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Experimental Investigation Of Undi Oil Methyl Ester And Diesel Blends As A Fuel In Vcr Diesel Engine And Development Of Emission Models

#1Harshad.T.Magar, #2Shylesha Channapattana, #3Dr. Abhay Pawar

harshadmagar@gmail.com
svchanna@yahoo.co.in
pawar_abhay@rediffmail.com

[1] PG student,[2] Prof. ,[3] Prof. and Head of department
Rajarshi Shahu College of engineering, Pune, Maharashtra. India

ABSTRACT

For liquid fuels as an alternative to diesel, which is being used in large quantities in transport, agriculture, Industrial, commercial and domestic sector. Increase environmental awareness and depletion of resources are driving industry to develop viable alternative fuel from renewable resources that are environmentally more acceptable. Among the many alternative fuels biodiesel are considered are most desirable fuel and vegetable oil is potential candidate. The world is confronted with the twin crises of fuel depletion and environmental degradation. The indiscriminate extraction and consumption of fossil fuels have led to a reduce in petroleum reserve. Alternative fuel, energy conservation and management, energy efficiency and environmental protection have become important in recent years. The increasing import bill has necessitated the search in present study efforts can be made to investigate the performance characteristics of diesel blended Undi biodiesel in VCR compression ignition engine. This work also includes the combustion analysis and Emission modeling.

Keywords -Biodiesel, Undi Oil, Fuel Blends, Compression Ratio, Engine Load, Performance and Emissions, VCR Engine.

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I. INTRODUCTION

In recent years conventional sources are used mostly but these sources are one day comes to end because of that we need to discover the alternative for convention sources. Biodiesel is perfect option for conventional sources in which we can use Biodiesel in percentage like 10% 20% 40% 60% 80% & 100%.in the biodiesel (Undi oil) used here for performance, using biodiesel in diesel engine it's also controls on pollution because increase in population and also because of convention sources increase in pollution also effects on human life for minimizing biodiesel desire option using diesel in percentage. Energy is a major need for the development of country and the increase in population needs more energy for both economic and social development

Bawane ET. Al [1] the problem of using neat vegetable oils in diesel engines relates to their high viscosity. The high viscosity will lead to blockage of fuel lines, filters, high nozzle valve opening pressures and poor atomization. One hundred percent vegetable oils cannot be used safely in DI diesel engines. The problems of high fuel viscosity can be overcome by using esters, blending and heating. Vegetable oils exhibit longer combustion duration with moderate rates of pressure rise, unlike petroleum derived fuels. The use of vegetable oils, such as palm, soya bean, sunflower, peanut, and olive oil, as alternative fuels for diesel is being promoted in many countries.

II. LITERATURE REVIEW

Wagner et al. [4] conducted 200 h engine tests with soybean oil ester fuel on John Deere (4239T Model) engine. It was reported that the engine performance with methyl, ethyl and butyl esters was nearly the same as that with diesel fuel. There was no difference in thermal efficiency resulting from the use of the various fuels to power the engine. The esters showed a slight power loss and increased fuel consumption, which was attributed to the lower gross heating values. Engine wear was normal. There was, however, an increased carbon deposition on the pistons with the methyl and butyl esters. Emissions of oxides of nitrogen were significantly higher for the esters. They concluded that the ester should be used on a short-term basis, and that further testing to be done for determining long-term ester fuel effects...

C. Srinidhi at al. [2] performed an experiment analysis of performance parameter (such as brake power, break specific fuel consumption, brake thermal efficiency and Exhaust Gas temperature) and emission characteristics (NOx, HC, CO. etc.) is obtained for various bio diesel and diesel blends and compared with ordinary diesel at various loads on a modified variable compression ratio CI engine. The results of the investigation shows that the performance and emission characteristics of the engine fuelled with Undi oil methyl ester – diesel blends is comparable to the ordinary diesel. S.Sundarapandian and G.Devaradjane [5] experimental work done and evaluate the performance characteristics, combustion parameters and emissions of vegetable oil esters like Jatropha, Mahua and Neem Oil esters. From the results, it is found that the heat release and work done are reduced by about 4% for Jatropha, 5% for Mahua and 8% for Neem oil esters when compared to diesel. From the investigation, it is concluded that the performance of vegetable oil esters are good. Thus the developed model is highly compatible for simulation work with bio diesel as an alternative fuel.

