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A Comparative Study on Emission and Performance Characteristics of Neem Biodiesel Under Various Load Conditions

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Abstract--*In the current energy scene of fossil fuel, renewable energy sources such as biodiesel, bioethanol, biomethane, and biomass from wastes or hydrogen have become the subjects of great interest. The present study was intended to consider aspects related to the testing of performance and emission of biodiesel from Neem oil and additives investigating its fuel properties. Biodiesel can make a major contribution in the future if it meets the few percent of petroleum and it can provide improved fuel properties lower emission of unburned hydrocarbons, carbon monoxide but higher level of oxides of nitrogen in biodiesel but eventually can be reduced by using selected additives in biodiesel. Comparative study on properties of diesel and biodiesel fuels with/without presence of water and nanoparticle additives have been made. It was seen that blending nano particles with these type of emulsion fuel would improve performance and reduce emission of an IC Engine characteristics.*

Key words-- *Fossil Fuel, Biodiesel, Bioethanol, Biomethane, and Biomass from Wastes or Hydrogen.*

I. INTRODUCTION

The increase in the use of fuel based engine in various applications like agriculture, transport and power generation increase the demand of diesel, due to the high need of the fuel price and gets rising. The increase in use of fuels leads to emission of the diesel engine gets increased day by day, is the reasons makes us to use of alternate fuels and emission reduction technology. When an alternate fuel is used in an IC engines, reduction in toxic emissions like oxides of nitrogen (NOx), oxides of carbon (CO), percentage is reduced when compared with diesel fuel. Alagu, R. M et al (2018) studied the thermal and catalytic pyrolysis were performed on neem seed and a maximum pyrolytic oil yield of 60% was observed for catalytic pyrolysis using $Al_2O_3$and K_2CO_3 catalysts. Higher calorific and pH values of 23.837 MJ/kg and 5.96 respectively were observed in the pyrolytic oil obtained from the catalytic pyrolysis using Al2O3 catalysts. It is found that NOx emission was observed less at full load for both the blends (upto 20.7%) due to reduced combustion temperature caused by water content present in the blends. Athirvel, et al (2016) used the waste cooking oil methyl ester is a viable alternative fuel in compression ignition engine, because of renewable nature, non-toxicity, low cost. Due to this minimization of greenhouse gases, CO_2, SO_2 and NO, this is to notice the performance, combustion and emission parameters utilization of blend in diesel. Carbon monoxide gets decreased and brake thermal efficiency increases, there is a minimum increase in oxides of nitrogen. ANN modelling proven as minimum error percentage of the performance and emission characteristics.

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Baskar, et al (2017) made an attempt to reduce the air pollution and the engine exhaust, diesel-water emulsion is used as a fuel, oxygen line is connect with the inlet valve and intake air is enriched with 27% of oxygen and water-fuel emulsion of 10%. This is not only to reduce the emission but also to reduce the ignition delay and to overcome power and torque loss. Reduce in NO_X, HC emission. Oxygen is used in the intake air so brake thermal efficiency increased, NO level is increased. The diesel water emulsion is found to be most suitable fuel due to reduction in particulate matter and NO_x emission, besides that it also improves the brake thermal efficiency. A reduction in NO_x emission was observed due to reduction in combustion chamber temperature as the water concentration increases. The brake thermal efficiency was enhanced, combustion characteristics improved and there is also a reduction in HC emissions. The brake thermal efficiency was enhanced, combustion characteristics improved and there is also a reduction in HC emissions. Çelebi, et al (2017) The higher BSFC results observed with the higher biodiesel ratios. Higher compression ratio resulted with improved BSFC. All biodiesel blends improved diesel engine vibration. H2 addition has improved engine vibration. Biodiesels that are produced from frequency spectrum indicated that this decrement was primarily lowered due to less energy transmitted through engine pistons that converted from chemical energy of fuels. Pongamia Pinnata and Tung oils used as a biodiesel and its blended with low sulphur diesel fuel, volume of 50% and 75%. High viscous fuel and hydrogen is used as the products, hydrogen gas was injected to inlet manifold and to mix with high viscous fluid. Brake specific fuel consumption was increased due to hydrogen addition, vibration of the engine is reduce with biodiesel and hydrogen. Higher BSFC and H2 further improves the vibration for low and medium load. Dhinesh, et al (2017) A novel bio fuel, Cymbopogon Flexuous is used as an alternative energy source. Resulting in higher thermal efficiency and lower HC, CO, emission. NOx and smoke emission was simultaneously reduced by 3% and 6.6%Due to higher thermal stability and oxygen buffer of Cerium oxide nano particle the brake thermal efficiency was higher by 4.76% and cylinder pressure and heat release rate was also higher. Catalyst can improve performance and emission characteristics, here diesel, bio-diesel and alumina nanoparticle used as a fuel. Both performance and emission test was conducted in a CI single cylinder engine, dosages of alumina were 30, 60, 90 ppm for each fuel blend. Results torque, power, brae thermal efficiency, exhaust gas temperature and SFC reduces. CO, UHC emission and the percentage of NO_X increases, negative statistical correlation between CO and NO emission Cymbopogonflexuosus is used as a biofuel and cerium oxide is used as nanoparticles, and synthesized method of sol-gel combustion. 20% of biofuel mixed with diesel and nanoparticles of different ratio as 10, 20,30 ppm, load condition with constant speed of 1500 rpm NO_X and smoke emission reduces and it has higher thermal stability and high brake thermal efficiency due to oxygen buffer in the cerium oxide nanoparticles even cylinder pressure and heat release rate is higher.

