Performance Evaluation And Emission Analysis Of Four Stroke Single Cylinder Diesel Engine Using Cotton Seed Bio Diesel As an Alternative Fuel With Additives

S. D. Jadhav[1], N. S. Biradar[2], K. P. Kolhe[3], S. L. Chavan[4]
PG Student[1], PG Guide[2], PG Coordinator[3], PG Co-Guide[4]
[1, 2, 3, 4] JSPM's Imperial College of Engineering & Research, Wagholi, Pune-14, India

***Abstract:** To reduce environmental pollution like global warming and air pollution has highly promoted the research of application of study of renewable fuel like bio-diesel and its blends to internal combustion engine. In this project practically investigated & compared the performance & emission of 4 stroke single cylinder diesel engine using diesel & diesel-cotton seed biodiesel blends with additives. In diesel, blends are 10%, 20%, 30%, 40%, 50%, 60%, 70% of cotton seed biodiesel with each 10 ml of Nitromethane and Nitroethane in each blend by volume basis. For existing CI engine with brake specific fuel consumption, brake thermal efficiency are improved and emission of NOx and smoke are reduced without modification in engine. To carry the test we used computerized 4 stroke single cylinder kirlosker make CI engine & fuel efficiency monitor for emission analysis. Performance evaluation contains evaluation of brake power, friction power, brake specific fuel consumption, brake thermal efficiecy. Emission analysis contain analysis of co%, no (ppm), no2 (ppm), exhaust gas temp (0c).*

***Key Words-** cotton seed biodiesel, Diesel, fuel blends, Nitromethane, Nitroethane, Diesel engine, performance, Exhaust emission*

1. INTRODUCTION

Nitromethane (NM) and Nitroethane (NE) are using as nitrogenated additives to improve brake specific fuel consumption (BSFC), combustion performance and reduce emission from diesel engine. Exhaust emission of compression ignition (CI) engine will evaluated experimentally for sole diesel and NM/NE-Diesel-cotton seed biodiesel fuel blends. The addition of nitrogenated additives to the standard diesel fuel caused brake thermal efficiency (BTE) increased. The smoke emission decreased at the maximum torque speed (1500 rpm).

Exhaust gases of an engine can have up to 2000 ppm of oxides of nitrogen. Most of this will be nitrogen oxide (NO), with a small amount of nitrogen dioxide (NO2).NOx is very undesirable. Released NOx reacts in the atmosphere to form ozone and is one of the major causes of photochemical smog. NOx is created mostly from nitrogen in the air. At high temperature and pressure higher levels of NOx is created and at low temperature lower level of NOx is produced. In addition to temperature, the formation of NOx depends on pressure and air-fuel ratio..

2. EXPERIMENTAL SET UP

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Fig 2.1 Photographic View of Experimental set up

Table 2.1 Specification of engine.

Particulars	Specifications
Product	VCR Engine test setup 1 cylinder, 4 stroke, Diesel (Computerized)
Engine	Make Kirloskar, Type 1 cylinder, 4 stroke Diesel, water cooled, power 3.5 kW at 1500 rpm, stroke 110 mm, bore 87.5 mm. 661 cc, CR 17.5, Modified to VCR engine CR range 12 to 18
Dynamometer	Type eddy current, water cooled, with loading unit
Propeller Shafts	With universal joints
Fuel Tank	Capacity 15 lit with glass fuel metering column
Calorimeter & Pump	Pipe in pipe, Mono-block Pump
Crank angle	Resolution 1 Deg, Speed 5500 RPM
sensor	with TDC pulse
Temperature sensor	Type RTD, PT100 and Thermocouple, Type K
Load indicator	Digital, Range 0-50 Kg, Supply 230VAC
Load Sensor	Load cell, type strain gauge, range 0-50 Kg
Rota meter	Engine cooling 40-400 LPH; Calorimeter 25-250 LPH
Overall Dimensions	W 2000 x D 2500 x H 1500 mm