III. TEST SET-UP

1. The supply mains of the control panel were switched ON.
2. The mains gate valve was opened and the pump was switched on and the water flow rate to the engine cylinder jacket (300 lit/hr) and the calorimeter (50 lit/hr) were set.
3. Engine was started by hand cranking and allowed to run for about 20-25 min to steady state conditions.
4. The engine had a compression ratio of 17.5 and a normal speed of 1500 rpm controlled by the governor. The engine is first run with neat diesel at loading conditions of 0%, 20%, 40%, 60%, 80%, and 100%. Between two loads trials, the engine was allowed to reach stable steady state condition by running it for 3 min before talking the readings. At each loading condition, performance parameters namely speed, exhaust gas temperature, brake power and emission parameters NOX, CO, HC, C were measured under steady state conditions. With the above experimental results, total fuel consumption, brake specific fuel consumption, brake specific energy consumption and brake thermal efficiency were calculated.
5. Engine was then run with blends of Undi mixed with diesel 20%, 40%, 60%, 80%, 100% by volume. Performance parameters and emission at each loading conditions were measured.
6. The whole set of experiments were repeated for compression ratio of 15,16,17,17.5 and 18.
7. The above described experimental procedure was repeated for Undi.

Table No. 1

Sr.	Test	B00	B20	B40	B60
1	Density Kg/m3	830	840	852	860
2	Viscosity	2.9	3.6	4.1	4.4
3	Cetane No	51	51.3	51.4	51.4
4	CV KJ/kg	42.5	41.3	41.1	41
6	Flash point 0c	65	76	108	130
7	Fire point 0c	78	101	142	158

IV. EXPERIMENTAL SET UP

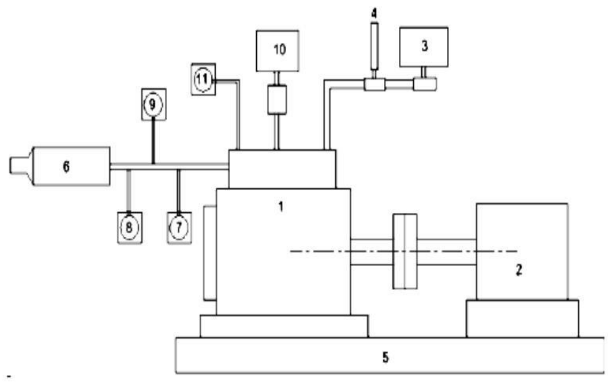
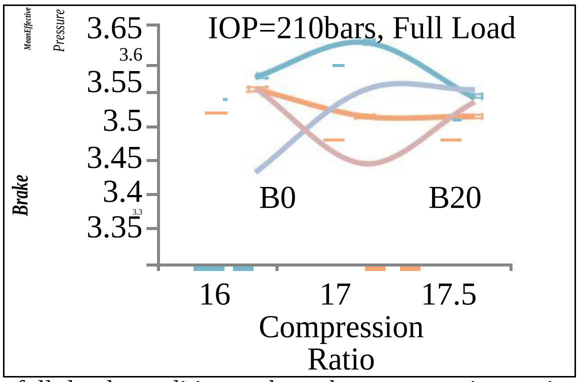


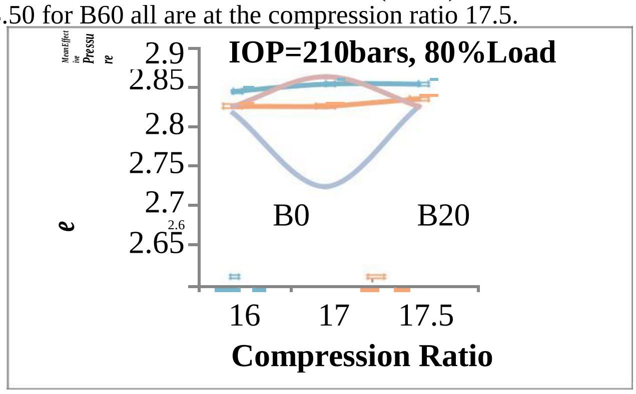
Fig.1:-Engine set up

Test Engine, 2.Electrical Dynamometer 3.Fuel Tank, 4.Fuel Burette, 5. Test Bed, 6. Silencer, 7.Smoke Meter, 8.HC/CO/NO_x/CO_2/O2Analyzer 9.Exhaust Temperature Sensor, 10 Air Flow Meter, 11.Stop watch