Ghanbari, et al (2017) Nano additives on fuel properties present here, Density and kinematic viscosity of the nano emulsion fuel increases due to the presence of water. Multi wall carbon nano tube and nano silver particle is used as an additive agent, biodiesel and diesel was blended and fuel was prepared. Multiwalled carbon nano tube has 40, 80 and 20 ppm, nano silver particles as 40, 80 and 120 ppm. Test was conducted on six cylinder, four stroke DI engine with different speed, the result due to this blend was increased diesel engine performance and engine power, torque output 2%, brake specific fuel consumption decreased 7.08%. CO_2, CNT increased, CO and UHC emission decreased due to nano particles blend. NO_X emission increased, performance and emission characteristics with correlation coefficient in range of 0.93-1. Adding nano particles with diesel

and biodiesel fuels, increases diesel engine performance variable includes engine power it results torque output up to 2%, brake specific fuel consumption decreased up to 7.08% (approx) when compared with diesel fuel. CO_2 emission increased 17.03% but CO emission is lower up to 25.17%, UHC decreased 28.56%, NOx increased 25.32%. silver and multi wall carbon nano tubes were used as a nano particles with biodiesel blend diesel. Hagos, et al (2017) The commonly used fuel oxygenators in diesel engines are water, alcohol, biodiesel and the combinations of these. Secondary atomization resulting from the micro-explosion phenomenon of emulsified fuels and fuel oxygenation are responsible for the improvement of combustion, performance and CO and PM emissions. Latent heat of vaporization is found to be responsible for the reduction of NOx emissions. The current review article targets the blending and emulsification techniques used in the oxygenation and fuel substitution of diesel. Water, alcohol, biodiesel are commonly used fuel oxygenators in diesel engine, blending fuel with oxygen. Overall efficiency of diesel engine 45%, but it has high emission drawbacks PM (particulate matter), THC (total gaseous hydrocarbons), NO_X, SO_X (sulphur oxides), CO_2, CO and smoke.

II. EXPERIMENTAL SETUP

The experimental work was done on a Four Stroke Single Cylinder CI Engine with Mechanical Load (Belt Drum). In this experimental investigation, Engine is sample fuel, Performance and Emission characteristics of these samples were found. Which was compared with that those of diesel.

