Studies on Performance of Honge Biodiesel Fuelled Ci Engine By Varying Injection Pressure And Number Of Injector Holes

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ABSTRACT- Considering the fast depletion of 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, with small modifications in engine by varying the injection pressure and nozzle. Injector opening pressure has an effect on the spray formation , increase in the injection pressure leads to better atomization in turn better and complete combustion. The number of holes of the fuel injector nozzle plays a vital role controlling diesel spray atomization and combustion. increase in the number of holes ,the exposure of fuel and air increases which leads to better fuel atomization, faster evaporation and better mixing. Increasing the injection pressure (180,200 and 220 bar) and increasing the number of injector nozzle holes improves the performance of CI diesel engine fuelled with Honge biodiesel in terms of increased Brake thermal efficiency(BTE). From the analysis we got the better efficiency at B20 4 hole, 220 bars injection pressure.

Index Terms—Biodiesel, injector nozzles, honge, brake thermal efficiency, brake power

INTRODUCTION:

The world is presently confronted with the twin crises of fossil fuel depletion and environmental degradation. Indiscriminate extraction and lavish consumption of fossil fuels have led to reduction in underground-based carbon resources. 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. The vegetable oils and their esters are the most suited substitute fuels for diesel engine applications as they have lower emission levels with comparable thermal efficiency. However, the atomization of biodiesel is poor due to its higher viscosity (almost twice the diesel). Biodiesels can replace diesel fuel completely however it being less volatile needs to be blended with other low viscosity fuels such as diesel or ethanol to get better performance. Modern diesel engines use micro-orifices having various orifice designs and affect engine performance to a great extent. Effects of dynamic factors on injector flow, spray combustion and emissions have been investigated by various researchers. The geometry of the nozzle in an injector plays a vital role in controlling diesel spray atomization and combustion. In order to bring fuel droplet size small, the nozzle-hole size is required to be reduced to produce smaller droplets. By decreasing the nozzle hole size, the spray tip penetration is reduced due to the low spray momentum. High injection pressures with small nozzles are common in the modern diesel engine as they reduce injection duration and improve combustion efficiency.

METHODOLODY:

- Tests are conducted to evaluate the performance on single cylinder, 4 stroke, water cooled CI engine test rig.
- Experiments are conducted using D100 as reference fuel with 180bar injection pressure with 3 hole nozzle at different loads of no load condition, 20% of full load, 40% of full load, 60% of full load, 80% of full load and full load, at same compression ratio and at constant speed of 1500rpm .

- Comparative study is done using B20, B100 Biodiesel as fuel for 3,4 and 5 injector holes at 3 different injection pressure of 180, 200 and 220 bar at different loads of no load condition, 20% of full load, 40% of full load, 60% of full load, 80% of full load and full load, at same compression ratio and at constant speed of 1500rpm.
- Plot the graph of Brake power V/S Brake thermal efficiency.
- To analyze graph to understand the effect of pressure and different number of holes on CI engine

EXPERIMENTAL PROCEDURE:

The engine tests were performed on a single cylinder four stroke air cooled CI engine.

- The experiments are carried out taking the diesel as reference fuel for 3 holes, 180 bar injection pressure at constant speed of 1500 rpm and for different loads of no load condition,20% of full load,40% of full load,60% of full load,80% of full load and full load condition.
- The experiments are repeated for 3 different injection pressure (180 bar, 200 bars and 220bar)
- The experiment are carried out on B100 and B20 pongamia bio diesel for,
- For 180 bar injection pressure 3 holes, 4 holes and 5 holes at different loads of no load condition, 20% of full load, 40% of full load, 60% of full load, 80% of full load and full load.
- For 200 bar injection pressure 3 holes, 4 holes and 5 holes at different loads of no load condition, 20% of full load, 40% of full load, 60% of full load, 80% of full load and full load.
- For 220 bar injection pressure 3 holes, 4 holes and 5 holes at different loads of no load condition, 20% of full load, 40% of full load, 60% of full load, 80% of full load and full load.

RESULTS AND DISCUSSION:

This section explains the performance behaviour of diesel engine using B20 and B100 Honge biodiesel.

