International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 11 | Nov 2019 www.irjet.net p-ISSN: 2395-0072

EFFECT OF INJECTION PRESSURE ON THE PERFORMANCE AND EMISSION CHARACTERISTICS OF DI DIESEL ENGINE USING HONNE OIL BLENDS AS AN ALTERNATIVE FUEL

Bhoomireddy Supraja[1], Dr.K.Govindarajulu[2]

[1]*PG Scholar, Dept. of Mechanical Engineering, JNTUACEA, A.P, India*
[2]*Professor, Dept. of Mechanical Engineering, JNTUACEA, A.P, India*

***

Abstract - *The world's fossil fuels are depleting at higher pace due to exponential growth of population. In recent days, Biodiesel is so extensively considered as an alternative fuel in diesel engine which constitutes a major role in transportation. In this present work, experimental study was carried out using various blends of Honne oil (B5, B10, B15, B20, B25 and B30) and diesel in a single cylinder, 4-stroke water cooled DI diesel engine at various injection pressures 180,190,200 bars. It was found that blend B20 (20% Honne oil by volume in diesel) has the thermal efficiency nearer to that of diesel. So the tests were carried out for pure diesel and blend of 20% Honne oil by volume in diesel at constant speed with varied loads at all the injection pressures (180,190,200). The Brake thermal efficiency of the blend B20 is less than the diesel at 180 bar, 190bar and higher than the diesel at 200 bar. The emissions UHC and CO_2 of the blend B20 and the diesel are below BS-IV values at all the loads and injection pressures. The CO emissions of the blend B20 are below the BS-IV value at all the loads and injection pressures and the CO emissions of diesel are below the BS-IV value at all the loads (except at the initial loads starting from zero to 3Kgs)and at all the injection pressures. The NO_X emissions of the blend B20 and diesel are above the BS-IV value.*

Key Words: Bio-diesel, Honne oil, Varying Injection Pressure, Performance and Emission characteristics.

1. INTRODUCTION

An engine which is used to convert heat into work is called heat engine. In this heat is low grade energy and work is high grade energy. Heat engines are either external combustion engines or internal combustion engines .The internal combustion engines are having higher efficiency than the external combustion engines and emits fewer pollutants in this diesel used as a fuel .The main idea of alternative fuels is good reserves in the sector of transportation because they will not only assist to the environment quality but also has distinct positive socioeconomic results. From last century, many number of scientists had suggested that the bio-fuels are good alternatives to fossil fuels. In present research we will introduce Honne oil as an alternative fuel.In present day's major pollutants from automobiles are Carbon monoxide (CO), unburned hydrocarbons (UHC), oxides of Nitrogen (NO_X), sulphur compounds, lead compounds and particulates .In India highest number of vehicles are 2-stroke two wheeler engines .In many countries these vehicles are banned because they emit large number of pollutants.

In present diesel engines, the fuel injectors are designed to maintain very higher injection pressures in order to acquire better performance results .The main intention of this design is to decrease the exhaust emissions and increase the efficiency of the engine .The fuel injection pressure is inversely proportional to the droplet size of the fuel. When the fuel droplets diameter increases at lower injection pressures then the ignition delay period increases during combustion. This further leads to increase in the injection pressure. Engine performance will be reduced since combustion goes to poor condition. When the injection pressure is increased the fuel particle size is decreased. The air and fuel mixture formation becomes better from that complete combustion was done in the cylinder during the period of ignition. When the injection pressure is high the ignition delay period is shorter. The homogeneous mixture leads to increase in combustion efficiency.

1.1 Injection Pressure Variation

To acquire high degree of fuel atomization in the injection system, high injection pressure is needed for the purpose of sufficient evaporation of fuel in very short time.From that the fuel particles acquire better spray penetration so that it can easily exploit the fuel air charge inside the cylinder.The desired amount of fuel should be measured by injection system of fuel, depending upon engine load and speed, and inject the fuel at desired rate in correct time. The appropriate shape and size of fuel particle obtained depends on the particular combustion chamber. Generally a supply pump withdraws the fuel from the fuel tank and carries it to the fuel injector via filter. In present experimental study the fuel injection pressure varied from 180 to 200 bars.The injection pressure is varied by tightening or loosening the screw provided on the top of the injector .For the measurement of injection pressure on fuel injector system, a fuel injector pressure tester is used.

