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Performance on Diesel Engine is Conducted by Nerium Oil as Alternative Fuel

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ABSTRACT

The world's fossil fuel reserves are depleting rapidly, according to the survey, 75% of fossil fuel production will be decreased in coming 11 years. Developing countries like India, invests heavily on imports of fossil fuels. Diesel fueled vehicles discharge significant amount of pollutants like CO, HC, NOx, lead, soot, which are harmful for the environment. In this present work, four different blend ratios of Nerium oil esters in varying proportions viz., 20%, 30%, 40% pure Nerium oil with diesel are used. for investigating performance and emission characteristics. Experiments are carried out on a diesel engine using Nerium oil as alternative fuel which is a single cylinder, four-stroke, water cooled, and constant speed engine capable of developing a power output of 6.6 kW at 1500 rpm. Performance parameters such as brake power, specific fuel consumption, and thermal efficiency are calculated based on experimental analysis of the engine. Emissions such as carbon monoxide, carbon dioxide and unburned hydrocarbon are measured.

Keywords : Nerium Oil, Diesel Engine, Performance, Emissions.

I. INTRODUCTION

Compression ignition engines are employed particularly in the field of heavy transportation and agriculture on account of their higher thermal efficiency and durability. However, diesel engines are the major contributors of oxides of nitrogen and particulate emissions. Hence more stringent norms are imposed on exhaust emissions. Following the global energy crisis in the 1970s and the increasingly stringent emission norms, the search for alternative renewable fuels has intensified.

Probably in this century, it is believed that crude oil and petroleum products will become very scarce and costly to find and produce. Although fuel economy of engines is greatly improved from the past and will probably continue to be improved, increases in number of automobiles alone dictate that there will be a great demand for fuel in the near future.

Bio-diesel is reliable, renewable, biodegradable and non toxic. It is less harmful to the environment for it contains practically no sulphur and substantially reduces emissions of HC, CO, sulphates, polycyclic aromatic and particulate matter. It can be mixed with mineral oil and used in standard diesel engines with minor or no modifications at all. Bio diesel works well with new technologies such as catalysts, particulate traps and exhaust gas recirculation. to produce and control this energy source, which is a situation very different to crude oil business. Another reason for bio-diesel development is the fact that large percentage of crude oil must be imported from other countries which decrease the dependency on foreign fuel and increase the Indian economy.

II. PROPERTIES OF EUCALYPTUS OIL

Table 1. Properties of Nerium oil

Properties	Diesel	Eucalyptus oil
Calorific Value(kj/kg)	42,700	36570
Density at 15^0C(kg/m^3)	822	910
Flash point (^{0}C)	74	148

Boiling point (^{0}C)	180-340	176-177
Cetane number	50	
Kinematic viscosity at 40 ^{0}C (m2/s)	3.6*10^-6	4.88*10^-6

III. SPECIFICATIONS OF DIESEL ENGINE

The engine which is supplied by New Kissan Company the engine is single cylinder vertical type four stroke, water-coo1ed, and compression ignition engine. The engine is self-governed type whose specifications are given in Table 2 is used in the present work.

Table 2. Engine specifications

Item	Specification
Engine	NEW KISSAN ENGINE, 4 stroke-stationary.
Type	water-cooled
Injection	direct injection (DI)
Maximum speed	1500
Number of Cylinder	One
Bore	85 mm
Stroke	110 mm
Compression Ratio	16.5:1
Maximum HP	5 HP
Injection timing	25^0 before TDC
Injection pressure	200 bar

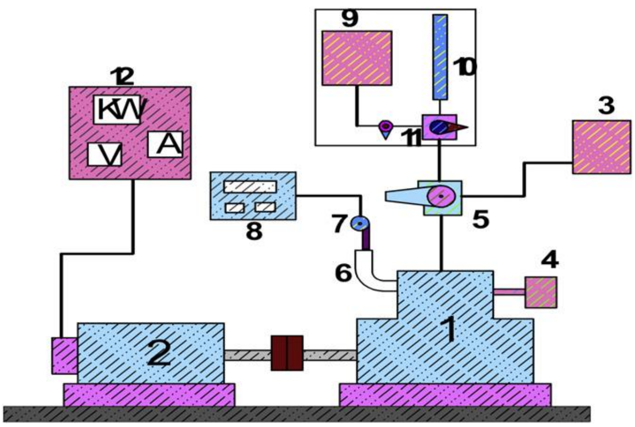

Figure 1. Experimental set up

The experimental set up consists of engine, an alternator, top load system, fuel tank along with immersion heater, exhaust gas measuring digital device and manometer.

