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Performance and Emission parameter of Agriculture Diesel Engine Fueled with Biodiesel

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Abstract. In the earlier farm equipment made use of human power, animals for fulfilling the power need for farm equipment. However modern agriculture equipment is powered by internal combustion engines.Since1970's all agriculture equipment are compression Ignition engine .Compression ignition engine uses diesel as a fuel to produce power .These power is delivered to load by the help of crankshaft .Most of the energy obtained from diesel is lost before converting to useful work. The diesel used as a fuel for agriculture diesel engine can be alternate with the help of vegetable and animal origin biodiesel .The use of biodiesel helps in reducing in NOx, HC and CO emissions without the power loss. It also helps to reduce wear of engine parts. Therefore, the aim of this study was to quantify the change in torque, power, and emission of agriculture diesel engine fuel using biodiesel.

Keywords: Bio-fuel, exhaust emission, diesel blend, jatropha, soybean**.**

1. Introduction

The country is demonstrated that the growth in agriculture which has helped India to become an independent in food grains by increasing the production of food grains. Application of engineering in agriculture is increasing day by day due to unavailability of labor and time consuming. [2, 1-3] A concept of farm power availability per hector was used to know the level of farm mechanization. The total farm power available in 1951 from and mechanical sources was 0.2 kW/ha and increased up 0.97kw /ha in1997.In 1997 the contribution from mechanical up to 78% from 3.6 %(Table 1). The diesel engine power available (KW/ha) has increased from 0.203 in 1995-96 to0.273 in 2005-06 (table 2). The farm sector therefore, has to absorb more use of engine whose work output can be improved by utilizing, effective fuels as tools. [2, 1-4]

(Table 1) Farm power availability per unit net cropped area

Power	1951-52	19661-62	1971-72	1981-82	1991-92	1996-97
Total farm power MkW	23.54	29.29	44.65	70.26	114.08	138.65
Unit farm power, kW/ha	0.2	0.22	0.32	0.5	0.8	0.97
Tractive over total power,%	0.82	2.38	7.73	17.61	26.75	29.6
Mechanical over total power,%	3.6	8.9	36.9	63.7	76.9	78.0

Note: Human power-0.5 kW, Animal power-0.25 kW per animal, Tractor-22.5 kW, Diesel engine-5.2 kW, Electric motor-3.73 kW.

(Table 2) Population of Power Sources and their power availability in India

Year	Agriculture Workers/Power(kw/ha)	Diesel Engines Power (kw/ha)	Electric Motors Power (kw/ha)
95-96	0.071	0.203	0.196
00-01	0.079	0.238	0.250
05-06	0.087	0.273	0.311

Source 1. Power Availability in Indian Agriculture, 2000, CIAE, Bhopal, India

2. Agricultural Research Data Book 2003, IASRI, New Delhi

Agricultural mechanization uses a small Horse power diesel internal combustion engines, as most of the agriculture operations are carried out in motion such as for harvesters and self-propelled sprinklers .The fuel used for this engine is basically a diesel which

produces harmful emission. Identification of alternative fuels for IC engine is one of the major challenges throughout the globe. Performance test of different alternative fuels such as hydrogen, alcohol, producer gas and verities of edible oil shown better suitability. [4, 2, 3]

Biodiesel are produced from renewable agriculture crops containing vegetable oil which is easily available. Biodiesel such as Jatropha and Soybean lower carbon than diesel fuel hence CO2emission is comparatively lower. Jatropha and soybean biodiesel and its blends helps to reduce NOx and HC emissions without any imperceptible power loss, the increase in fuel consumption and the slight increase in CO2. The jatropha and soybean increases the efficiency, and decrease the particulate matters (CO, HC, etc.) from exhaust gases which are released to environment. Jatropha and soybean are economical and efficient for diesel engine. [9, 2-3]

Nomenclature

HC	hydro carbon
NOx	oxides of Nitrogen
BP	Brake horse power.
BTE	Brake thermal efficiency.
IP	Indicated power
SB40D60CR18EGR	40% soyabean biodiesel ,60%Diesel,with 18 compression and EGR0
JB40D60CR18EGR0	40% jatropha biodiesel ,60%Diesel,with 18 compression and EGR0

2.EXPERIMENTAL DETAILS

The test was performed at APEX innovation PVT.ltd. For four stroke single cylinder diesel engine. The technical specifications were summarized in (Table 3) that employed for testing. Jatropha and soyabean as a blend where used during the experimentation. The experiment was carried out to determine the emission characteristics and performance of a diesel engine fuelled with two types of biodiesel fuel Jatropha and soyabean and compared to diesel fuel. The engine had been equipped with pressure sensor for measuring pressure with respect to crank angle .A eddy current dynamometer was used to change the load. The experiment set up is shown in fig.1

(Table 3) Engine Specification

Make	Kirloskar Oil Engines Ltd
Model	CC418
Type	Single Cylinder Air cooled diesel engine
Power	7.5hp
Rated RPM	3000
Displacement	418
Bore*stroke	86*72
Weight	125kg
Starting	Manual