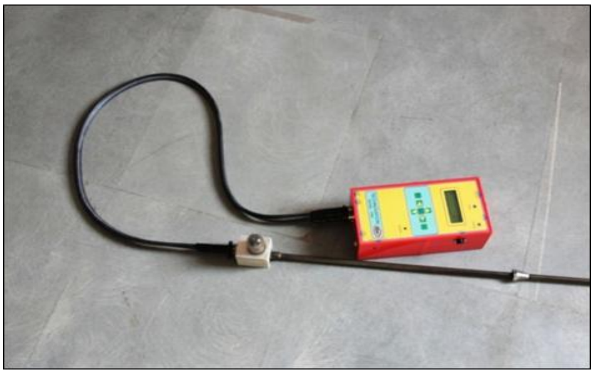

Fig. 2.2 Photographic View of Emission analyzer

3. PROCEDURE

Cotton seed Biodiesel Production

Biodiesel is commonly produced through chemical trans esterification, a process in which triglycerides in vegetable oils or animal fats react with an alcohol in the presence of a catalyst. Transesterification reaction is accomplished in a stirred reactor maintaining the temperature 55-60˚C the trans esterification process of cotton seed oil was performed using 13 gm of potassium hydroxide and 250 mL of methanol per liter of raw cotton seed oil. First, raw cotton seed oil was taken in a container and stirred with a mechanical stirrer and simultaneously heated with the help of a heating coil. The speed of the stirrer should be minimal till the temperature of the raw oil reaches 55°C.Then, KOH was mixed with methanol separately in a beaker and stirred until they were properly dissolved. The solution was then added to the preheated cotton seed oil in the reactor and the reactor was closed with air tight lid. After the mixture was stirred for 30 min at a fixed temperature of 60°C, the solution was transferred to a glass container where the separation of glycerin takes place and allowed to settle down for15 h.

Now the methyl ester of cotton seed oil (biodiesel) gets collected in the upper portion of the glass container, whereas glycerin gets collected at the bottom portion and drain the bottom layer containing glycerin. Then biodiesel was washed with water repeatedly for 4 to 5 times at a time interval of 1 hr until no glycerin was left in the biodiesel. Now the biodiesel was heated at 103°C to 105°C in order to remove the water contained in it. Finally, the produced Methyl Ester of Cotton Seed Oil (MECSO) was left to cool down and was ready for use.

For test engine, windows based engine performance analysis software package "engine-soft" was taken for on line performance evaluation. The emissions of various gases were measured by fuel efficiency monitor. The tests were conducted at the rated speed of 1500 rpm at different break power. The engine was started with diesel fuel and warmed up. The warm up period ends when cooling water temperature is stabilized. Then fuel consumption, brake power, brake specific fuel consumption, brake thermal efficiency, exhaust gas temperature etc. Were measured. Same procedure was repeated for NM/NE-diesel -cotton seed biodiesel.

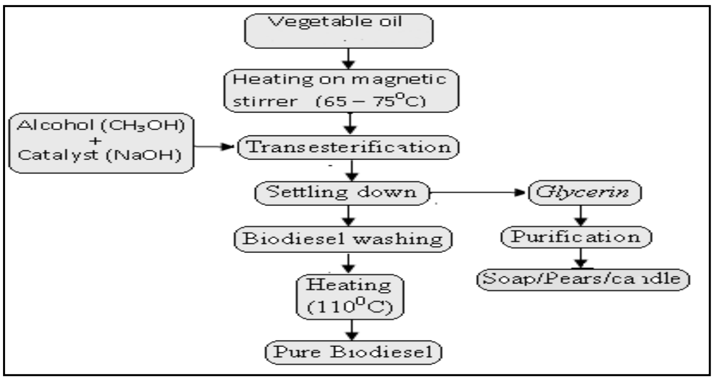

Fig. 3.1 Flow chart of Biodiesel production

4. OBSERVATION TABLES

Table 4.1 Readings for BSFC at various Brake power

Break power	1	2	3
Diesel (BSFC)	0.7	0.4	0.3
NM-NE-30%CSOBD(BSFC)	0.6	0.35	0.25

Table 4.2 Readings for BTH Effn at various BP

Break power	1	2	3	4
Diesel(BTH Effn)	12	22	27	29
NM-NE-30%CSOBD(BTH Effn)	11	20	24	25