Engine:

The engine which is supplied by M/s Alamgir Company. The engine is single cylinder vertical type four stroke, Air-coo1ed, compression ignition engine. The engine is self governed type whose specifications are given in Appendix 1.is used in the present work.

IV. Experimental Procedure

The diesel engine alone is allowed to run for about 30 min, so that it gets warmed up and steady running conditions are attained. Before starting the engine, the lubricating oil level in the engine is checked and itis also ensured that all moving and rotating parts are lubricated.

The Experiments were carried out after installation of the engine. The injection pressure is set at 200 bar for the entire test..Precautions were taken, before starting the experiment. Always the engine was started with no load condition. The engine was started at no load condition and allowed to work for at least 10 minutes to stabilize. The readings such as fuel consumption, spring balance reading, cooling water flow rate, manometer reading etc., were taken as per the observation table. The load on the engine was increased by 20% of FULL Load using the engine controls and the readings were taken as shown in the tables. Step 3 was repeated for different loads from no load to full load. After completion of test, the load on the engine was completely relieved and then the engine was stopped.

V. RESULTS AND DISCUSSION

Experiments were conducted when the engine was fuelled with Nerium oil and their blends with diesel in proportions of 20:80, 30:70 and 40:60 (by volume) which are generally called as NO-20, NO-30 and NO-40 respectively. The experiment covered a range of loads.

The performance of the engine was evaluated in terms of brake specific fuel consumption, brake thermal efficiency and volumetric efficiency. The emission characteristics of the engine were studied in terms exhaust gas temperature, concentration of HC, CO and CO_2. The results obtained for Nerium oil and their blends with diesel were compared with the results of diesel.

A. Specific Fuel Consumption

The result for the variations in the brake specific fuel consumption (BSFC) is presented in the fig.4.1. For all the fuels the BSFC falls with increasing load up to 3000W and beyond that the BSFC increases with load. This indicates the existence of an optimum value of BSFC at a load of 3000W. From fig. it can be clearly seen that BSFC is maximum for diesel fuel and minimum NO 30 and in between NO 20 and NO 40 at given load. A similar trend is BSFC can be observed at all the load considered in present work. The maximum BSFC values are 0.67 kg/kW hr for diesel, 0.627 kg/kWhr for NO-20, 0.597 kg/kWhr for NO-30 and 0.63 kg/kWhr for NO-40.

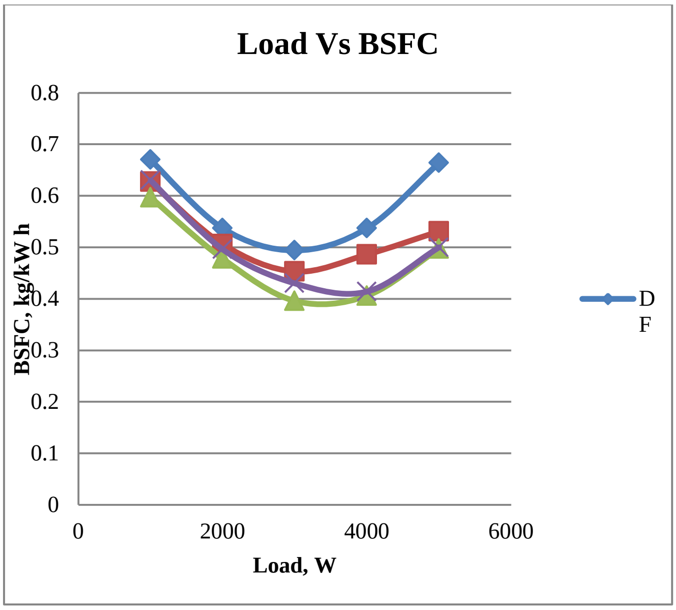

Figure 2. specific fuel consumption (blend) Vs Break power

B. Brake Thermal Efficiency

The variation of brake thermal efficiency with respect to load for NO-DF blends and DF is shown in Fig.4.2 It can be observed that the thermal efficiency is increase with load up to 3000W and than after reducing. It can be observed that the engine fueled with NO 20, NO 30, NO 40 and Diesel gives brake thermal efficiency of 19.56%, 21.16%, 20.35 % and 19.12 respectively at 3000W load. Because of the changes in composition, viscosity, density and calorific value of NO-DF blends the brake thermal efficiencies of NO 20, NO 40 are low particularly at 3000W load and increased for NO 30. Part load thermal efficiency is good for the NO-DF blends.

