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EXPERIMENTAL INVESTIGATION OF VEGETABLE METHYL ESTER ADDITIVE IN DIESEL ENGINE

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ABSTRACT:
nowadays, researchers are view in multidimensional of the consumption of fossil fuels, energy conversion and emission control. Many researches proved that biodiesel is the best alternate sources for conventional diesel fuel. In worldwide biodiesel is extracted from vegetable oil obtained from transesterification process. Compare to methyl esters of nerium oil, ethyl esters of nerium oil has lower viscosity. In the present investigation, the nerium oil methyl ester with L-ascorbic acid as additive is used to study the performance and emission characteristics of single cylinder, four stroke CI diesel engines. The nerium oil methyl ester (NOME) blends percentage are 20%, 40%, 60%, 80% and 100% of with 1% L-ascorbic acid as additive. The break thermal efficiency of B20 blend with 1% L-ascorbic acid is 3.12% higher when compare to the pure diesel at full load condition. The BSFC decreased 3.84% by adding of LA additive with B20 blend (B20+LA 1%) at full load condition. The HC, CO and NO_X emissions are found slightly reduced than that of pure diesel.
Key Words: Nerium oil methyl ester, L-ascorbic acid, Viscosity, Performance, Emission.

INTRODUCTION :

Investigation of alternative energy sources have been continuing widely because of increasing Consumption of fossil fuels, energy conversion and global warming issue as such situation demand for searching alternative fuels for conventional diesel engines. Vegitable oil had a promise as suitable alternative source for conventional diesel engine. vegitable oils had higher viscosity because it contains triglycerides and fatty acids. So it is not possible to use directly to the engine as fuel so why transesterification process is used to convert it into esters. The converted free fatty acid and vegetable oil esters are called as biodiesel. Now a days biodiesel has used as alternate for diesel because it have more advantage like global warming benefits and mainly it is converted from renewable vegetable source.And another one benefit of biodiesel is operates in diesel engine with little (or) no modification. [1-4].Extraction of biodiesel is mainly from edible oils like pumpkin, sunflower, castor and some other vegetable oils. Since india is not satisfied in the production of edible oil with compliance of non edible oils based on plants such as jatropha, neem, nerium, rubber, pongamia seed and etc., these seed oil esters are used as alternate for pure diesel.

Investigate the combustion and performance characteristics of vegetable oil biodiesels such as sunflower oil, waste cooking oil, castor oil, jatropha oil and these all are compared with diesel fuel. From the investigations sunflower oil biodiesel has higher brake thermal efficiency for various load conditions. Among the biodiesel research sunflower oil methyl esters have higher NOx emission. At the same time all the biodiesels emits lower CO, HC, and exhaust emissions when compared to diesel fuel. Vegetable oil methyl esters emits less amount of toxic gases and minimum amount of CO2 because of addition of methanol. Some researchers found that slight change in the NOx, CO, and HC over pure diesel. Usage of non edible vegetable oil biodiesels in diesel engine, it is noted that increasing treand in exhaust gas temperature at full load condition.

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MATERIALS AND METHODS:

Transesterification:

In this transesterification process 2000 ml of nerium oil is kept in the flask. Simultaneously on the other side 20 grms NaOH and calculated amount of methanol is mixed until both are dissolved. Then the dissolved NaOH and methanol is mixed with the nerium oil and it is undergoes to stirring process by using magnetic stirrer. At the time of stirring process it is kept at 60 ºC in the hit plate. This process allowed for upto 2 hours and it took 6 hours to settle down the unwanted glycerin at the bottom of the beaker and the required methyl esters of nerium oil is floated on the top of the beaker. Then the unwanted methanol is removed by heating the coarse biodiesel for 15-20 minutes at 100°C. This coarse biodiesel have some amount of the impurities which are removed by washing process with 500ml of water. Then the neat solution is called nerium oil methyl ester.