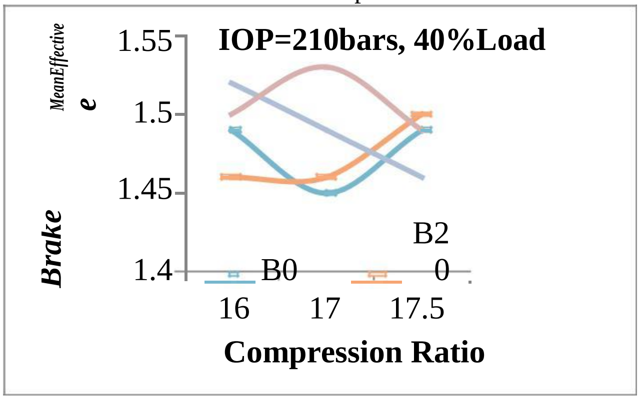
IV. RESULTS AND DISCUSSION



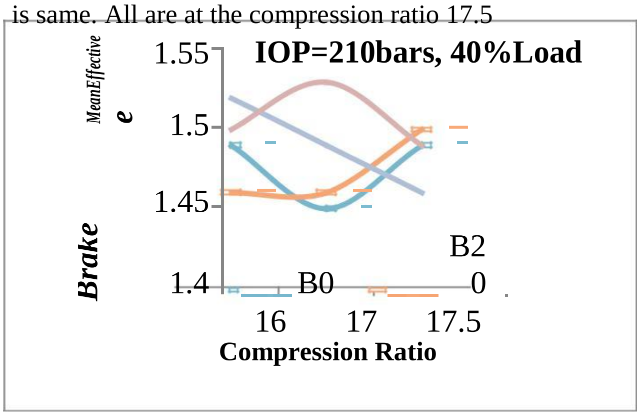
For full load condition, when the compression ratio is varied from 16 to 17.5, the highest pressure obtained is 3.52 bar for B40, 3.51 bar for B0 (diesel), 3.48 for B20, 3.50 for B60 all are at the compression ratio 17.5.



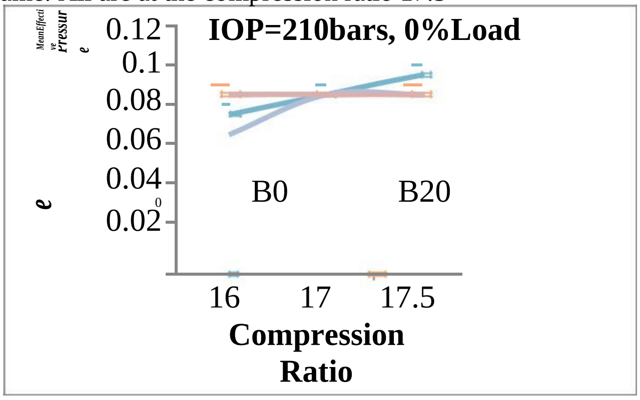
For 80% load condition, when the compression ratio is varied from 16 to 17.5, the highest pressure obtained is 2.86 bar for B0 (diesel), 2.84 bar for B20, 2.83bar for B40 and B60 is same .All are at the compression ratio 17.5.



For 40% load condition, when the compression ratio is varied from 16 to 17.5, the highest pressure obtained is 1.50 bar for B20 and lowest pressure obtained is 1.46bar for B40, 2.84 bar for B20, 1.49bar for B0 (diesel) and B60 is same. All are at the compression ratio 17.5



For 40% load condition, when the compression ratio is varied from 16 to 17.5, the highest pressure obtained is 1.50 bar for B20 and lowest pressure obtained is 1.46bar for B40, 2.84 bar for B20, 1.49bar for B0 (diesel) and B60 is same. All are at the compression ratio 17.5



For 0% load condition, when the compression ratio is varied from 16 to 17.5, the highest pressure obtained is 0.1bar for B0 (diesel), 0.09bar for B20, B40 and B60 is same. All are at the compression ratio 17.5.