BRAKE THERMAL EFFICIENCY

a) **Brake thermal efficiency for injection pressure of 180 bar:** Figure 1 shows the variation of Brake power(BP) versus brake thermal efficiency(BTE), whose respective values are tabulated in table1.the tabulation contains the value of BTE and BP of diesel, B20-3hole, B20-4holes,B20-5holes,B100-3holes, B100-4holes,B100-5holes for 180 bar pressure. From the analysis it is cleared that B20-4 holes gives better

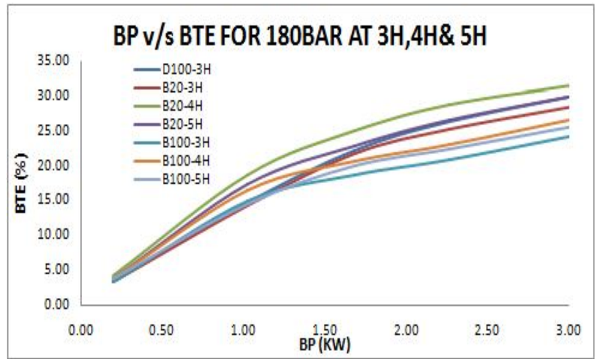

Figure .1: Variation of BP v/s BTE for various fuel blends and number of holes for 180 bar injection pressure.

Table .1: Table of results for BP V/S BTE for 180 bar injection pressure.

BP in KW	D100 -3H	B20-3H	B20-4H	B20-5H	B100 -3H	B100 -4H	B100 -5H
0.19	3.36	3.27	4.12	3.84	3.33	3.66	3.67
1.02	14.63	14.22	18.75	17.34	14.91	16.41	14.41
1.68	22.23	21.81	24.95	22.90	18.75	20.63	19.94
2.26	26.28	25.30	28.82	26.57	20.91	23.00	22.46
3.14	30.52	29.06	31.98	30.51	24.74	27.22	26.16

b) **Brake thermal efficiency for injection pressure of 200 bar:** Figure .2 shows the variation of Brake power(BP) versus brake thermal efficiency(BTE), whose respective values are tabulated in table2.The tabulation contains the value of BTE and BP of diesel, B20-3hole, B20-4holes,B20-5holes,B100-3holes, B100-4holes,B100-5holes for 200 bar pressure. From the analysis it is cleared that B20-4 holes gives better thermal efficiency.

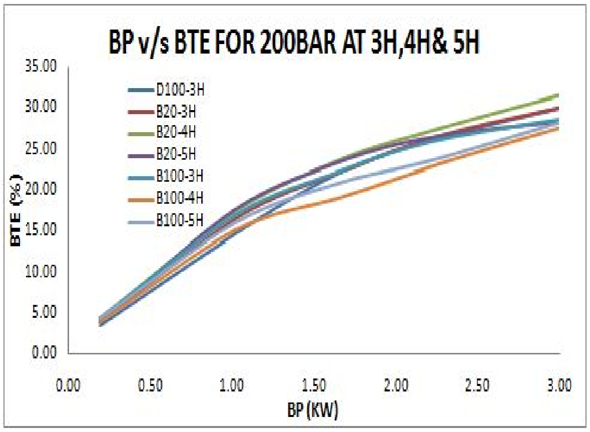

Figure 2: Variation of BP v/s BTE for various fuel blends and number of holes for 200bar injection pressure.

Table 2: Table of results for BP V/S BTE for 200 bar injection pressure

BP	D100-3H	B20-3H	B20-4H	B20-5H	B100-3H	B100-4H	B100-5H
0.19	3.36	3.86	4.31	3.89	4.43	3.98	4.43
1.02	14.63	16.48	17.44	17.64	17.01	15.14	15.90
1.68	22.23	22.27	23.80	23.58	22.42	19.18	20.94
2.26	26.28	26.56	27.49	26.62	26.04	23.19	23.87
3.14	30.52	30.49	32.42	28.58	29.10	28.34	28.96

c) **Brake thermal efficiency for injection pressure of 220 bar:** Figure 3 shows the variation of Brake power(BP) versus brake thermal efficiency(BTE), whose respective values are tabulated in table.3 the tabulation contains the value of BTE and BP of diesel, B20-3hole, B20-4holes,B20-5holes,B100-3holes, B100-4holes,B100-5holes for 220 bar pressure. From the analysis it is cleared that B20-4 holes gives better thermal efficiency.