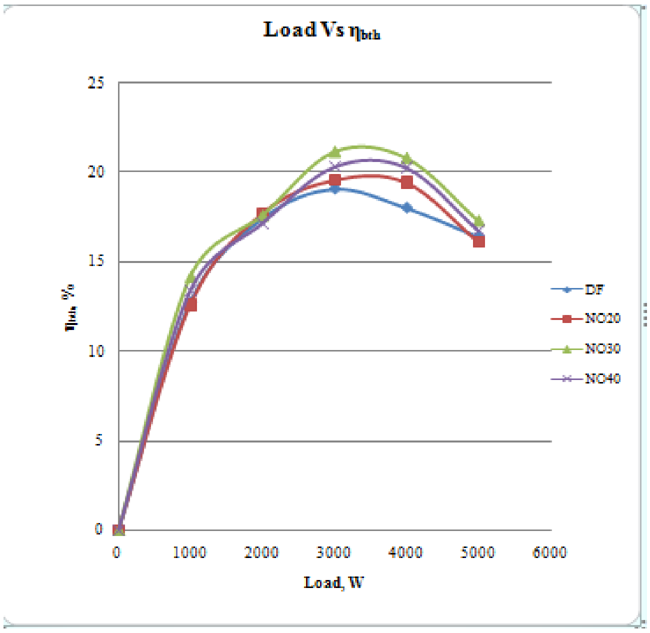

Figure 3. Brake thermal efficiency (blend) Vs Break Power

C. 6.3 Indicatedthermal Efficiency:

The variation of Indicated thermal efficiency with respect to load for NO-DF blends and DF is shown in Fig.4.3 It can be observed that the thermal efficiency is 23.28% at 3000W load for diesel. It can be observed that the engine fuelled with NO 20, NO 30and NO 40 gives Indicated thermal efficiency of 27.6%, 30.63%, and 29.53% respectively at 3000W load. Because of the increase in brake power and reduction in frictional power, the Indicated thermal efficiencies of NO-DF blends are high particularly at load 3000W.

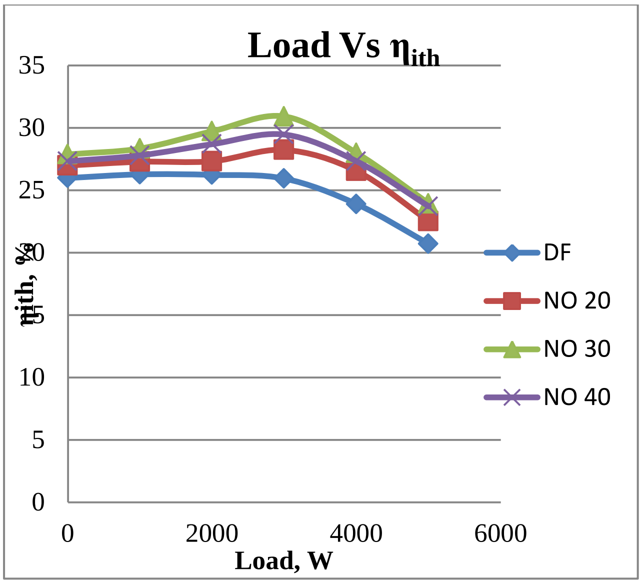

Figure 4

D. Volumetric Efficiency:

Volumetric efficiency variation for NO-DF blends and DF with respect to load is shown in the Fig.4.4.From the Fig.4.3,it may be observed that ,the Volumetric efficiency is maximum for NO 40 and minimum for Diesel and in between these two NO20 and NO 30 at a given load. Volumetric efficiency of DF is 67.04% at 3000W load and for NO 20, NO 30 and NO 40 is 69.56%, 71.04%and 73.56% respectively. Volumetric efficiency is slightly increased for all the NO-DF blends compared to Diesel.