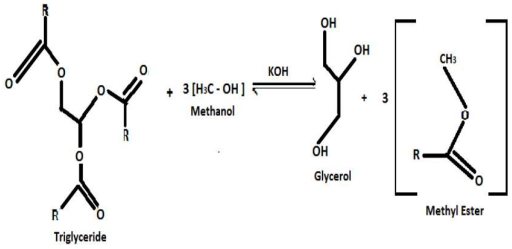

Fig. 1. Transesterification

PROPERTIES OF NERIUM BIODIESEL COMPARED WITH DIESEL :

Table I. Properties of Nerium Biodiesel

Properties	Units	Diesel	Nerium oil methyl ester(NOME)
Calorific value	MJ/kg	43.2	42.19
Kinematic viscosity 40℃	cst	3.1	3.7
Density	Kg/mm^3	830	850
Flash point	℃	65	70
Fire point	℃	69	83
Cetane number		45	55

Experimental Setup :

A constant speed single cylinder diesel engine is connected with eddy current dynamometer which is used to find out the performance, emission and combustion characteristics. The engine is constantly connected with data acquisition system and AVL gas analyzer and smoke meter. The Fig.2 shows the experimental setup.

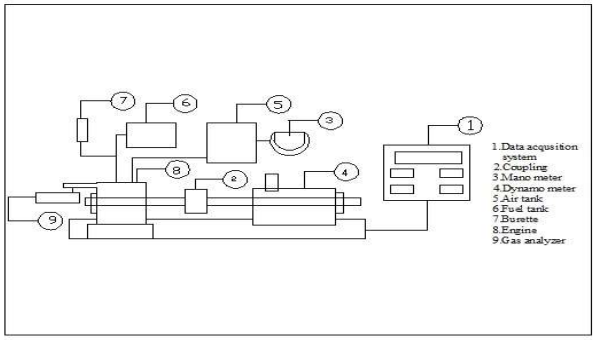

Fig. 2. Experimental set up

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Engine Specification:

Table 2. Engine Specification

Manufacturer	Kirloskar oil engines limited
Type of Engine	Vertical, 4-Stroke Single cylinder
Model	SV1
Rated Output	5.2 kW
Speed	1500 rpm
Compression Ratio	17.5:1
Bore and stroke	87.5 x 110 (mm)

Experiment procedure :

The manual diesel engine was started by using mechanical lever and warmed up at low idle, long enough to establish the recommended oil pressure.this engine is allowed to run 15-20 mins to attain the steady state condition with constant speed of 1500 rpm. Then various performance, combustion and emission values were noted for different load conditions. The exhaust gas emissions like CO, UBHC, NOx and particulate matters readings were measured by using exhaust gas analyzer which is connected with exhaust pipe line. Smoke capacity of engine is measured by smoke meter. Three sets of readings were taken during each load condition for standardizing the value.

RESULTS AND DISCUSSION:

Performance Characteristics of Nerium Methyl Ester

Brake Thermal Efficiency (BTE):

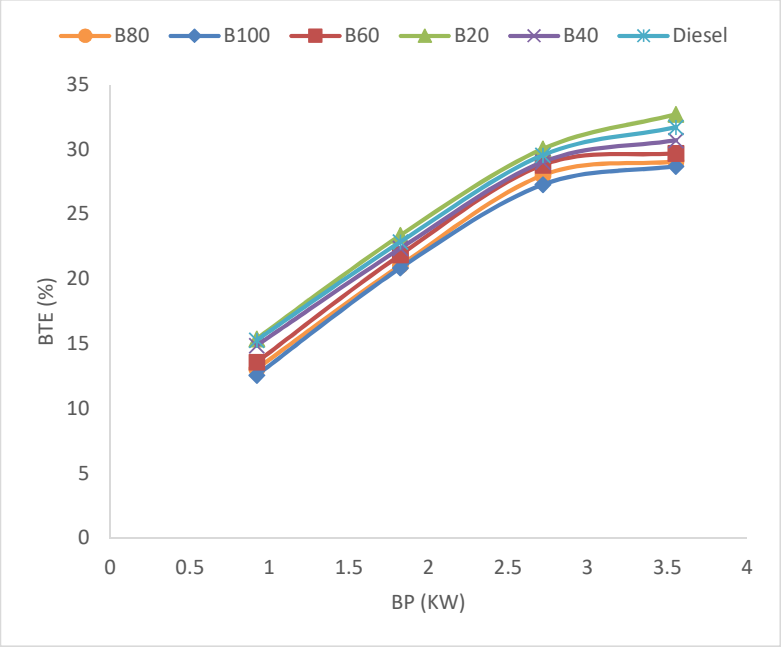

Fig.3. Variation of brake thermal efficiency with brake power

The brake thermal efficiency is noted for nerium oil methyl esters with anti oxidant with respect to different brake power which is shown in Fig.3. it shows that pure diesel shows higher brake thermal efficiency for all loads. As we know that the biodiesel have lower heating value, high viscosity and low volatility when compared to pure diesel. The Adding of 1% L-ascorbic acid as an additive, improve the oxidation stability of nerium oil biodiesel and also biodiesel 1% (NOME) having excess

oxygen content, When this leads to complete combustion of B20+LA 1% blend have 3.12% higher brake thermal efficiency compare to the diesel at full load.