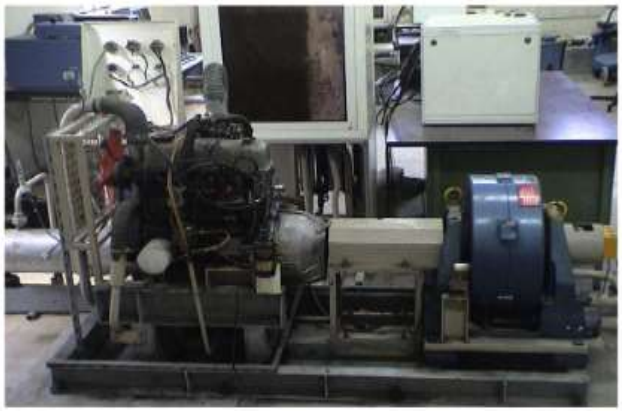

Fig. 1. Experimental Setup

3. RESULTS AND DISCUSSION

The indicated power increases with respect to load as shown in fig.2 Initially the load consider was 0.3 kg and slowly increased up to 12 kg.The indicated power has the same trend according for diesel and SB40D60CR18EGR0. The power increase initially at 0.3 kg was same for diesel, JB40D60CR18EGR0, and SB40D60CR18EGR0 but beyond these engine power of JB40D60CR18EGR0 increases more than the diesel. SB40D60CR18EGR0 is average between diesel and JB40D60CR18EGR0. The reason behind these the mean effective pressure is directly proportional to indicated power.

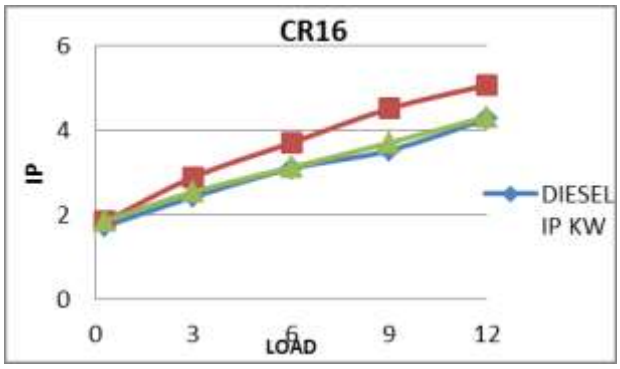

Fig.2Variation of indicated power with respect to load.

The Fig.3 shows load vs. brake power diagram with comparison of diesel SB40D60CR18EGR0 and JB40D60CR18EGR0 blends at 16 compression ratio. Initially the load consider was 0.3 kg and then slowly increased by 12 kg .The trend of the all the three diesel SB40D60CR18EGR0 and JB40D60CR18EGR0 blends where same but JB40D60CR18EGR0 is slightly greater than diesel.

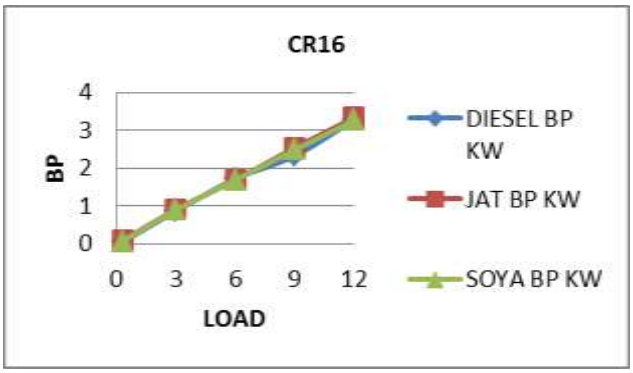

Fig.3Variation of brake power with respect to load.

The variation of brake thermal efficiency of engine when operated with SB40D60CR18EGR0 and JB40D60CR18EGR0 blends with diesel, at 16 compression ratio as shown in below graph (fig.4). It is notice that BTE of diesel is higher than the SB40D60CR18EGR0 and JB40D60CR18EGR0.

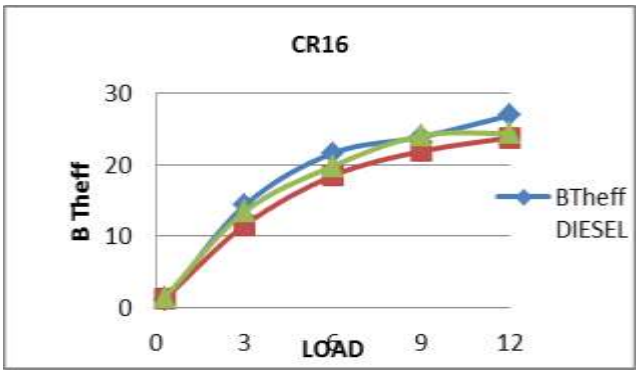

Fig.4Variation of brake thermal efficiency with respect to load

The mechanical efficiency of fuel mixture is plotted in fig.5 It can be seen that mechanical efficiency for diesel are higher than SB40D60CR18EGR0 and JB40D60CR18EGR0. The reason behind decreasing mechanical efficiency is decreasing brake power and increasing indicated power.

