature, change in properties of the fuel, air-fuel ratio.

Fig 5 Hydro carbon (Diesel) Vs Load

**6.4 CARBON MONOXIDE**

Figure 6 shows the variation of carbon monoxide (CO) emission with fuel injection pressure for diesel mode, and B50 at full load condition. It may be observed from the figure that CO emission for diesel mode of operation is lesser compared to B50 mode at all fuel injection pressure conditions considered because of the Honne oil blend to the engine reduces the amount of oxygen required for complete combustion. This creates incomplete combustion and increase in the CO emissions

Fig 6 Carbon monoxide (Diesel) Vs Load

**6.5 Carbon dioxide**

From figure 7 it can be observed that the variation of carbon dioxide emission with load for diesel and B50 operation. From the results, it is observed that the amount of CO2 produced while using B50 blend is higher than diesel at all load conditions. Carbon dioxide is a desirable byproduct that is produced when the carbon from the fuel is fully oxidized during the combustion process. As a general rule, the higher the carbon dioxide reading, the more efficient the engine is operating

Fig 7 Carbon dioxide (Diesel) Vs Load

**7. CONCLUSION**

The engine was made to run on diesel fuel mode, and honne oil- diesel mode. The experiments were conducted at 3 different fuel injection pressures of 180 bar, 200 bar and 220 bar. The performance and emission of the engine at full load were investigated. The following results were obtained.

The engine was able to run on 180 bar, 200 bar and 220 bar fuel injection pressures on diesel fuel mode and honne oil- diesel mode.

* Brake specific fuel consumption for the honne oil-diesel blend when lower than the BSFC with 0.522 kg/kWhr at 180 bar, 0.510 kg/kWhr at 200 bar and 0.503 kg/kWhr at 220 bar .
* The brake thermal efficiency of the engine for honne oil- diesel blend of operations is high compared to diesel mode at 180,200 and 220 bar.
* The exhaust gas temperature of honne oil-diesel mode is less compared to diesel mode at fuel injection pressures of 180,200 and 220 bar.
* CO emission of honne oil-diesel mode is higher compared to that of diesel fuel mode at all fuel injection pressures.
* CO2 emission increased up to the fuel injection pressure of 200 bar for honne oil- diesel mode and then decreased slightly at 220 bar injection pressure.
* CO emission decreased with increase in fuel injection pressure from 180 bar to 220 bar for fossil diesel mode of operation.
* HC emission of honne oil-diesel operation is less than the diesel fuel mode at 180 bar fuel injection pressure.

From the above analysis the main conclusion is honne oil blend are suitable substitute for diesel at high injection pressure, at produce lesser emission and better performance then diesel.

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