Table 4.3 Readings for CO emission at various BP

Break power(kW)	0	1	2	3
Diesel (CO emission ppm)	0.12	0.1	0.07	0.05
NM-NE-30%CSOBD(CO emission ppm)	0.1	0.08	0.07	0.04

Table 4.4 Readings for HC emission at various BP

Break power(kW)	0	1	2	3
Diesel (HC emission ppm)	30	25	20	18
NM-NE-30%CSOBD(HC emission ppm)	28	23	19	15

Table 4.5 Readings for NOx emission at various BP

Break power	0	1	2	3
Diesel (NOx emission ppm)	0	1000	1800	3100
NM-NE-30%CSOBD(Nox emission ppm)	0	900	1500	2500

Table 4.6 Readings for Smoke Density at various BP

Break power	0	1	2	3
Diesel (Smoke Density)	0.7	0.9	1	1.3
NM-NE-30%CSOBD(Smoke Density)	0.2	0.5	0.8	1

Table 4.7 Properties Table

Properties	Cotton-seed oil	Bio-diesel	Diesel
Density (g/cc)	0.9	0.88	0.84
Boiling Point (° C)	319	262	248
Calorific Value(MJ/Kg)	41.95	38.51	45
Kinematic Viscosity at 34˚C(mm2/s)	29.215	7.2	3.0

5. RESULT

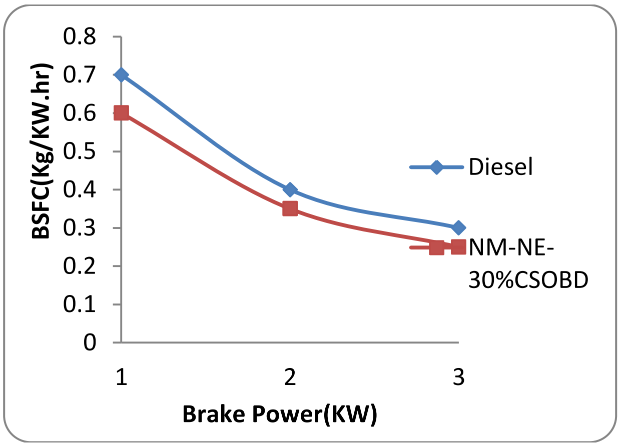

Fig.5.1 Variation of BSFC with BP

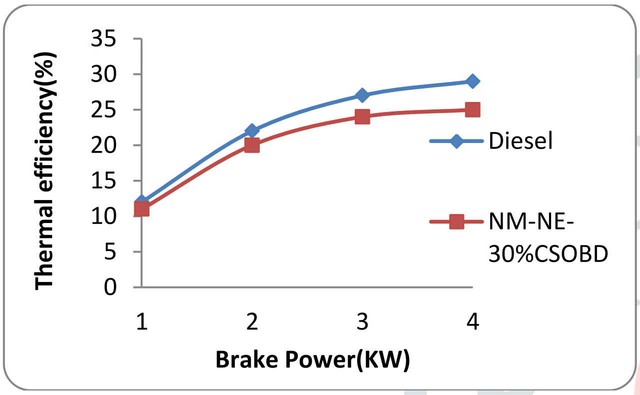

Fig.5.2 Variation of Thermal Efficiency with BP.

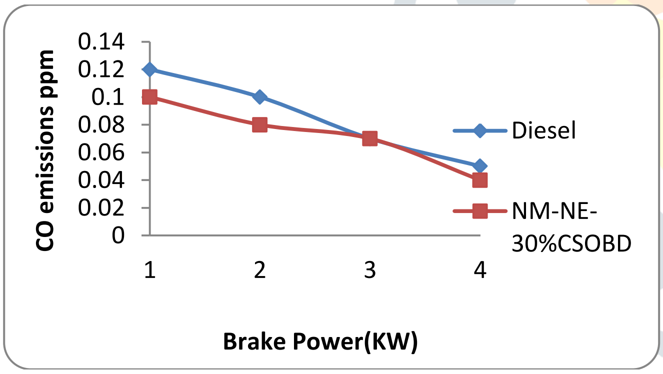

Fig. 5.3 Variation of CO emission with BP.