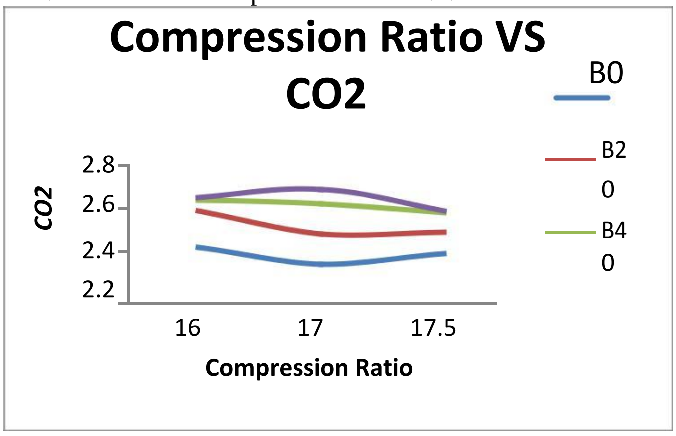


Fig. 2 CO2 emission vs compression ratio

CO_2 emission is decreases with increase compression ratio for blend B60 and B40 of UNDI OIL.

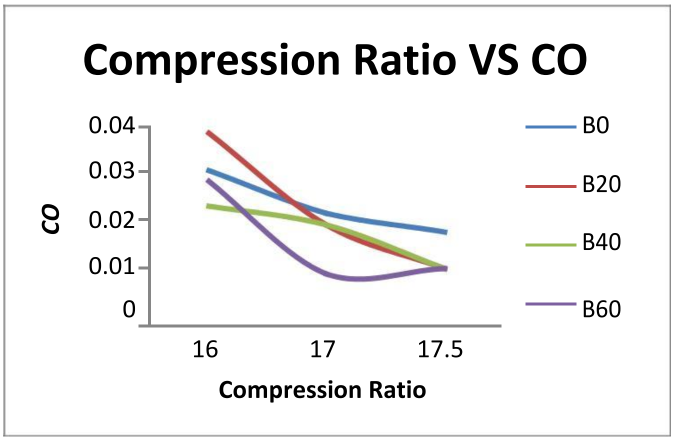


Fig. 3 CO emission vs compression ratio

Compare diesel engine here decreases in co emission. It is lowest for B60 blend. With increase in compression ratio the CO emission decreases.

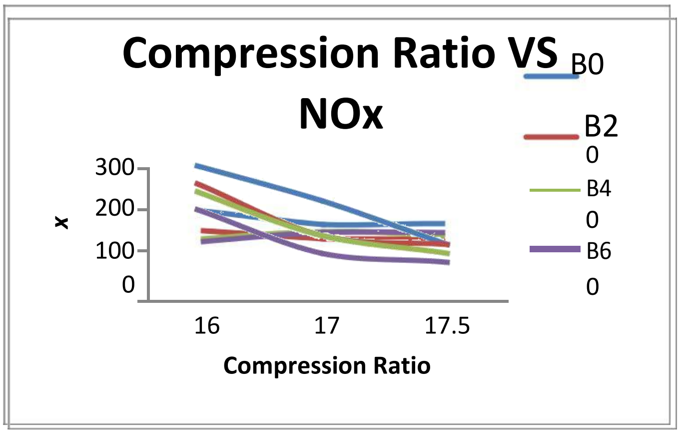


Fig. 4 NOx emission vs compression ratio

With increase in compression ratio there is no change in NOx emission doesn't change with emission.

