EXPERIMENTAL INVESTIGATION OF THE EFFECT OF BTE AND NOX IN A DIRECT INJECTION VCR DIESEL ENGINE RUNNING WITH RICE BRAN METHYL ESTER

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Abstract

In the world, day to day increases consumption of energy with increase the production rate of automobile. Petroleum based fuels are obtained from limited reserves. Therefore, those countries not having these resources are facing a foreign exchange crisis, mainly due to the import of crude petroleum oil. Hence it is necessary to look for alternative fuels, which can be produced from materials available within the country. In this investigation, rice bran methyl ester (RBM) was used in four stroke, single cylinder variable compression ratio type diesel engine. The results proved that the use of biodiesel in compression ignition engine is a viable alternative to diesel. In this work the engine performance and exhaust emissions were measured at different variable compression ratio (VCR-18, VCR-16 & VCR-14) and at different injection pressures (220 bar, 200 bar & 180 bar) with different blends of biodiesel rice bran oil.

Keywords: Bio-diesel; Rice Bran Oil; Variable Compression Ratio; Injection Pressure; Performance: Emissions.

I. INTRODUCTION

At present days need of automobile increases and shrinking the crude oil reserves. Due to the increase in price of petroleum and environmental concern about pollution coming from automobile emission, biodiesel is emerging as a developing area of high concern [1]. Rice bran oil is extracted from rice bran, which is a by-product of rice milling process. As rice production is a renewable process the availability of rice bran for oil extraction is also renewable in nature. Alternative fuels, promise to harmonize sustainable development, energy conversion, management, efficiency and environmental preservation. Vegetable oil is a promising alternative to petroleum products [2].Experimentally investigated and found the effect of injection pressures in diesel engine [3]. The effect of compression ratio (VCR) in diesel engines have been studied in detail at many places [4]. Engine tests were conducted with biodiesel derived from refined rice bran oil [5] only and not with crude rice bran oil methyl ester. As the FFA content of refined oil is less than 3% it can be easily converted into biodiesel by base catalyzed reaction alone [6-7]. Earlier research works on biodiesel indicated that B20) will be an optimum fuel blend for CI engine rather than neat biodiesel [8]. Investigated a diesel engine using rubber seed oil biodiesel blends and found that the lower blends increases the efficiency of the engine and lowers the fuel consumption compared to the higher biodiesel blends [9] &[10].

2. MATERIALS & METHODS

In this research work the fuels used were conventional diesel fuel, rice bran oil biodiesel and methanol. Fuel properties of rice bran oil biodiesel and methanol are determined in the laboratory as shown in the table 1.

Property parameters	Diesel Fuel	Rice Bran Oil Biodiesel	Methanol
Density at 20^0 C (g/cm^3)	0.82	0.96	0.78
Viscosity at 40^0C (mm^2/s)	3.4	4.56	1.35
Flash Point ^{0}C	57	160	21
Fire Point ^{0}C	60	175	25
Calorific value (KJ/kg)	43,500	39,800	28,700

Table 1: properties of diesel, rice bran oil biodiesel and bio methanol.

2.1 RESEARCH ENGINE TEST SET UP

The aim of the present study is to investigate the performance characteristics of a single cylinder variable compression ratio diesel engine using rice bran oil biodiesel. Experimental set up used for this research work consists of a single cylinder, four strokes, variable compression ratio engine connected to eddy current type dynamometer for loading. The detailed specifications of the engine used as shown in Table 2. Figure: 1 shows the schematic diagram of engine test rig. The tests were conducted at different loads at different compression ratios (VCR-18, VCR-16, & VCR-14) and also at different injection pressures (IP 220 bar, IP 200 bar & IP180 bar).

Make	Kirloskar Model AVL
No of strokes per cycle	04
No of Cylinders	01
Combustion chamber position	Vertical
Cooling Method	Water cooled
Starting Method	Cold Start
Ignition Technique	Compression Ignition
Stroke Length (L)	110 mm
Bore Diameter (D)	87.5 mm
Rated Speed	1500 r.p.m.
Rated Pow er	3.5 KW
Compression ratio	12:1 To18:1

Table 2: *Specifications of the diesel engine*

Figure: 1 Schematic diagram of engine test rig.