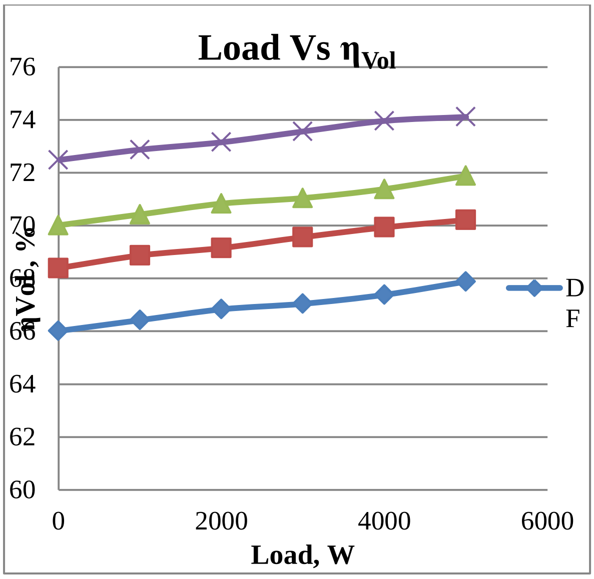

Figure 5

E. Brake Mean Effective Pressure

Brake mean effective pressure with respect to load exists for all kinds of test fuels can be observed from the Fig. 4.5. At 4000W load Brake mean effective pressure for the diesel is 317.17kN/m^2, whereas for NO 20, NO 30and NO40 is 325.54 kN/m^2, 359.49 kN/$m^2$and 352.6kN/m^2 respectively. Linear variations of brake mean effective pressure can be observed and there is no significant deviation in brake mean effective pressure for the NO-DF blends from that of pure diesel

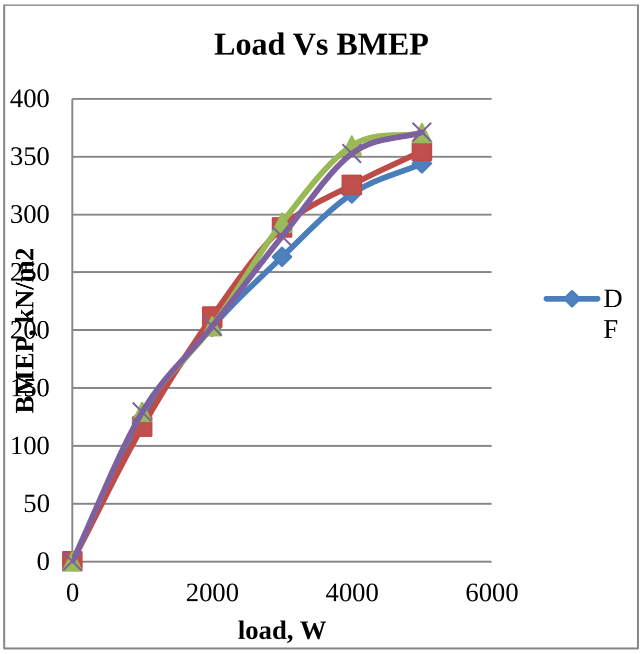

Figure 6

F. Indicated Mean Effective Pressure

Linear variations of indicated effective pressure with respect to load exist for all kinds of test fuels can be observed from the Fig. 4.6. Indicated mean effective pressure for the diesel at 4000W load is 451.75kN/m^2, where as for NO 20, NO 30and NO 40 is 465.09kN/m^2, 477.63kN/$m^2$and 447kN/m^2 respectively. Linear variations of Indicated mean effective pressure can be observed and there is no significant deviation in indicated mean effective pressure for the NO-DF blends from that of pure diesel.