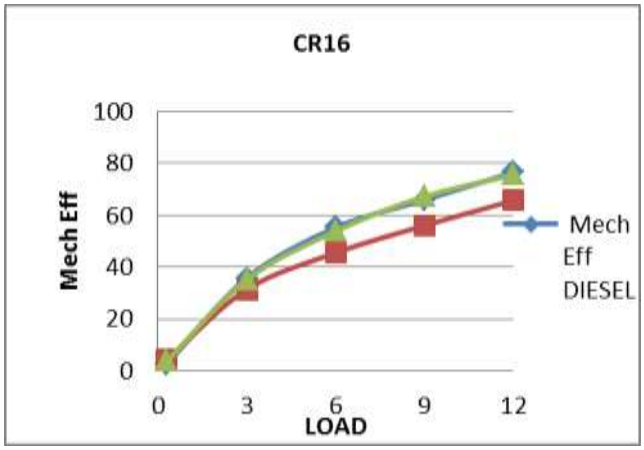

Fig.5Variation of Mechanical efficiency with respect to load.

In the fig.6 NOx emissions was found to be increase with increase in load. NOx emissions where found higher for diesel up to 3 kg and SB40D60CR16EGR0 195ppm/vol at load 0.3 kg. After that it continuously increases up to 12kg at the end it emmits2803ppm/vol at load12kg.

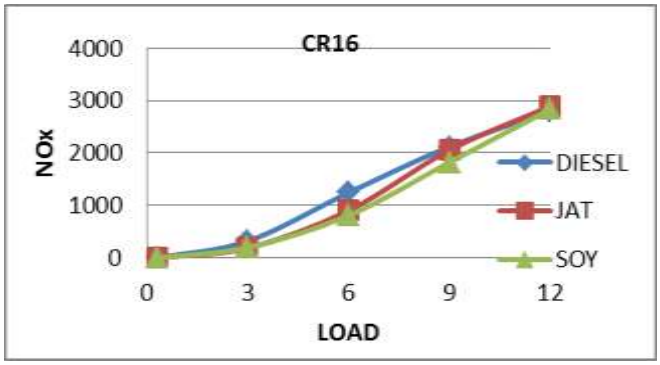

Fig.6 Variation of NOx emission with engine load

From the below graph (fig7) ,it can been seen that there is fluctuation in SB40D60CR18EGR0 and JB40D60CR18EGR0 and Diesel .Where as for JB40D60CR18EGR0 ,HC emission increases at the start then decreases .it lies at highest 62 (ppm/vol),at 12kg load for diesel. The emission of SB40D60CR18EGR0 &JB40D60CR18EGR0 remains slightly same and ends at 73ppm/vol.

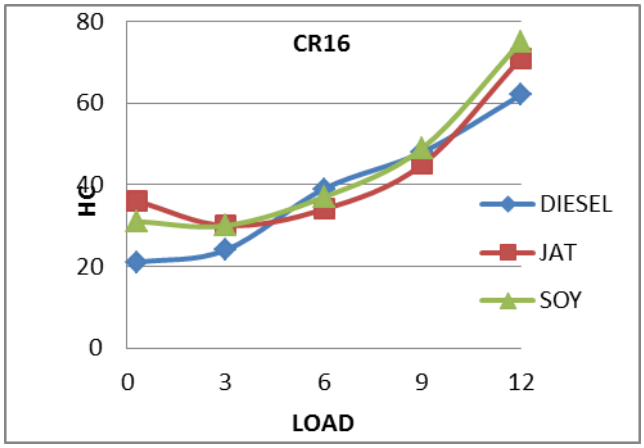

Fig.7 Variation of CO emission with engine load.

4. CONCLUSIONS

Biodiesel produced from renewable and often domestic sources, represents a more feasible energy and hence play a vital role in providing the energy required for farm equipment. Each test has been conducted to compare diesel and different blends at various loads. The following conclusions were drawn:

1) It can be seen that for increases in load the IP increase at remarkable level. The IP obtained using biodiesel fuel is greater than diesel for all the blends .It has been found that the indicated power for jatropha were better than that of soyabean blends.

2) It can be seen that for increases in load the BP increase at remarkable level. The BP obtained using biodiesel fuel is approximately same for all the blends of jatropha and soyabean.

3) The JB40D60CR18EGR0 blends shows very closed values of brake thermal efficiency at all the load conditions as that of the diesel fuel. At 12 kg load brake thermal efficiency was found to be greater when compared to blends with other additives

4) The mechanical efficiency for blends was found to be lower than that for diesel. For lower blends the mechanical efficiency was found to be approximately near to the diesel fuel but for higher blend mechanical efficiency decreases.

5)It was seen that the HC emission were found to be increased as the load increase for all the biodiesel blends The HC emission increased at start and then decreases Lower HC were seen for diesel at higher load.

6)NOx emission were found to be increase with increase in load .All biodiesel blends showed lesser NOx emission compared to diesel .The reason for this is that decrease in oxygen content in higher biodiesel blends which leads to insufficient cylinder temperature.

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