Experimental results were obtained at different loads (20%, 40%, 60%, 80% and 100%) on the engine. In the same manner the test was conducted with the blend of 90% diesel and B10 %,blend of 80%diesel B20% , and 70%diesel B30 %. The experiment tests were conducted with these three blends and measured brake power (B.P), brake specific fuel consumption (BSFC) and brake thermal efficiency (BTE). Exhaust emissions such as Carbon Monoxide (CO) and Nitrogen Oxides (NOx) were measured by AVL exhaust analyzer and by AVL smoke meter for diesel and blends separately under all load conditions. The results from the engine with a blend of rice bran oil biodiesel methanol were compared with the baseline parameters obtained during engine fuelled with diesel fuel.

3. RESULTS AND DISCUSSIONS

Experimental results obtained from the research work pertaining to the performance of the engine are demonstrated with the help of graphs. The vary of BTE with load for diesel and blends at 220 bar IP and VCR 18:1 is shown in the Fig. 2.

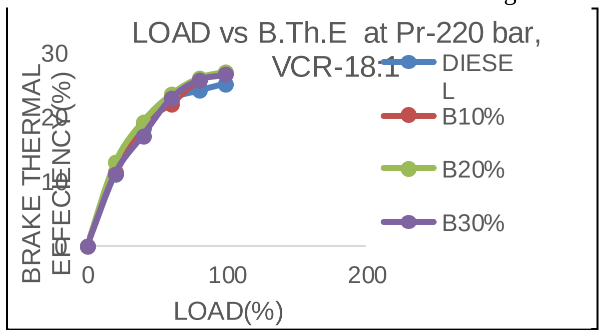


Fig: 2 Vary of BTE with load at 220 bar IP and at VCR-18:1

The vary of BTE with load for diesel and blends at 220 bar IP and at VCR 16:1 is shown in the Fig. 3

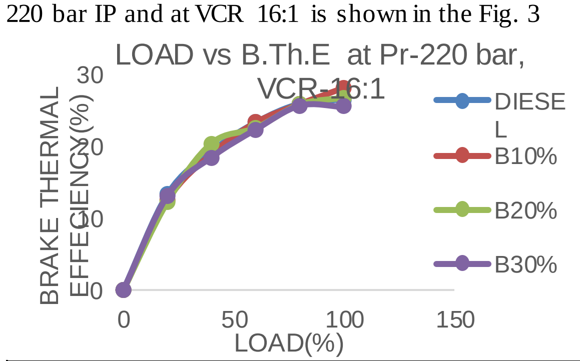
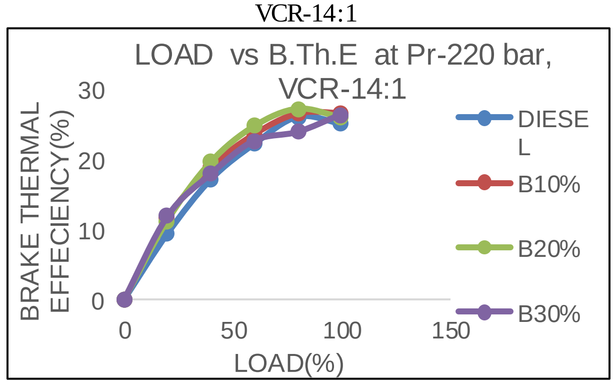


Fig: 3Vary of BTE with load at 220 bar IP and at VCR-16:1

The vary of BTE with load for diesel and blends at 220 bar IP and at VCR 14:1 is shown in the Fig. 4.

Fig: 4Vary of BTE with load at 220 bar IP and at VCR-14:1



The vary of BTE with load for diesel and blends at 200 bar IP and at VCR 18:1 is shown in the Fig. 5.