Figure 1 Single Cylinder 4 Stroke CI Engine with Mechanical Load (Belt Drum)

Table 1 Engine specifications

Type of Engine	**Single Cylinder 4 Stroke CI Engine – Constant Speed**
Engine Make	KIRLOSKAR
Power (BP)	3.7kW (5 BHP)
Speed (N)	1500 rpm
Bore (B)	80 mm
Stroke (SL)	110 mm

Cooling Type	Water Cooled
Fuel	Diesel
Circumference of Break Drum (Cb)	0.785 m
Coefficient of Discharge	0.65
Lubrication	Splash

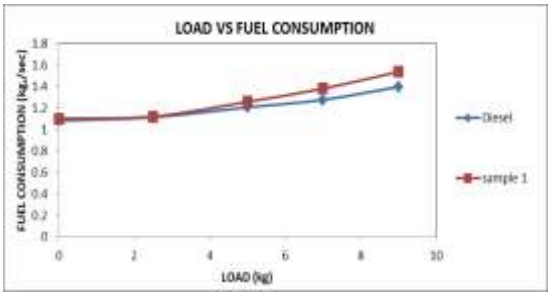

Figure 2 Load Vs Fuel Consumption

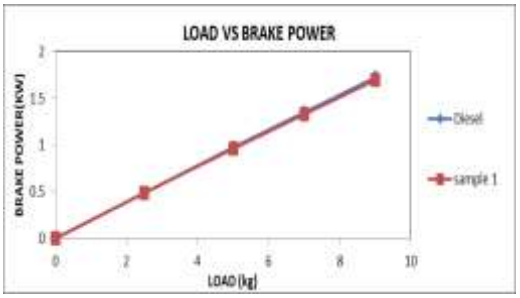

Figure 3 Load Vs Brake Power

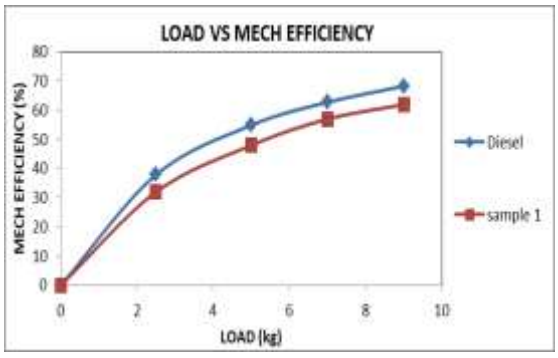

Figure 4 Load Vs Mechanical Efficiency graph

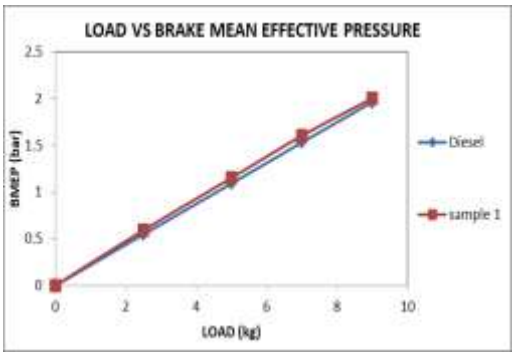

Figure 5 Load Vs Brake Mean Effective Pressure

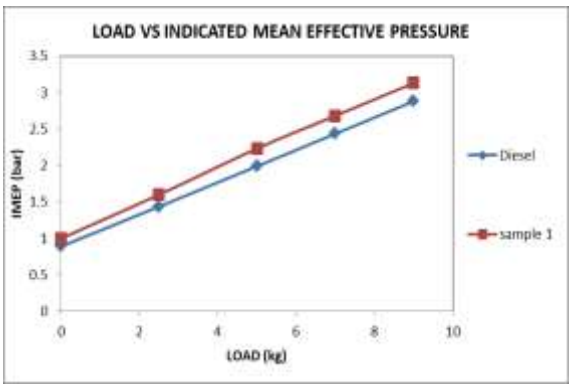

Figure 6 Load Vs Indicated Mean Effective Pressure graph

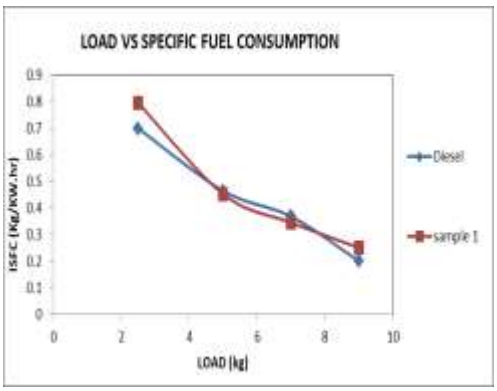

Figure 7 Load Vs Specific Fuel Consumption graph

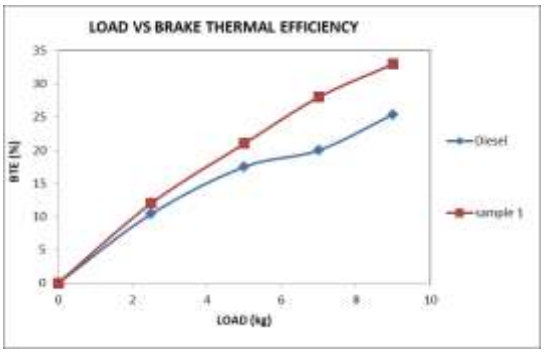

Figure 8 Load Vs Brake Thermal Efficiency

The Performance of biodiesel is better than diesel which is shown in the Fig.2 and with the described sample the diesel has very less fuel consumption than sample. This is because of less calorific value of the fuel then diesel. The analysis shown in Fig.3, that the brake power of an IC engine with diesel and bio diesel has remain same. The sample made does not affect the brake power of the engine. The mechanical efficiency of the engine with biodiesel is not so good and the samples made are less mechanical efficient than diesel. The mean brake effective