Performance And Emission Evaluation Of A Biodiesel (Rice Bran Oil Methyl Ester) Fuelled Transportation Diesel Engine With And Without EGR

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ABSTRACT--- This research is aimed at finding a sustainable alternate source of energy that can be used as a substitute for conventional fuel sources, which are fast dwindling towards the point of exhaustion. Bio-diesels are viewed as an effective alternate source of energy which can be better than conventional fossil fuels in its performance, combustion and greenhouse gas emission rates. The oil of rice bran methyl ester is used for experimentation. The oil is blended in different ratios with pure diesel in a process known as blending. The various blends are then subjected to performance test in a diesel engine. The biodiesel blends have also been tested for emission properties with and without exhaust gas recirculation. The results reveal that rice bran biodiesel emits less amount of carbon monoxide emissions.

Keywords: Biodiesel, rice bran oil, emission test.

I. INTRODUCTION

Rising demands for fuel has become a global concern. Depleting fossil fuels and increased pollution from greenhouse gases add more to the woe. Countries like India, Brazil and African countries are the worst affected due to increased population growth and soaring fuel prices. Due to mankind's increased dependency on fossil fuels there has been an equally proportional increase in pollution from greenhouse gases. The effect of greenhouse gases has had a drastic change in the environment around us. Phenomenon like acid rain, depleting ozone layer are the after effects of increased usage of fossil fuels. The after effects of this are even seen in human bodies. Diseases such as nausea, suffocation etc., are the results of this. Now the question arises. Is there a solution for this?

1.1 Problem Definition And Solution

The increased pollution due to greenhouse gases from fossil fuels has now risen and the need for an alternative energy source has been in great demand. That is where biodiesel comes into the picture. The use of biodiesel as an alternative replacement is an apt solution.

The objective of the research is also an effort to produce the bio-diesel which could be used as a long-term replacement for fossil fuels. Its sustainability as an effective alternative to conventional fossil fuels is also a prime objective of the research.

The produced bio diesel is then subjected to performance and combustion tests to check for its suitability and usage as an effective alternate source of energy.

II. OIL CHARECTERISTIC TESTS APPARATUS

The fuel properties of Rice Bran biodiesel oil is given in table 1.

Table 1. Properties of Rice bran oil

S.NO.	PROPERTIES	RICE BRAN OIL
1	Miscibility in mineral oil and fuel	Complete
2	Kinematic Viscosity, cst at 100º c, min	6.5
3	Viscosity index,min	95
4	Flash point, º C, min	> 70
5	Relative density at 20 º C	0.88
6	Lubricity index, min	95
7	Pour point ºC,max	-54
8	Ash sulfate %,max	0.12
9	Water % by vol., max	0.03
10	Detergency index, min	95
11	Smoke index,min	85
12	Piston varnish index, min	90

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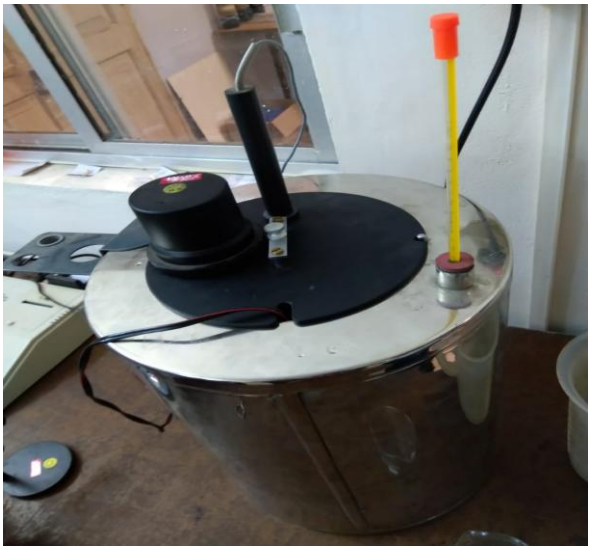


Fig. 2.1.Bomb Calorimeter

Fig. 2.2.Flash Point Apparatus

III. EXPERIMENT PROCEDURE

3.1.Test equipment and procedures

The test setup is shown in Figure 3.1.The engine used for the experimentation is Texvel engine, Single cylinder, vertical, four stroke cycle, water cooled, direct ignition diesel engine of rated power output of 6.5 Kw

CO,NO_X and HC was measured using Kane emission monitoring systems. Fuel consumption was measured using burette.