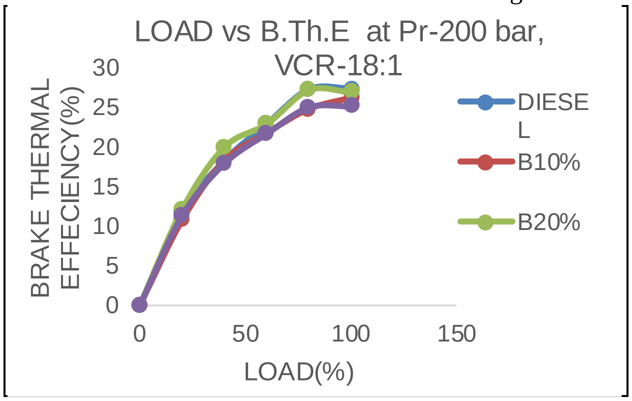
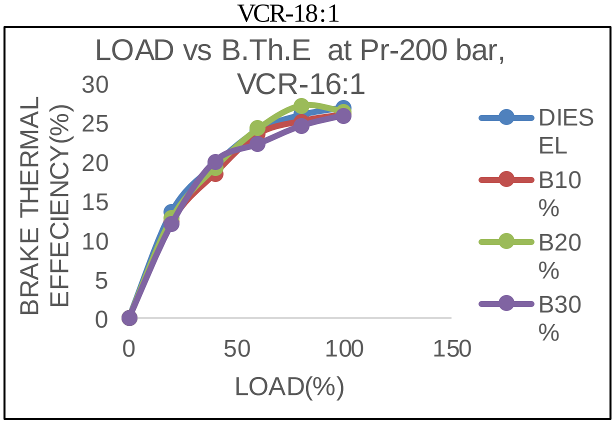
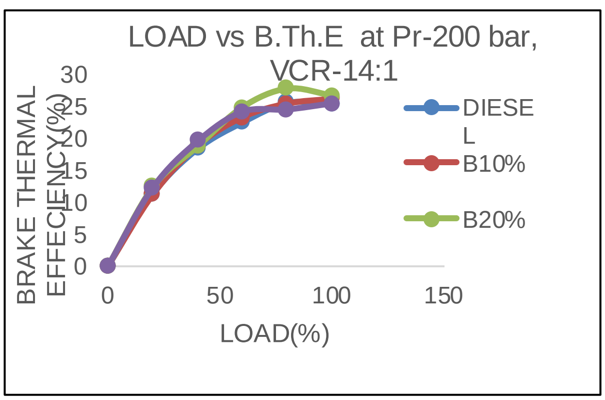


Fig:5Vary of BTE with load at 200 bar IP and at VCR-18:1





The vary of BTE with load for diesel and blends at 200 bar IP and at VCR 16:1 is shown in the Fig. 6.

Fig: 6Vary of BTE with load at 200 bar IP and at VCR-16:1

The vary of BTE with load for diesel and blends at 200 bar IP and VCR 14:1 is shown in the Fig. 7.

Fig:7 vary of BTE with load at 200 bar IP and at VCR 18:1

The vary of BTE with load for diesel and blends at 180 bar IP and at VCR 18:1 is shown in the Fig. 8.

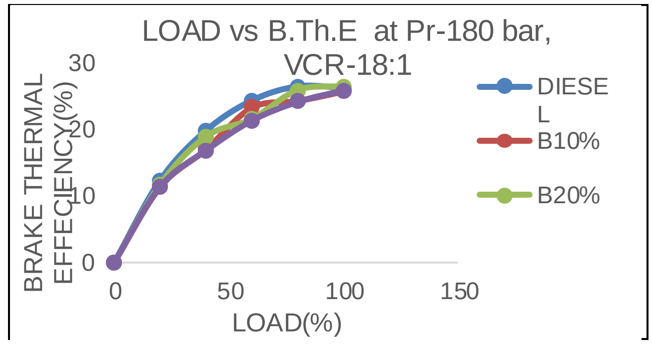


Fig: 8Vary of BTE with load at 180 bar IP and at VCR-18:1

The vary of BTE with load for diesel and blends at 180 bar IP and VCR 16:1 is shown in the Fig. 9.