2. EXPERIMENTAL SETUP

The engine used for experimentation is Kirloskar make single cylinder, four stroke ,water cooled diesel engine coupled to eddy current dynamometer with all necessary instrumentation as shown in fig.1.The specifications of the engine is shown in table 1.

Table -1: Engine Specifications

Make	Kirloskar
Type	Single cylinder, four stroke, water cooled
Capacity	5HP
Bore diameter	80mm
Stroke length	110mm
Connecting rod length	234mm
Orifice diameter	20mm
Compression Ratio	16.5:1

FIG.1 SINGLE CYLINDER, FOUR STROKE DIESEL ENGINE TEST RIG

In present research experimental tests were carried out on 4-stroke single cylinder diesel engine using different proportions of Honne oil with diesel at different injection pressures usually 180,190,200 bars. The injection pressure of the fuel is one of the main characteristics which affect the performance as well as emission characteristics of a diesel engine. It was found that blend B20 has the brake thermal efficiency nearer to that of diesel so the tests were carried out for pure diesel and blend of 20% Honne oil by volume in diesel by varying loads at different injection pressures. Emission test was done using AVL DIGAS-444 five gas analyser.

Fig.2. AVL DIGAS-444 five gas analyser

3. RESULTS AND DISCUSSIONS

3.1 PERFORMANCE PARAMETERS:

A.BRAKE THERMAL EFFICIENCY:

Fig.3 shows the variation of brake thermal efficiency with load for various blends and diesel. It is clearly seen in the figure that the the brake thermal efficiency of the blends and diesel increases with increase of load .The brake thermal efficiency of all the blends is less than the diesel but the blend B20 is close to diesel at all the loads.

Fig.4 shows the variation of brake thermal efficiency with load at varied injection pressures like 180,190,200bars when diesel and the blend B20 are used. It can be seen in the figure that the brake thermal efficiency of the blend B20 and diesel increases with increase of load at all injection pressures. A higher brake thermal efficiency is obtained for the blend B20 at 200bar compared to diesel only at 60 and 80% of full load.

Fig.5 shows the variation of brake thermal efficiency with load at varied injection pressures like 200,210 bar when diesel and the blend B20 are used. The brake thermal efficiency of the blend B20 and diesel increases with increase of load at injection pressures 200,210bar.A higher brake thermal efficiency is obtained for the blend B20 at 210bar at all the loads starting from 20% of full load but significant knocking is observed which lead to the termination of further experimentation. Thus observations of blend B20 at 210bar are not shown in results.

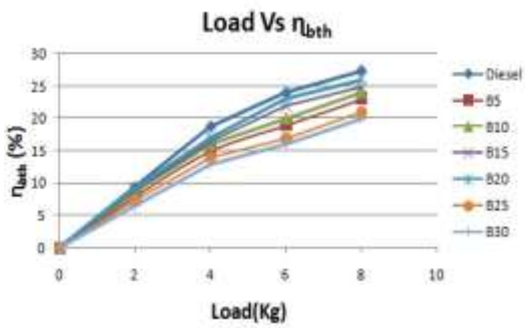

Fig.3 Comparision of Brake Thermal Efficiency for various blends

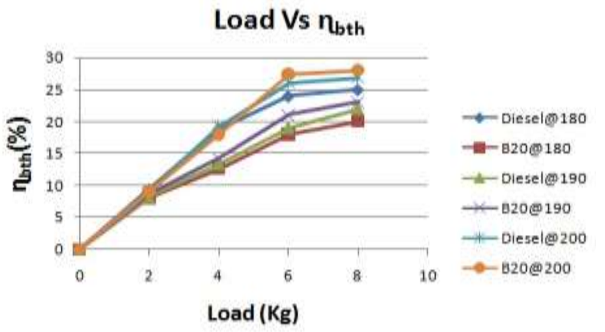

Fig.4 Comparision of brake thermal efficiency for different injection pressures (180,190,200bar)