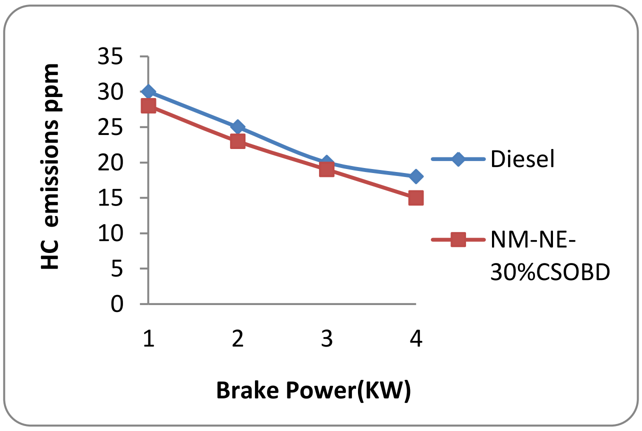

Fig.5.4 Variation of HC emission with BP.

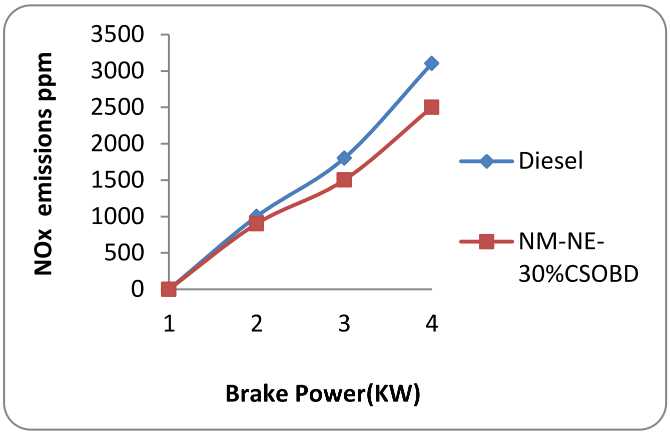

Fig.5.5 Variation of NOx emission with BP

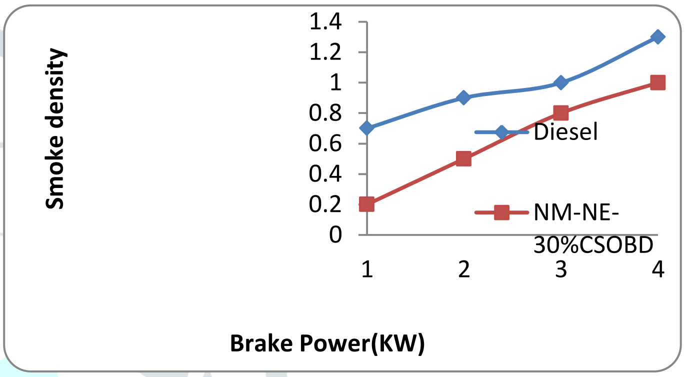

Fig.5.6 Variation of smoke density with BP

6. CONCLUSION

Cotton seed oil is renewable, clean burning fuel. Cotton seed Biodiesel blends can show performance characteristics close to diesel (Brake power, mechanical efficiency, and brake specific fuel consumption) hence can be used in compression ignition engine to reduce use of diesel. And in this work we will try to improve brake thermal efficiency and reduce emission by adding nitromethane & nitroethane .

Although calorific value of Cotton seed Biodiesel is lower than that of diesel, but by using some additives it may be improved. Emission of blended fuel more (CO, NO) but it can be reduced by supercharging, exhaust gas recirculation & catalytic converter. It is observed that the exhaust emission reduced by Cotton seed Biodiesel .Also we will try to reduce emission (NO) by adding Neopentane.

If Cotton seed Biodiesel production is done in mass basis, the use of diesel may be reduced significantly also cost

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