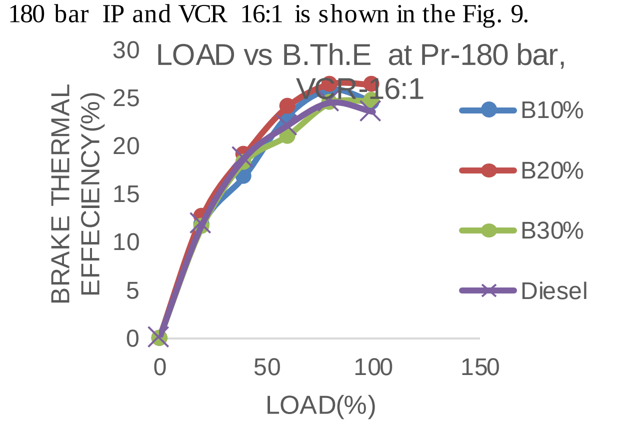
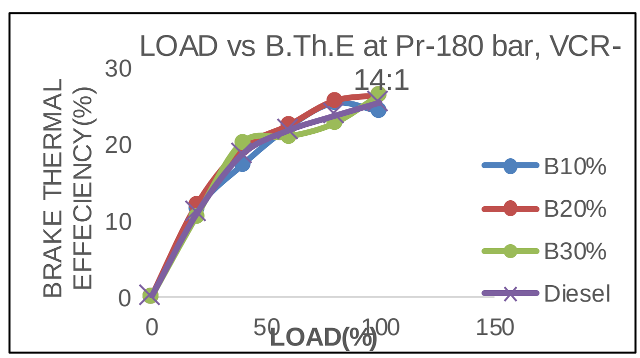


Fig:9Vary of BTE with load at 180 bar IP and at VCR-16:1

The vary of BTE with load for diesel and blends at 180 bar IP and at VCR 14:1 is shown in the Fig. 10.

Fig: 10Vary of BTE with load at 180 bar IP and at VCR-14:1

The vary of NOx with load for diesel & blends at 220 bar IP & at VCR-18:1 is shown in the Figure 11.



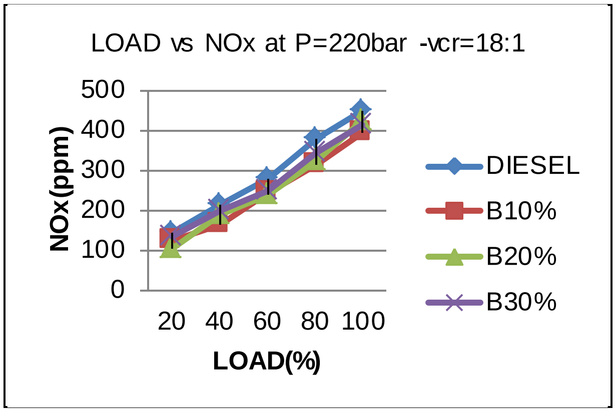


Fig:11 Vary NO_X with load at 220 bar IP and VCR-18:1

The vary of NOx with load for diesel & blends at 220 bar IP & at VCR-16:1 is shown in the Figure 12.

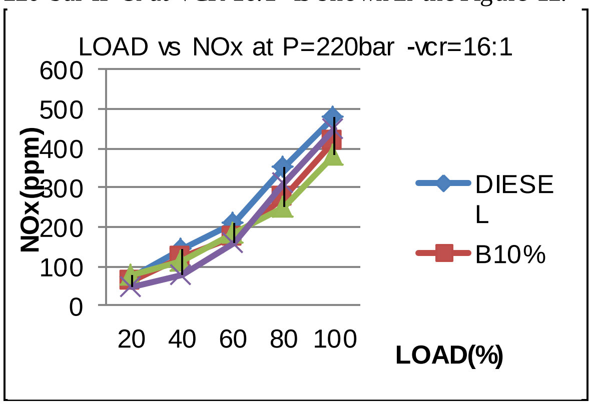


Fig:12 Vary NO_X with load at 220 bar IP and at VCR-16:1

The vary of NOx with load for diesel & blends at 220 bar IP & at VCR-14:1 is shown in the Figure 13.