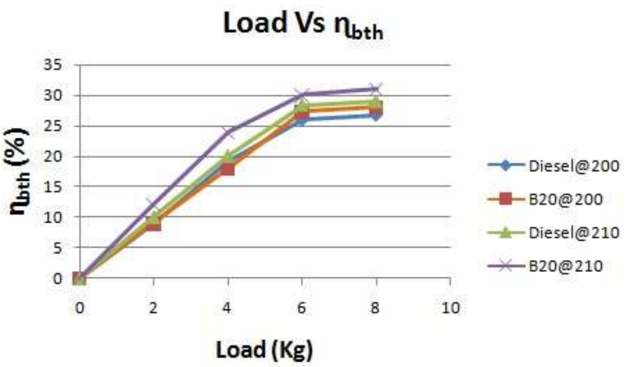

Fig.5 Comparision of brake thermal efficiency for different injection pressures (200,210bar)

B.BRAKE SPECIFIC FUEL CONSUMPTION:

Fig.6 shows the variation of Brake Specific Fuel Consumption with load for the blend B20 and diesel at injection pressures like 180,190,200bars. It can be seen in the figure that the BSFC of blend B20 and diesel decreases upto a load of 6Kg and thereafter increases at all the injection pressures. The BSFC of the blend B20 is higher than the diesel at injection pressures 180,190bar and less than the diesel at 200bar. From the graph it is clearly seen that the blend B20 at 200bar has lowest BSFC value at all the loads and injection pressures.

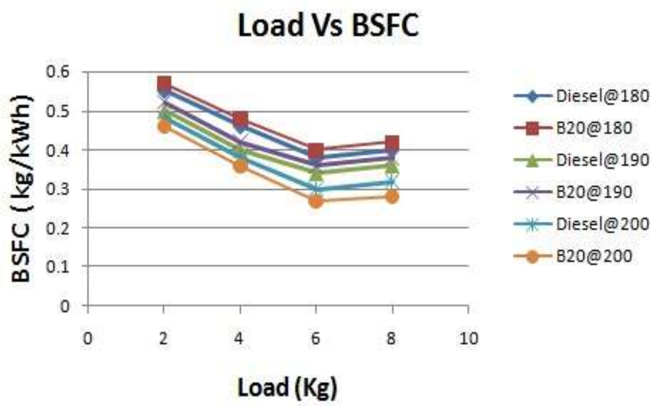

Fig.6 Comparision of Brake Specific Fuel Consumption

3.2 EMISSION PARAMETERS:

i) UNBURNED HYDROCARBON EMISSIONS:

The variation of unburned hydrocarbon emissions with load at three different injection pressures for diesel and blend B20 is shown in Fig.7.It is clearly seen in the figure that the unburned hydrocarbon emissions of the blend B20 and diesel decreases with increase of load at all the injection pressures and these emissions are below the BS-IV value. The UHC emission of the blend B20 is less than the diesel at all the loads and injection pressures. From the figure it can be seen clearly that the blend B20 has least unburned hydrocarbon emissions at an injection pressure of 200bar.

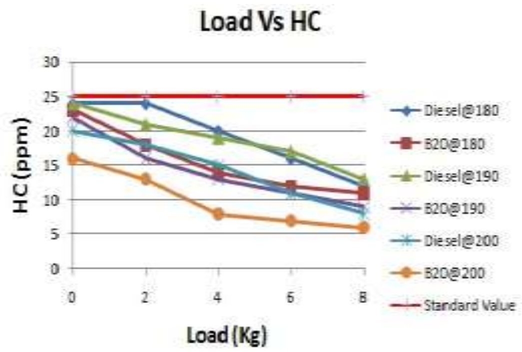

Fig.7 Comparision of HC emissions

ii) CARBON MONOXIDE (CO) EMISSIONS:

The variation of CO emissions with load at different injection pressures for pure diesel and blend B20 is shown in Fig.8.The CO emissions of the blend B20 and diesel decreases with increase of load at all the injection pressures. The CO emission of diesel is higher than the BS-IV value from zero to 2.6Kgs of load at 180bar, zero to 3.7Kgs of load at 190bar, zero to 3Kgs of load at 200bar and lower than the BS-IV value beyond a load of 2.6Kgs, 3.7Kgs, 3Kgs of load at 180,190,200bar .The CO emissions of the blend B20 is less than the BS-IV value at all the loads and injection pressures. It can be seen clearly from the graph that the blend B20 has lowest CO emissions at all the loads and at an injection pressure of 200bar.