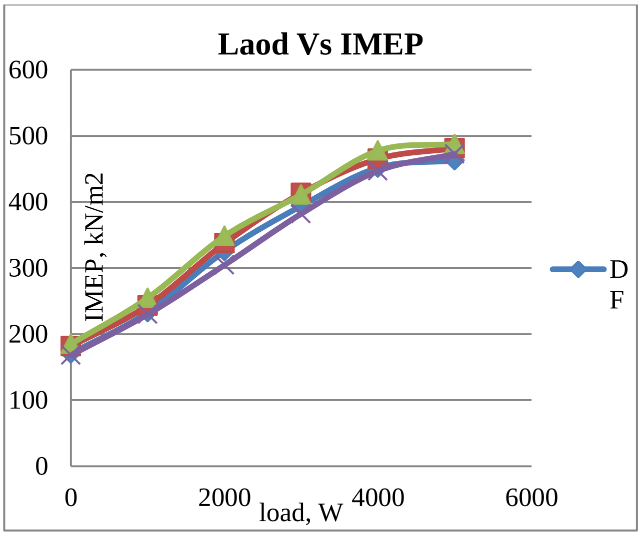

Figure 7

G. Exhaust Gas Temperature:

The variation of exhaust gas temperature at various load conditions is depicted in Fig.4.7. It is observed that the exhaust gas temperature increases with load because more fuel is burnt to meet the power requirement. It can be seen that in the case of diesel fuel operation exhaust gas temperature is 309 ^{0}C at 4000W load. For NO 20 and NO 30, the exhaust gas temperature marginally increases to 313 ^{0}C and 320 ^{0}C respectively. The exhaust gas temperature for NO 40 is 300 ^{0}C at 4000W load. Higher exhaust gas temperature in the case of NO blends compared to DF is due to higher heat release rate. It may also be due to the oxygen content of the NO, which improves combustion. In the case of NO, the fuel spray becomes finer and effective combustion takes place.

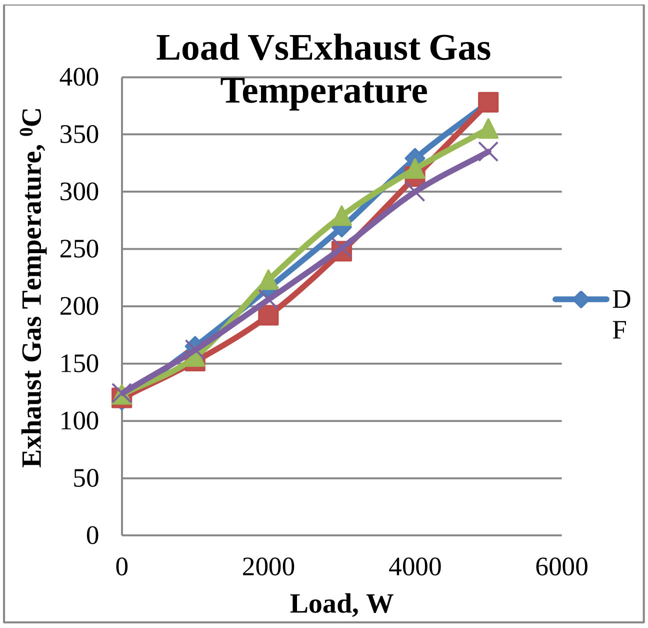

Figure 8

H. Mechanical Efficiency:

From the Fig. 4.8. the variation of mechanical efficiency with respect to load can be observed. Mechanical efficiency of the fuels tested is observed as 73.68%, 75.89% and 75.8% for NO 20, NO 30 and NO 40 respectively. The values of mechanical efficiency of blends are higher compared to DF with 72.44%. Particularly the NO 20 fuel gives more mechanical efficiency than the other fuels. As the engine produces higher power output, the frictional losses are changed and hence change in the mechanical efficiency.