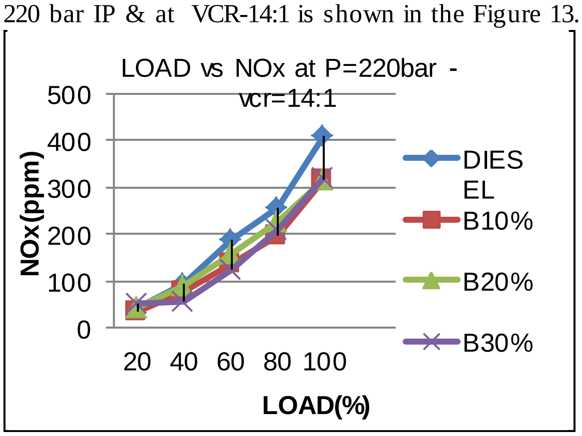


Fig: 13 Vary NO_X with load at 220 bar IP and VCR-14:1

The vary of NOx with load for diesel & blends at 200 bar IP & at VCR-18:1 is shown in the Figure 14.

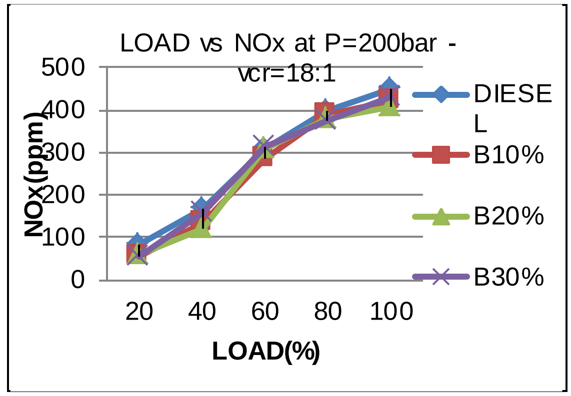


Fig: 14 Vary NO_X with load at 200 bar IP and at VCR-18:1

The vary of NOx with load for diesel & blends at 200 bar IP & at VCR-16:1 is shown in the Figure 15.

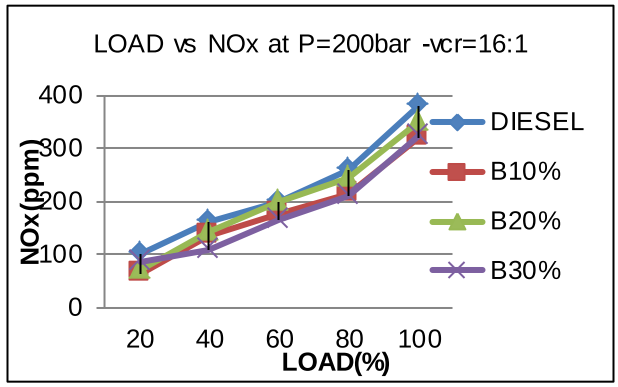


Fig: 15 Vary NO_X with load at 200 bar IP & at VCR-16:1

The vary of NOx with load for diesel & blends at 200 bar IP & at VCR-14:1 is shown in the Figure 16.

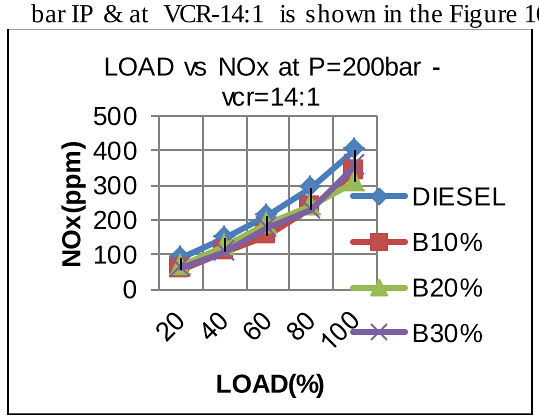


Fig: 16 Vary NO_X with load at 200 bar IP and VCR-14:1

The vary of NOx with load for diesel & blends at 180 bar IP & at VCR-16:1 is shown in the Figure 18