Brake Specific Fuel Consumption (BSFC).:

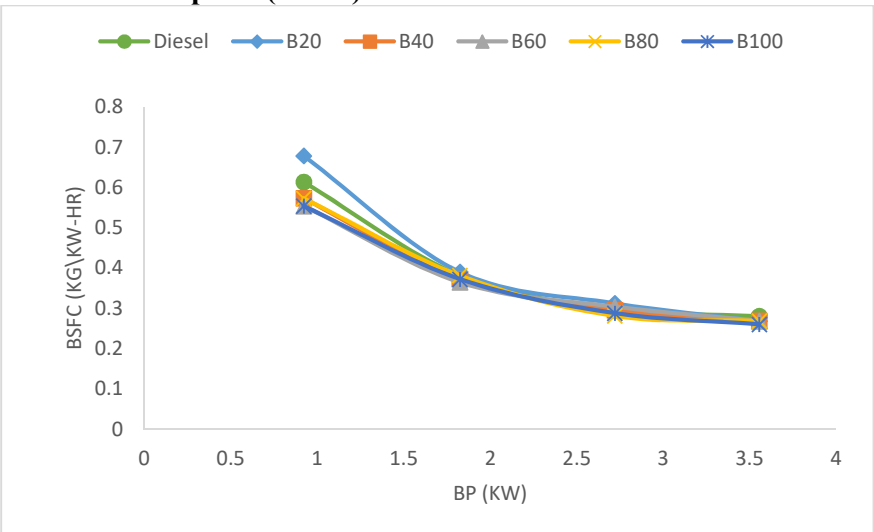

Fig. 4 Variation of brake specific fuel consumption with brake power

The variation of specific fuel consumption of nerium oil methyl ester and antioxidant additive, diesel and their blends were shown in the Fig. 4. The engine takes more fuel to generate the same power output, this is owing to As lower calorific value of nerium biodiesel. These made higher specific energy consumption for the nerium biodiesel and their blends.. Further it is also seen by the Fig. 4. At full load condition BSFC decreased 3.84% by adding of LA additive with B20 blend (B20+LA 1%). This is owing to proper and more complete combustion which results from anti oxidant addition.

Exhaust gas temperature:

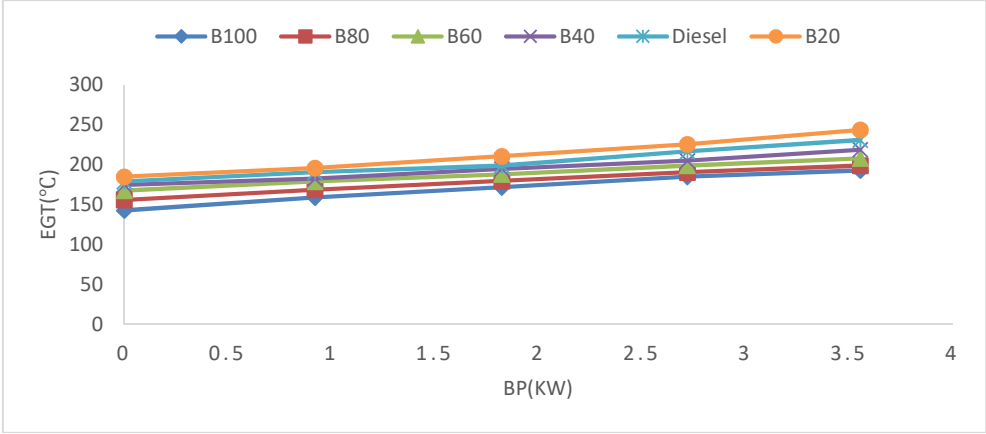

Fig. 5.Variation of exhaust gas temperature with brake power

The variation of exhaust gas temperature of nerium biodiesel, diesel and their blends were shown in the Fig. 5. The Exhaust gas temperature is gradually increases with respect to increasing percentage of blends of neurim oil esters and adding of LA additive. At full load condition B20 (B20+LA 1%) blend produces highest Exhaust gas temperature at full load condition over all other blends. This may be due to the proper combustion, which leads to higher combustion temperatures when compared to other biodiesel blends.