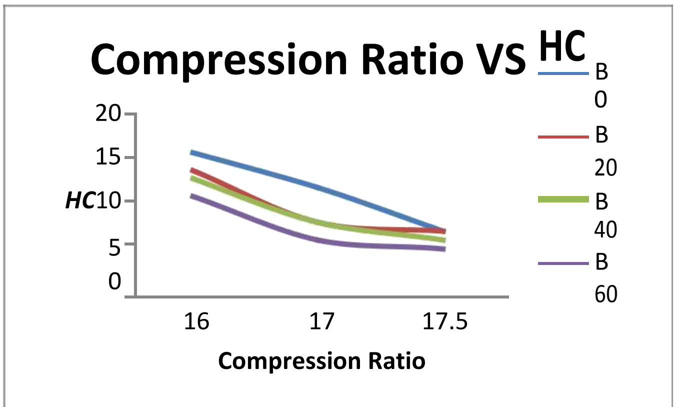


Fig. 5 HC emission vs compression ratio

From graph HC emission for pure diesel is higher than that for blends. HC is decreases with increasing compression ratio.

V. EMISSION MODEL

Dimensional analysis:
Load = $[M^1L^1T^{-2}]$
IP= $[M^1L^{-1}T^{-2}]$
BSFC = $[M^\circ L^{-2}T^2]$
HC = $[M^1L^{-3}T^\circ]$
Fuel/min = $[M^1L^\circ T^{-1}]$
N=No. of parameters =5
M= No. of fundamental dimensions = 3
Parameters in π terms = M + 1 =3+1 = 4

$$\pi\ terms = N - M = 5 - 3 = 2$$

Let

$$\pi 1 = \text{Load}\ \hat{}a\ \text{IP}\ \hat{}b\ \text{BSFC}\ \hat{}c\ \text{HC}$$

$$[M^\circ L^\circ T^\circ] = [M^1L^1T^{-2}]\hat{}a[M^1L^{-1}T^{-2}]\hat{}b[M^\circ L^{-2}T^2]\hat{}c\,[M^1L^{-3}T^\circ]$$

Equating power of M, L, T we get
For M: 0 = a +b +1 . . . . (1)
For L: 0 = a – b -2c – 3 . . . .
(2) For T: 0 =-2a -2b +
2c . . . . (3) Solving we get
a = 0, b = -1, c = -1.

$$\pi 1 = \text{Load}\ \hat{}0\ \text{IP}\ \hat{}(-1)\ \text{BSFC}\ \hat{}(-1)\ \text{HC}$$

$$\pi 1 = \frac{[HC]}{IP\ [BSFC]}$$

Now

$$\pi 2 = \text{Load}\ \hat{}a\ \text{IP}\ \hat{}b\ \text{BSFC}\ \hat{}c[\text{Fuel/min}]$$

$$[M^\circ L^\circ T^\circ] = [M^1L^1T^{-2}]\hat{}a[M^1L^{-1}T^{-2}]\hat{}b[M^\circ L^{-2}T^2]\hat{}c[M^1L^\circ T^{-1}]$$

Equating power of M, L, T we get
For M: 0 = a +b +1. . . . . (1)
For L: 0 = a – b -2c. . . . . . . (2)
For T: 0 =-2a -2b + 2c -1. . . . . (3)
a = -1, b = 0, c = -0.5

$$\pi 1 = \text{Load}\hat{}(-1)\ \text{BSFC}\hat{}(-0.5)\ \text{Fuel/min}$$

$$\pi 2 = \frac{[\text{Fuel/min}]}{\text{Load}\ [BSFC]\hat{}(-0.5)}$$

$$\pi 1\ \alpha\ \pi 2$$

$$[HC]\ \alpha\ [\text{Fuel/min}]$$

$$=K\left(\frac{[\ \ /\ \ ]}{\ }\right)\hat{}A(IP[BSFC]))\hat{}B$$

K=Coefficient of constant

A&B=Power Indices

The values K, A&B will be calculated by 75% experimental results and remaining 25% for validation of emission model with help of MINITAB Software.

VI. CONCLUSIONS

The experimental investigation proves that Undi oil has less emission as compare to fossil fuel Hydro carbon, CO, NOx emissions are reduced for blend of Undi oil.
Emission of CO2, CO, HC is reduced as compression ratio changes and mainly the emission of NOx is slightly increases.
We are using Blend 20% in that emissions are minimizes compare to the diesel fuel also mechanical efficiency is increases.
B60 blends the emission of NOx is increases due to high combustion temperature otherwise for blends is proportionally increases
For blend B10 Brake Specific fuel consumption is minimum as compare to diesel.

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