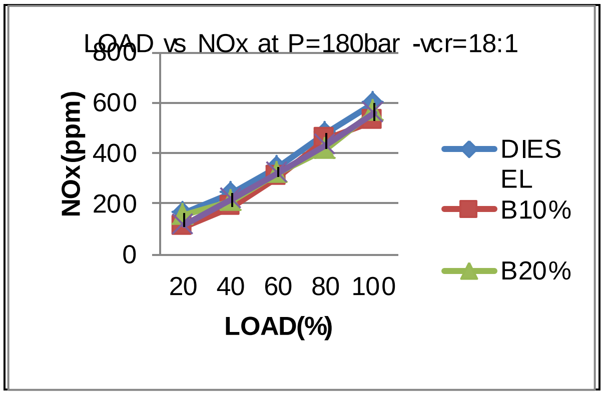


Fig: 17 VaryNO_X with load at 180 bar IP and at VCR-18:1

The vary of NOx with load for diesel &blends at 180 bar IP & at VCR-14:1 is shown in the Figure 19

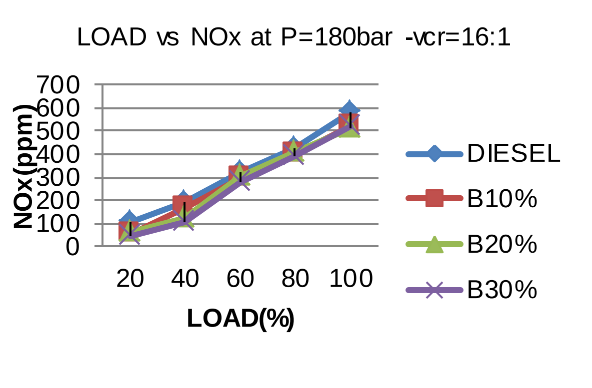


Fig: 18 VaryNO_X with load at 180 bar IP and at VCR-16:1

The vary of NOx with load for diesel &blends at 180 bar IP & at VCR-14:1 is shown in the Figure 19

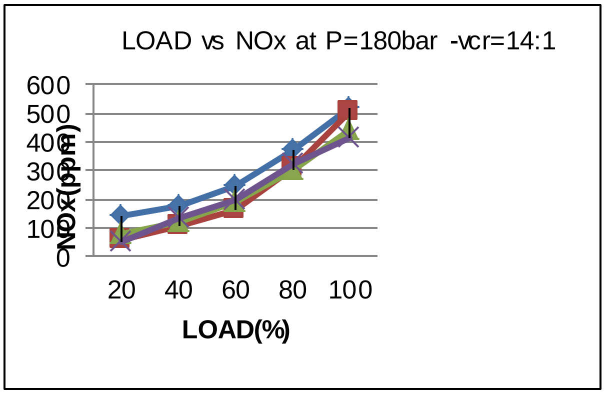


Fig: 19 Vary NO_X with load at 180 bar IP and VCR-14:1

4. CONCLUSIONS

The performance characteristics of conventional diesel and rice bran oil biodiesel-methanol blends were investigated on a single cylinder diesel variable compression ratio engine. The conclusions of this investigation are as follows:

- The brake thermal efficiency of blend 10% was higher at 200 bar IP and at VCR 16:1 with load for all the fuel modes. The minimum brake thermal efficiency of diesel fuel was observed at 180 bar IP and at VCR 16:1 with load for all the fuel modes.
- The Nitrogen Oxides emissions were increased with increased of the rice bran biodiesel at all loads and speeds of the engine. But NO_X emissions were low at all loads and all compression ratios of the engine compared with the conventional diesel fuel at all injection pressures and all compression ratios. The minimum CO emissions were observed with the blend B20% at 220 bar IP and at VCR-14:1.

5. REFERENCES

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