pressure of the engine also remained same and negotiable given in above Fig.5. The sample made does not affect the brake power of the engine when compared with diesel. The indicated mean effective pressure of sample is high efficient than the diesel as shown in Fig.6. Among these, sample shows its greatest potential in achievement. The specific consumption of fuel is remained same and negotiable are shows the result in Fig.7. The samples have improved brake thermal efficiency, due to the frictional power increase shown in above Fig.8. The objective of this experiment is to analyze the effects of using emulsion fuel in CI engine instead of diesel. A "AVL" Type Digas 444N, Emission analyzer was used to analyze the exhaust gases, the analyzer can measure the concentration of CO, CO2, O2, NOx and HC. The Emission analyzer and its specifications.

Table 2 AVL-Exhaust gas analyzer Specification

Type	Digas 444N
Manufacturer	AVL
Materials	HDPE Case, medium grey; polycarbonate membrane switch; stainless steel probe
Calibration Interval	60 seconds
Storage Environment	0 to 50°C, 0 to 95% relative humidity
Operating Environment	5 to 45°C, 0 to 95% relative humidity, non-condensing
Sample Gas Flow	180 litres/min
Power source	11 to 22VDC/100-300 VAC@50 Hz
Power consumption	15W Max

Directly measures and Displays	• Carbon Monoxide level: (0 to 15% vol) • Oxygen level (0 to at least 25%) • NO_X level (0-5000ppmvol) • Carbon dioxide level (0-20% vol) • Hydro Carbon level(0-20000 ppm vol) • Lamda (0-9.999)
Oxygen sensor type	Electro Chemical
Oxygen sensor mode	O_2 –SENS1