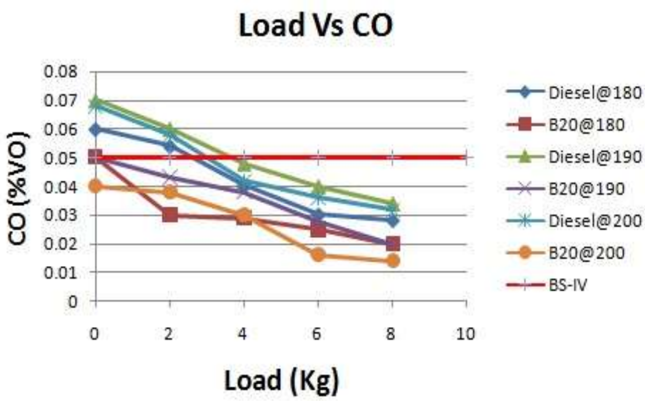

Fig.8 Comparision of CO emissions

iii) Carbon dioxide (CO_2) Emissions:

The variation of CO_2 emissions with load at different injection pressures for diesel and blend B20 is shown in Fig.9.The CO_2 emissions are increased by increasing load for diesel and blend B20 at all the injection pressures and these emissions are below the BS-IV value. From the graph lower CO_2 emissions are obtained for the blend B20 than diesel at all the injection pressures. It is seen from the graph that the blend B20 has lowest CO_2 emissions at 200bar injection pressure.

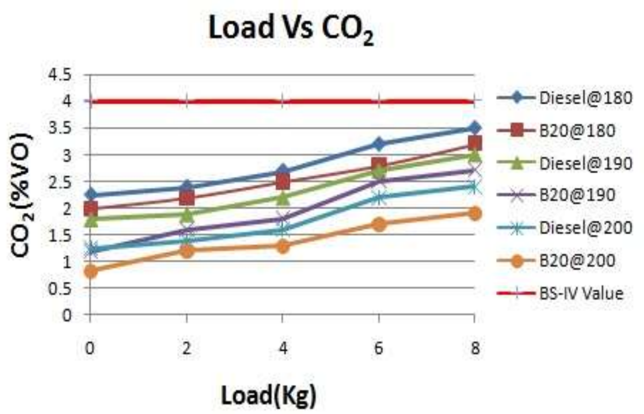

Fig.9 Comparision of CO_2 emissions

iv) OXIDES OF NITROGEN (NO_X) EMISSIONS:

Fig.10 shows NO_X variation with increasing load at all pressures for B20 blend and diesel. It can be seen clearly in the figure that the NO_X emissions are increased with increasing load for all the injection pressures. It can be observed from the figure that the NO_X emissions for pure diesel will be beyond the BS-IV value after a load of 3.8 Kg at 180bar, 4.2 Kg at 190bar, 4.9 Kg at 200 bar and the NO_X emissions for the blend B20 will be beyond the BS-IV value after a load of 3.8 Kg at 180bar, 5.8 Kg at 190bar, 6.7 Kg at 200bar.From the graph it is clearly seen that the blend B20 at 200bar has lowest NO_X emissions.