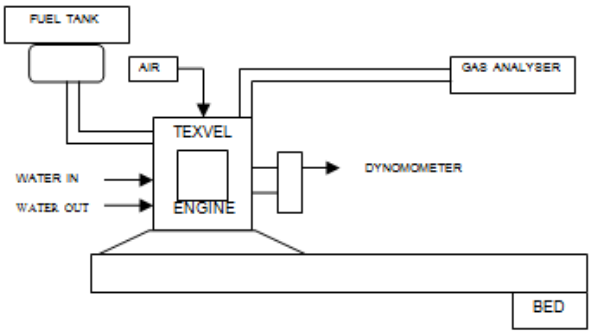


Figure 3.1. Test set up of the engine

The readings were taken with pure diesel fuel in the engine and the engine was run and stabilized. After engine stabilization the required readings were taken for different loads, then the fuel was drained. Then the engine was loaded with rice bran methyl ester biodiesel as fuel and the required readings were taken for different loads and different ratios of biodiesel. Exhaust gas was re-circulated also measured for emission.

IV. RESULTS

4.1.Brake specific fuel consumption

The Brake specific fuel consumption is shown in figure 2 (a) and (b).The characteristic behaviour of engine without EGR and with EGR shows that the BSFC for biodiesel is higher than diesel. This increase in BSFC of biodiesel and their blends may be due to their lower calorific value. (D+20% BD) blend has shown better BSFC which is comparable with diesel. (D+40% BD) blend with EGR has shown better BSFC when compared to other blends and this is due to the presence of EGR.

4.2. Brake thermal efficiency

The figure 3 (a) and (b). represents the characteristic behaviour of engine without EGR and with EGR shows that the Brake thermal efficiency is decrease with increase in concentration of rice bran oil in diesel, when compared to other blends(D+40% BD) blend without EGR has shown better BTE which is comparable with diesel. (D+20% BD) blend with EGR has shown better BTE which is comparable with diesel; the EGR effect has increased the thermal efficiency when compared to the ordinary diesel engine.

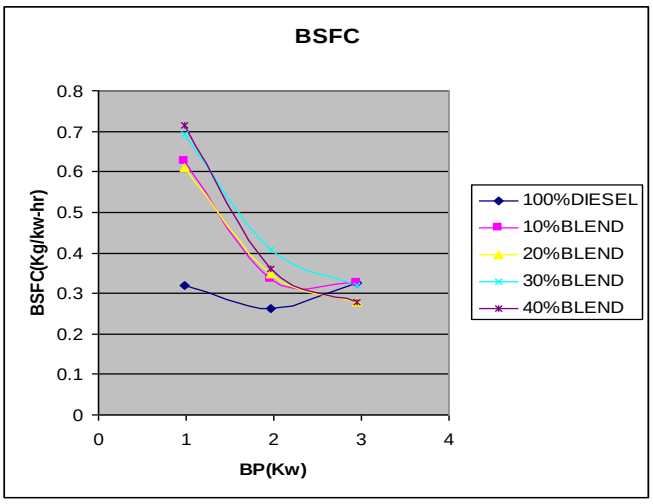
4.3 EMISSIONS

4.3.1.Nox Emission

The figure 4 (a) and (b).represents the characteristic behaviour of engine without EGR and with EGR shows the NO_X emission. It was found that the (D+40% BD) blend has lower NO_X emission.It was found that the (D+20% BD) blend has lower NO_X emission when compared to other blends and this is due to the presence of EGR.

4.3.2. CO Emission

Carbon monoxide is a toxic combustion product formed during the combustion when there is insufficient oxygen to oxidize fully. The figure 5 (a) and (b).represents the characteristic behaviour of engine without EGR and with EGR shows that the CO emissions were extremely low for blends when compared to diesel. The reduction in CO indicates more complete combustion of the fuel. It was found that the (D+40% BD) blend has lower CO emission.(D+40% BD) blend has lower CO emission when compared to other blends and this is due to the presence of EGR.