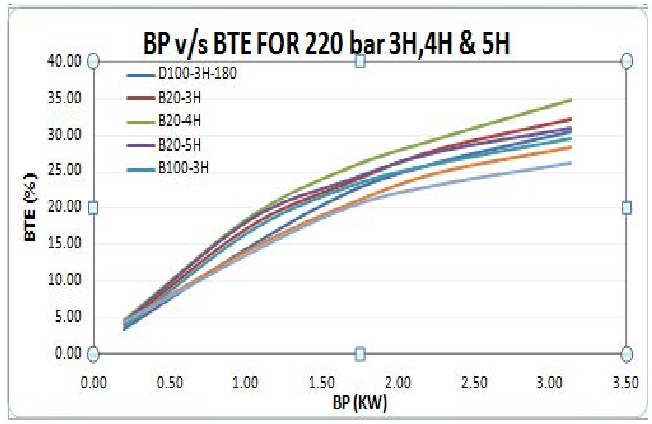

Figure 3: Variation of BP v/s BTE for various fuel blends and number of holes for 220bar injection pressure.

Table .3: Table of results for BP V/S BTE for 220 bar injection pressure.

BP	D100-3H-180	B20-3H	B20-4H	B20-5H	B100-3H	B100-4H	B100-5H
0.19	3.36	4.07	4.62	4.28	3.63	4.26	4.21
1.02	14.63	17.40	18.66	18.30	16.76	14.20	13.60
1.68	22.23	23.50	25.47	23.82	22.97	20.52	20.04
2.26	26.28	28.04	29.42	27.67	26.14	24.81	23.06
3.14	30.52	32.18	34.69	30.93	29.55	28.33	26.06

d) **Comparison of BP v/s BTE for B20-4 holes of 180,200 and 220 bar injection pressure:** Figure .4 shows the variation of Brake power (BP) versus brake thermal efficiency (BTE), whose respective values are tabulated in table 4 the tabulation contains the value of BTE and BP of diesel, B20-4 holes 180 bar, 200 bar and 220 bar injection pressure. After the analysis it is cleared that B20-4 holes 220 bar injection pressure gives better brake thermal efficiency.

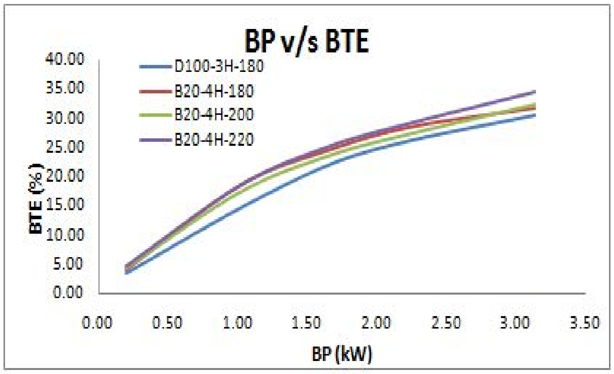

Figure 4: Variation of BP v/s BTE for B20-4 holes of 180,200 and 220 bar injection pressure

Table 4: Table of results for B20-4 holes of 180,200 and 220 bar injection pressure

BP	D100-3H-180	B20-4H-180	B20-4H-200	B20-4H-220
0.19	3.36	4.12	4.31	4.62
1.02	14.63	18.75	17.44	18.66
1.68	22.23	24.95	23.80	25.47
2.26	26.28	28.82	27.49	29.42
3.14	30.52	31.98	32.42	34.69

CONCLUSSION:

Based on the investigation conclusions are as follows

- At 180 bar injection pressure brake thermal efficiency of B20, 4 hole nozzle is maximum and B100, 3 hole nozzle is minimum.
- At 200 bar injection pressure brake thermal efficiency of B20, 4 hole nozzle is maximum and B100, 4 hole nozzle is minimum.
- At 220 bar injection pressure brake thermal efficiency of B20, 4 hole is maximum and B100, 5 hole is minimum.
- Over all thermal efficiency is maximum at B20, 4 holes nozzle at 220 bar injection pressure due to the exposure of fuel and air increases which leads to better fuel atomization, faster evaporation and better mixing.

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