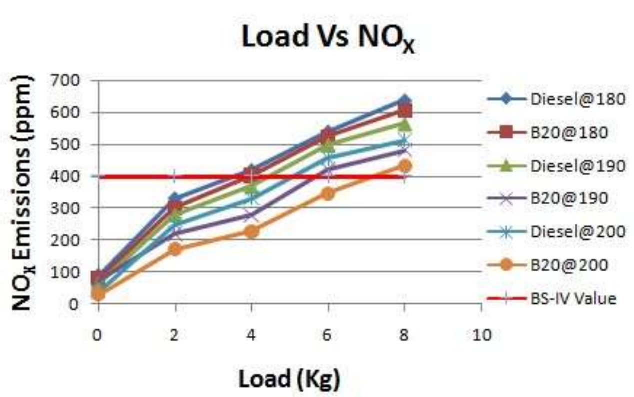

Fig.10 Comparision of NO_X Emissions

4. CONCLUSIONS:

From the experimental study following conclusions were drawn:

1) The brake thermal efficiency of biodiesel is very close to diesel at 200bar. However at 60 and 80% of full load brake thermal efficiency is higher for biodiesel than diesel at 200bar.

2) The Brake Specific Fuel consumption is high for Honne oil blend and diesel mode. As the injection pressure increased the BSFC is decreased. The blend B20 has lowest BSFC at 60% of load and at an injection pressure of 200bar.

3) CO and CO_2 emissions are low for B20 at 200bar and are below BS-IV values.

4) The NO_X emissions are low for B20 than diesel at all the loads and injection pressures.

5) The UHC emissions of the blend B20 is less than the diesel at all loads and injection pressures.

6) The UHC emissions of the blend B20 and diesel are below the BS-IV value.

Based on the experimental investigation it can be concluded that blend B20 (20%Honne oil by volume in diesel) at 200bar can be adopted as an alternative fuel for existing conventional engine without any major modification required in the system hardware.

ACKNOWLEDGEMENT:

I would like to express gratitude and thank profusely my guide Dr.K.GOVINDARAJULU, Professor, Department of Mechanical Engineering for his valuable guidance and suggestions.

REFERENCES:

[1] Prabhu and Anand,Production and application of biodiesel-A case study, International Journal of engineering Research and Development, ISSN:2278-067,Issue2,July2012,pp.28-41.

[2] Chavan S.B., Kumbhar R.R. and Deshmukh R.B., Calophyllum Inophyllum Linn ("Honne") oil-A source for biodiesel production, Research Journal of Chemical Sciences, Vol.3 (11).

[3] B.K.Venkanna, C.Venkataramana Reddy,An experimental investigation on the performance ,emission and combustion characteristics of preheated calophyllum inophyllum linn oil(Honne oil) fed diesel engine, International Journal of Energy Technology and Policy,2013 Vol.9,No.1,pp.1-14.

[4] T .Vasantha, MLS Devkumar, Performance and emission characteristics of diesel engine fuelled with cashew nut shell biodiesel by varying injection pressure, JNTUCEA, 2015.

[5] Kannan GR, Anand R, Effect of injection pressure and injection timing on DI diesel engine fuelled with biodiesel from waste cooking oil, Biomass Bioenergy 2012.

[6] SayinC, Gumus M, Canakci M., Effect of fuel injection pressure on the injection ,combustion and performance characteristics of a DI diesel engine fuelled with canola oil methyl esters-diesel fuel blends, Biomass Bioenergy 2012.

[7] Puhan S,Jegan R,Balasubramanian K,Nagarjuna G., Effect of injection pressure on performance ,emission and combustion characteristics of high linolenic linseed oil methyl ester in a DI diesel engine. Renewable energy 2009, 34:1227-33.

[8] B.K.Venkanna, C.Venkataramana Reddy, Influence of injector opening pressure on the performance ,emission and combustion characteristics of DI diesel engine running on calophyllum inophyllum Linn oil(Honne oil);International Journal of Renewable energy,Vol.6,No.1,January-June 2011.

BIOGRAPHIES

B.SUPRAJA
PG Scholar in Adv. I.C. Engines,
Dept. of Mechanical Engineering,
JNTUACEA, Anantapur, A.P,
India.

Dr. K. GOVINDARAJULU
M.Tech, Ph.D (IITR) Officer on Special duty & Professor of Mechanical Engineering, JNTUACEA, Anantapur, A.P, India.
Number of Research Publications:
International Journals : 62
National Journals : 4
International Conferences : 19
National Conferences : 20