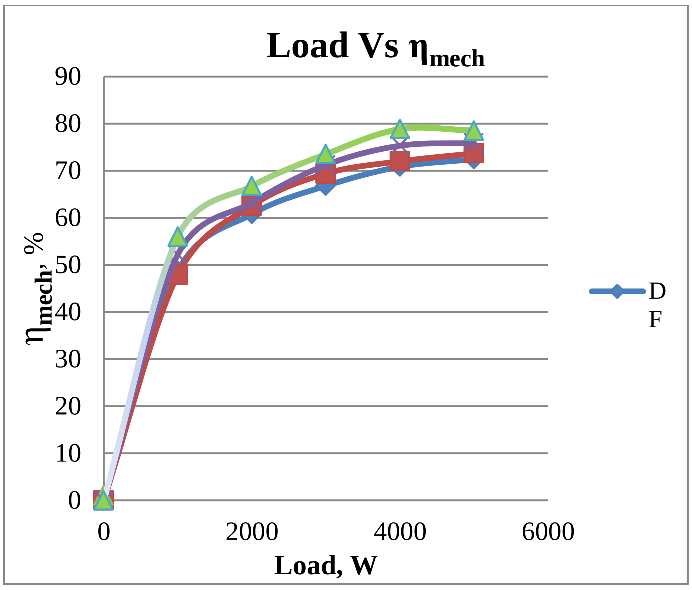

Figure 9

I. Hydrocarbon Emission

The variation of hydrocarbons with respect to load for tested fuels is depicted in Fig. 4.9. From the results, it can be noticed that the concentration of hydrocarbon of NO-DF blends is slightly lower than DF. Unburnt hydrocarbon from the exhaust gas for the diesel fuel is 24ppm and for NO20, NO 30and NO 40 are 12ppm, 14ppm and 30ppm respectively. With increase in power output, HC emission increased for 3000W load. It is cleared that the emissions concentration for all the blends are lower than Bharath Stage III norms.

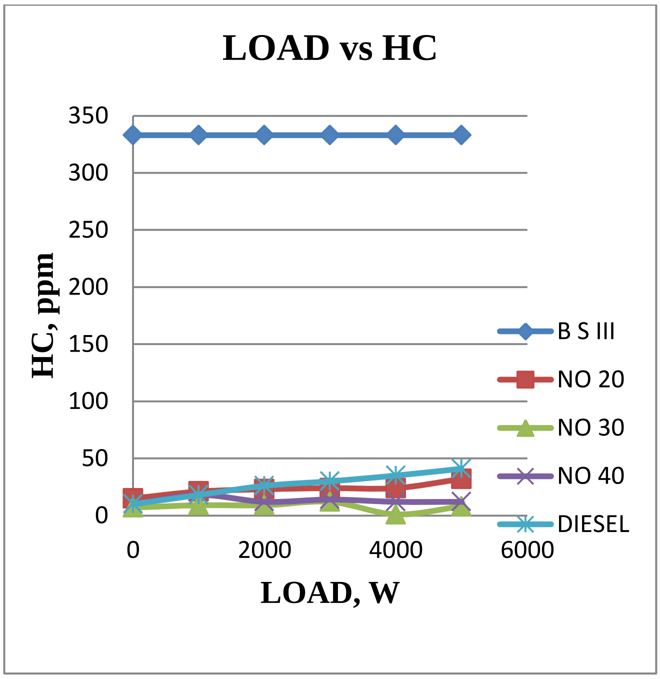

Figure 10. Hydro carbon (blend) Vs Load

J. Carbon Monoxides

From Fig. 4.10. the variation of carbon monoxide with respect to load can be observed for all the NO-DF blends and DF. The results show that CO emission of NO-DF blends is slightly higher than DF. Carbon monoxide from the exhaust gas for the diesel fuel is 0.04% by vol. and for NO20, NO 30 and NO 40 are 0.03% by vol., 0.02% by vol. and 0.03% vol. respectively. With increase in power output, the CO emission gradually reduces for all the test fuels. It is clear that the emissions concentration are lower than Bharath Stage III up to a load of 3000W, and beyond that the CO is higher than Bharath Stage III norm. Hence, higher concentration of CO emission at loads greater than 3000W, it not advisable to run the engine.