Emission Test

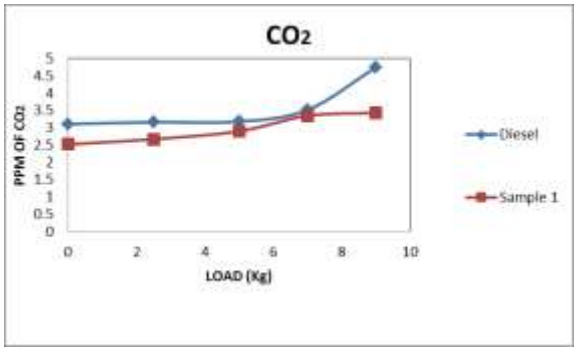

Figure 9 Load Vs CO2 Emission graph

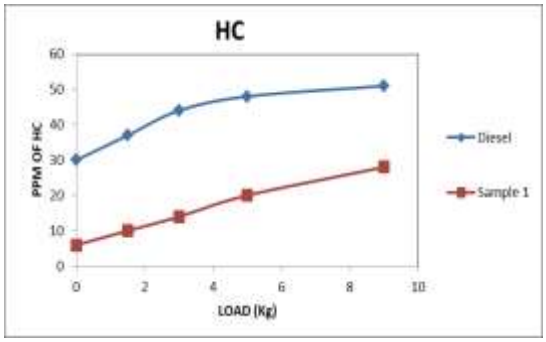

Figure 10 Load Vs HC Emission graph

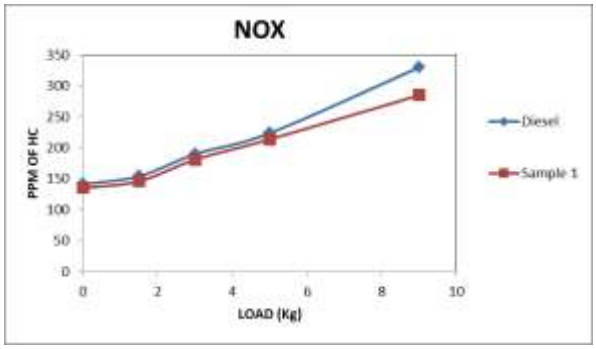

Figure 11 Load Vs NOX Emission graph

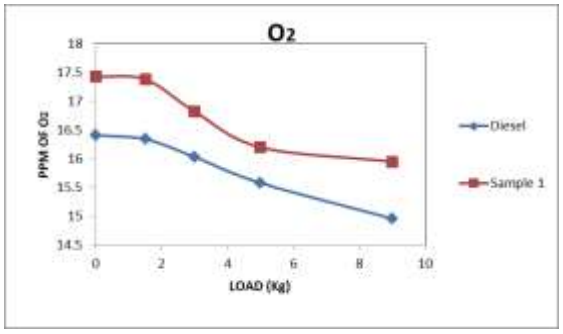

Figure 12 Load Vs O2 Emission graph

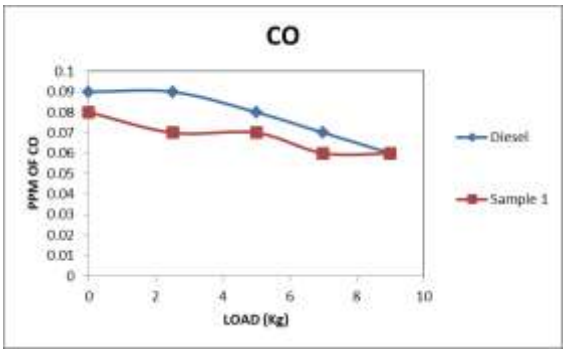

Figure 13 Load Vs CO Emission graph

CO emission of diesel is high when compared to biodiesel, It is due to less carbon content in sample fuel The emission of CO_2 is decreased in biodiesel which is shown in figure 9. because of renewable nature, non-toxicity. Due to this minimization of greenhouse gases, CO_2, This is to notice the performance, combustion and emission parameters utilization of biodiesel. The emissions of hydrocarbons are decreased efficiently and satisfactory to reduce the air pollution and the engine exhaust, this is due chemical composition of fuel is burnt completely in the chamber. All Samples compared with diesel are efficient in reducing the toxic gas emission and makes smoke emission. The emission of NO_X was reduced marginally The biodiesel results in increase in O_2 emission, biodiesel are commonly used fuel oxygenators in diesel engine, blending fuel with oxygen shown in Fig.12. Overall betterment in emission characteristics of diesel engine when compared with diesel.

III. CONCLUSION

This paper concludes with the performance, emission and the combustion characteristics of a diesel engine using biodiesel fuels have experimentally investigated. The use of biodiesel in diesel engine doesn't affect the brake power and does not make a major difference in brake mean effective pressure and indicated mean effective pressure and have showed up to 7% increase in indicated power. The emission from diesel is higher than the biodiesel ,where biodiesel showed a good percentage reduction in emission .The biodiesel showed upto 22%,12%,58% and 13% reduction in CO,CO_2,HC and NOx emissions. The smoke emission of diesel engine was reduced drastically for all samples compared to diesel at all engine loads. Emission of CO, HC, and NO_x, was lower than the diesel according to the analysation and expected results are obtained.

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