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Emission Characteristics of Nerium Methyl Ester :

Hydrocarbon emission

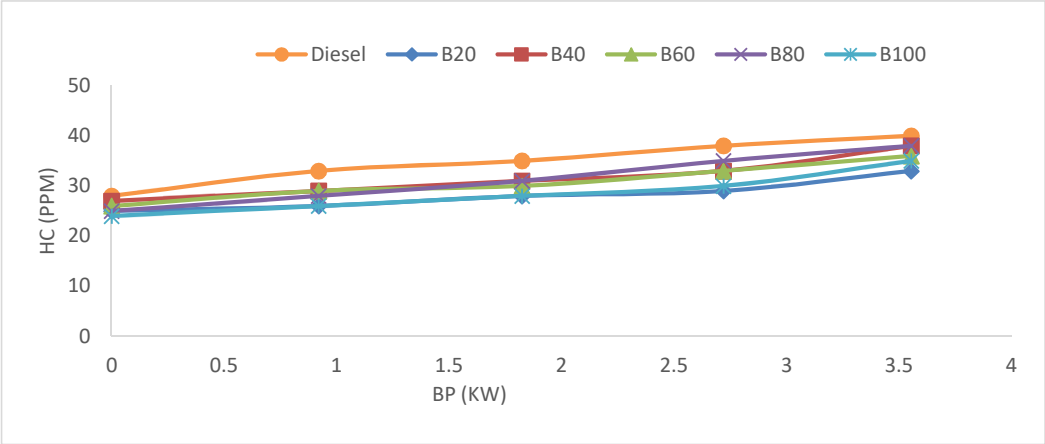

Fig. 6. Variation of hydrocarbon with brake power

The Fig. 6 shows the variation of hydrocarbon emission of nerium biodiesel, diesel and their blends. From the results the neurim oil methyl esters and their blends contains higher oxygen content because of this the HC emission is reduced by complete combustion and also LA antioxidant additive is a reducing agent and reducefunctional groups present the NOME with 1% of L-Ascorbic acid. The B20 blend of nerium oil methyl ester has 17.5% lesser HC emission at full load condition.

Carbon monoxide emission

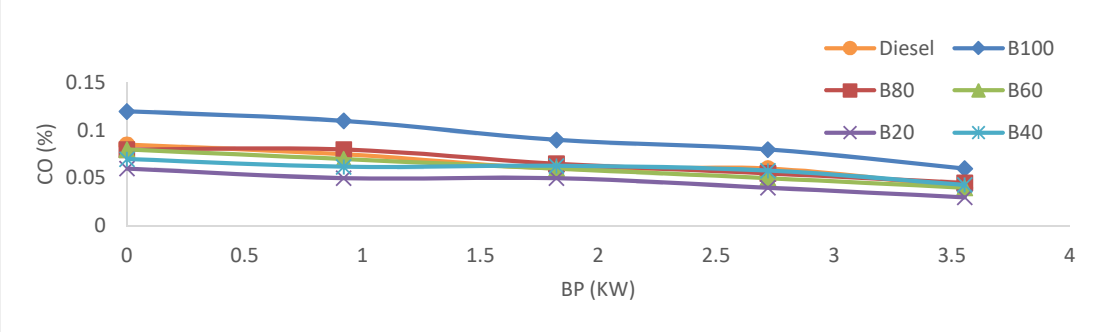

Fig. 7. Variation of carbon monoxide with brake

The variation of carbon monoxide emission of nerium biodiesel, diesel and their blends is shown in the Fig.7. The combustion values are increased and reducing the carbon monoxide emission because of higher oxygen content of the nerium oil biodiesel. The B20 blend of nerium oil methyl ester has 25% lesser CO emission at full load conditions. The adding of antioxidant at 1%, the slightly decrease of CO Emission. This is due to directly related to the amount of OH radicals present in the reaction.