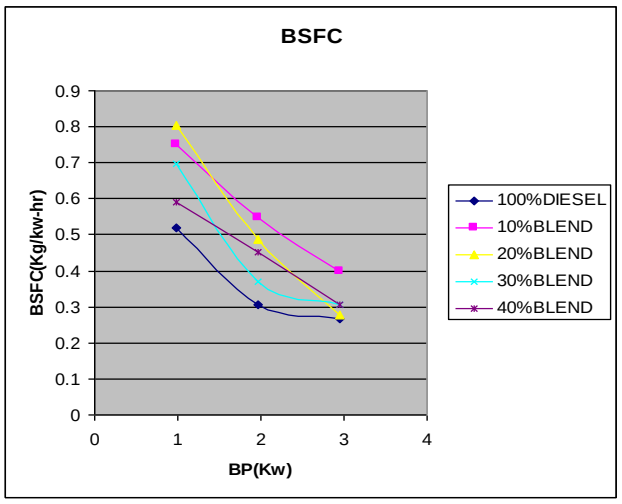
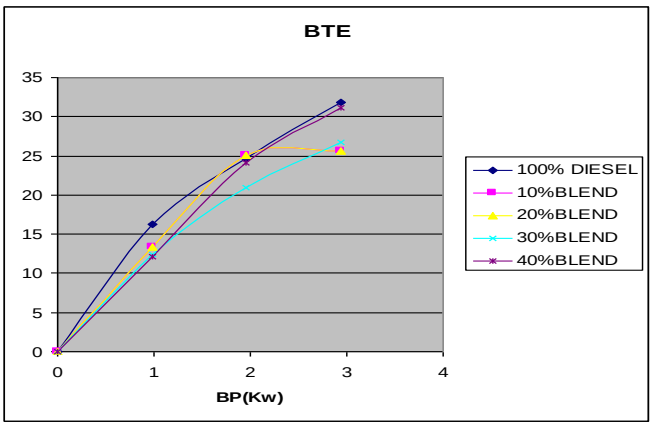


Fig. (a) **Fig.(b)**

Figure 2 (a) without EGR, (b) with EGR – BP Vs BSFC



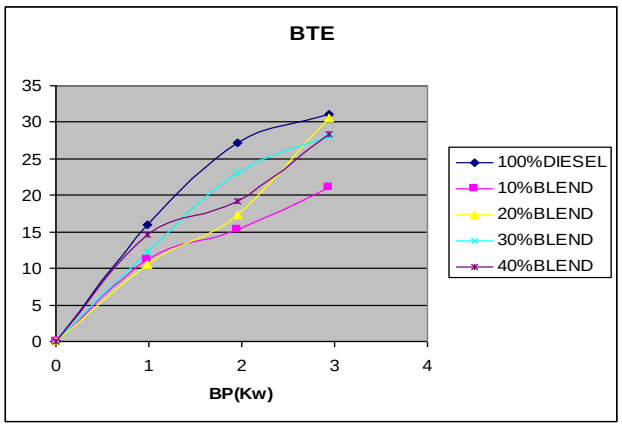
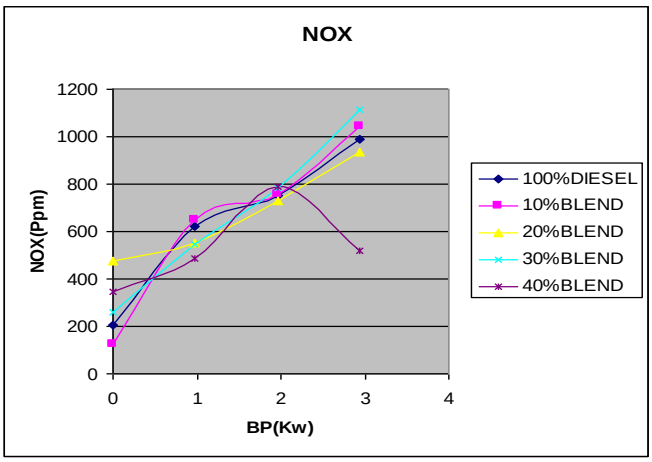