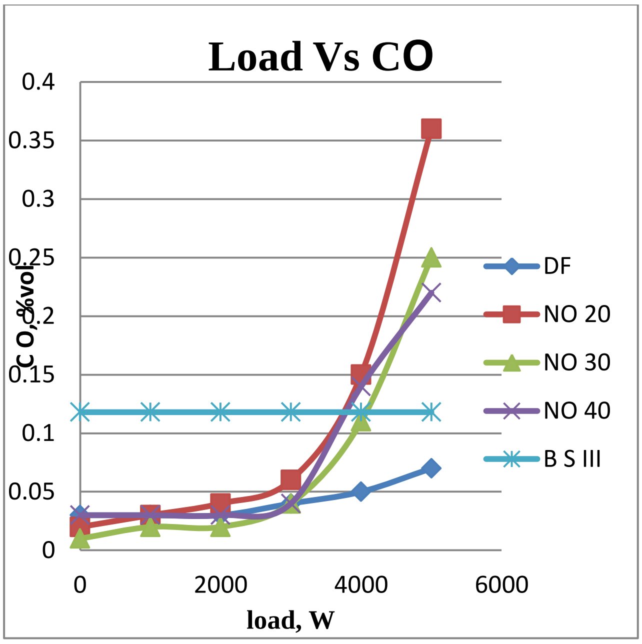

Figure 11. carbon monoxide (blend) Vs Brake power

K. Carbon Dioxide

As shown in Fig.4.11, the variation of carbon dioxide emission with respect to load for DF and NO-DF operation can be observed. From the results, it is observed that the amount of CO_2 produced while using NO-DF blends is higher than DF at all load conditions. Carbon dioxide from the exhaust gas for the diesel fuel is 1.3% vol. and for NO20, NO 30 and NO 40 are 1.3% vol., 0.8% vol. and 0.8% vol. respectively. Carbon dioxide, or CO_2, is a desirable byproduct that is produced when the carbon from the fuel is fully oxidized during the combustion process. As a general rule, the higher the carbon dioxide reading, the more efficient the engine is operating. The conclusions are drawn from the experimental investigations on the performance and emission parameters using diesel, NO 20, NO 30 and 40 NO are presented this section.

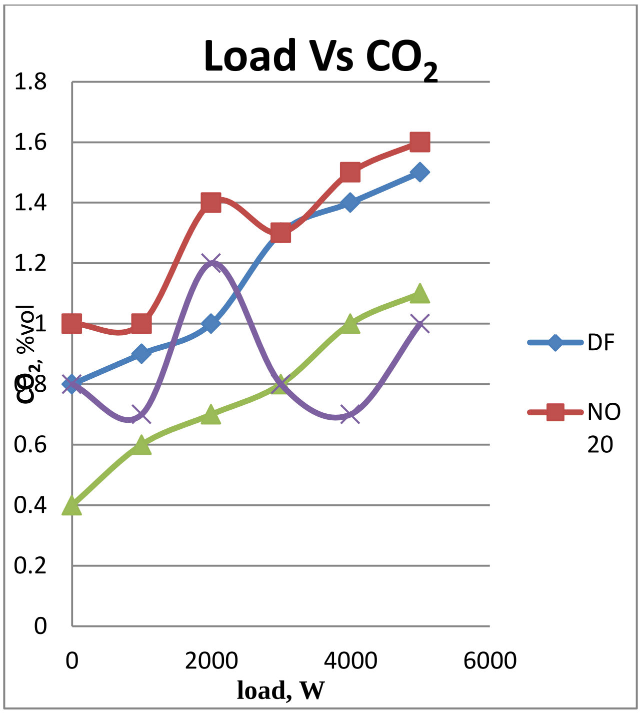

Figure 12. Carbon Dioxide(blend) Vs Brake Power

VI. CONCLUSION

Following are the conclusions based on the experimental results obtained while operating single cylinder air cooled diesel engine fuelled with Nerium Oil and its diesel blends. The blends of Nerium oil show lowest specific fuel consumption than the diesel at part loads. B.S.F.C is decreased the blend NO Brake Thermal efficiency of the tested diesel engine is improved when it is fuelled with Nerium oil-diesel blends. Mechanical efficiency for NO 30 is higher compared to Diesel fuel operation is observed. Brake mean effective pressure is also increased as the percentage of the Nerium oil increases with the diesel. But this increment in Brake mean effective power is insignificant. Actual Breathing capacity of the engine also slightly increased which leads to increase in volumetric efficiency. It is noted that the volumetric efficiency is raised as the blend of the Nerium oil increases in the diesel. CO emission decrease with increase in percentage of Nerium oil in the fuel up to 3000W.CO_2 emissions of Nerium oil and its diesel blends are slightly lower than that of diesel. HC emissions of Nerium oil and its diesel blends are lower than that of diesel.From the above analysis the main conclusion is Nerium oil and its diesel blends are suitable substitute for diesel as they produce lesser emissions than diesel upto a load of 3000W and have satisfactory combustion and performance characteristics.

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