Oxides of nitrogen:

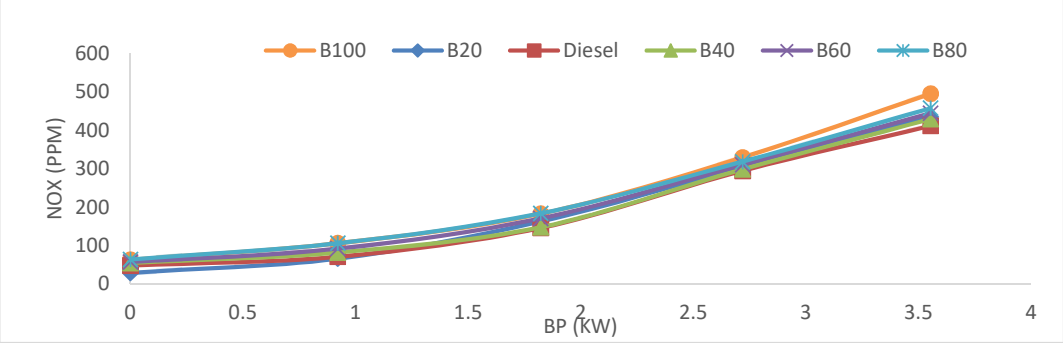

Fig. 8.Variation of NOx emission with brake power

The variation between NOx emission with brake power for various blending ratios is shown in the Fig. 8. Compare to diesel fuel the NOx emissions for neurim oil biodiesel is slightly high because of cetane number and oxygen content is high, the combustion temperature was also high. Thus the NOx emission was higher for the nerium biodiesel and their blends. Further, The NO_X emission has been reducing by adding of antioxidant additive (L-ascorbic acid) This is due to reduction in the formation of free radicals by antioxidants.

Emission:

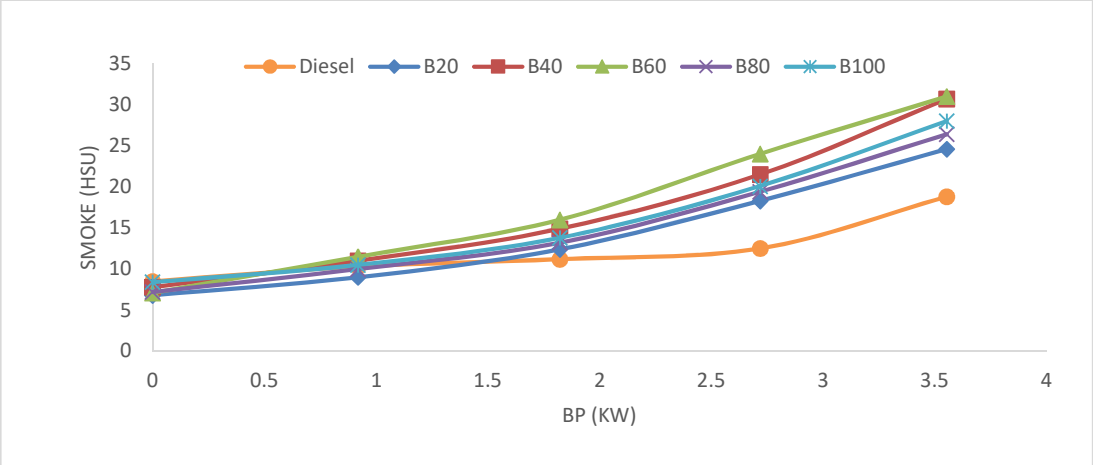

Fig. 9 Variation of smoke opacity with brake power

The variation of smoke emission of nerium biodiesel, diesel and their blends were shown in the figure 4.7. It was reported that smoke is formed by the incomplete combustion of the fuel. Since nerium biodiesel and their blends shown higher complete combustion it had shown slightly higher smoke emissions.

CONCLUSION:

Nerium oil, being non-edible oil proves to be a very effective alternate fuel. Nerium biodiesel was prepared by the transesterification process. After that the kinematic viscosity and density is reduced while the calorific value is increased. The brake thermal efficiency is 3.12% higher and brake specific fuel consumption is 3.84% lower than that of diesel fuel at full load conditions. Nerium bio diesel show better performance with 20% blend with 80% conventional fuel. The results show that 17.25% and 25% lower, HC and NOx emissions when compared to the diesel at full load conditions. Smoke is slightly higher than diesel. It can be substitute mineral diesel without affecting engine performance.

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