Fig. (a) **Fig.(b)**

Figure 3 (a) without EGR, (b) with EGR – BP Vs BTE



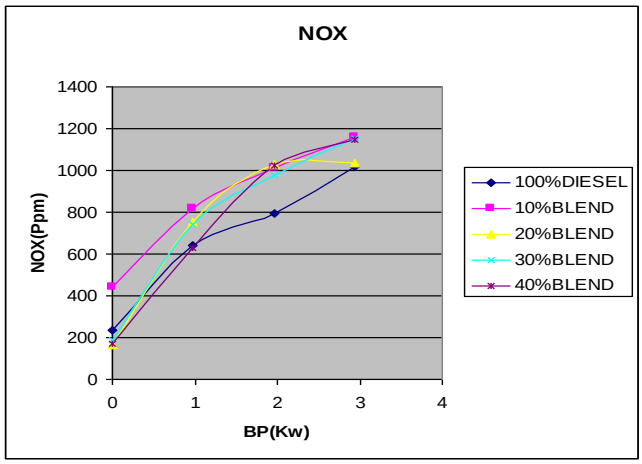


Fig. (a) **Fig.(b)**

Figure 4 (a) without EGR, (b) with EGR – BP Vs NO_X

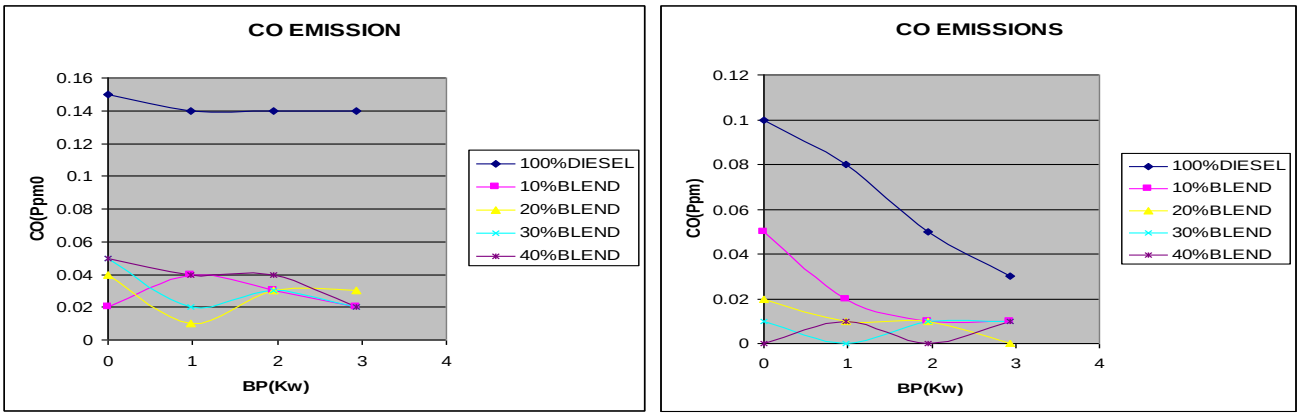


Fig. (a) **Fig.(b)**

Figure 5 (a) without EGR, (b) with EGR – BP Vs CO

V. CONCLUSION

An experimental investigation of performance and emission tests conducted on a single cylinder Texvel engine by without and with EGR method, was carried out with base fuel (diesel) as well as fuel blended with Biodiesel (Rice Bran oil) in different proportions.

In this present study, the fuel properties and exhaust emission characteristics of Rice Bran oil Methyl Ester can basically regarded as alternative to diesel fuel.

The engine performance for the Rice Bran oil does not differs greatly from that of diesel fuel. A meager power loss, combined with an increase in fuel consumption, is experienced with the ester this is mainly cue to the lower heating value of the ester. The emissions of NOx, CO were found to be low when compared to conventional diesel.

- The Biodiesel blend (D+40% BD) shows the optimum result when compared to diesel and all other blends without EGR.
- The Biodiesel blend (D+20% BD) shows the optimum result when compared to diesel and all other blends with EGR.
- The Brake thermal efficiency and Indicated thermal efficiency is decreased by 4.46 %and 21.5% respectively in ester when compared to diesel.
- The BSFC is increased by 4.47 % when compared to diesel.
- CO and NO_X emissions are reduced by 30% and 37.64% respectively in ester when compared to diesel.
- Short-term engine performance and emission indicates suitability of Rice Bran oil blends up to 40% concentration.

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