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Performance and emission Analysis in two stroke Diesel Engine of Neem oil

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1. ABSTRACT

In India Neem tree is a widely grown up termed as a divine tree due to its wide relevance in Many areas of study. This paper deals with Biodiesel production from neem oil, which is monoester produced using transesterification process. In a modern day world alternative source of energy are given importance due to gradual depletion of fossil fuels reserves vegetable oils can be used as an alternative to diesel in CI engines. The use of vegetable oils in CI engine results in low CO and HC emissions compared to conventional diesel fuel. The present work covers the various aspects of bio-diesels fuel derived from crude neem oil and performance emissions study on four stroke compression ignition engine with neem oil. Crude neem oil is converted to neem oil methyl esters by transesterification process. In the first stage the tests are conducted on the two stroke single cylinder diesel engine with constant speed by using diesel and base line data is prepare in the sense of performance and emissions parameters are measured by varying loads with constant speeds. In second stage, experimental investigation has been conducted on the same engine with same operating parameters by using the neem oil methyl esters in different proportions as N10, N20 and N30 to find out the performance and emission parameters. In the final stage the performance and emission parameters obtained from the above tests are compared with each other and the NOME blends shows better performance and emissions in the sense of increased brake thermal efficiency and decreased brake specific fuel consumption, decreased Carbonmonoxide,oxides of nitrogen, Unburned hydrocarbons,Smoke density. And the blend N20 shows better performance compared with the other blends N10, N30.

Keywords: Emission Characteristic, Performance, Diesel-Bio Diesel Blend.

2. Intorduction

Vegetable Oil have become more attractive in the recent past year owing to Its environmental benefits and the fact that it is made from renewable resources vegetable oils are a renewable and potentially inexhaustible source of energy with the energy content close to diesel fuel. Oil derived from Vegetable and microbial source may in course of time becomes as important as petroleum and the coal tar product of present time [1].Recent increase in petroleum price and due to uncertainties concerning petroleum availability there is renewed interest in Vegetable oil fuel for diesel engine [2].Neem is tree in the Mahogany family, Which is grows in Various parts of

India. The Neem grows on almost all types of soils including Clayey Saline and alkaline condition .Neem Seeds from this tree are collected depulped sun dried and crushed for oil extraction [4].Neem oil is proved to contain Methyl ester which is consider to be the base of Biodiesel .This Biodiesel contains alkyl ester of the fatty acid which is the product of transesterification process of the neem oil. Extraction of this diesel is complicated but it's result are more efficient like low carbon emission, increase the engine performance ,brake specific fuel is saved and the reduce the smoke density [5].The Plant oil usually contain free fatty acid, Phospholipids,Sterols,water,odorants and other impurities, Because of these the oil cannot be used as directly fuel. To overcome these problem the oil require slight chemical modification mainly transesterification, Pyrolysis. Transesterification is an important process to produce the cleaner and environmentally safe fuel from vegetable oil [6].While the Biodiesel industry is being established in many countries, it has also been hit by the current global economic crisis. In order to overcome the adversities of the economic background, it is critical for Biodiesel industry to continuously improve that will strengthen the prospect of better market penetration [7].

The extensive use of energy operated devices in domestic, industrial, transport and agricultural sectors in urban and rural areas have resulted in overall economical development of the society. The electricity available for farming operations and in rural and urban areas is been generated using the fossil and static energy resources such as petroleum oil, coal and atomic energy and to a limited extent by hydropower. These all sources have a great influence on our economy and environmental aspects. These have resulted in serious considerations for the use and availability of various energy resources. Globally, about 40% of worlds energy needs are being met from petroleum products as of today. The anticipated growth in demand was expected to be 7%. There has been a significant and impressive growth in this sector which has surpassed and failed all the estimates, forecast and projections made in this regard. It is estimated that the world oil consumption will increase from 68 million barrel per day to 94 million barrel per day in next decade. The purpose of this work is to compare used NOME with nonrenewable diesel when fuel in a diesel engine. Before this there is need for survey on various alternative fuels used in diesel engine by various researchers. C.V. Sudhir1and [1] They are analyze the potential of waste cooking oil (WCO) for their suitability as feed stock for biodiesel preparation and to compare the fuel properties of the derived esters of WCO (WCO-biodiesel)with those esters of fresh oil and baseline diesel fuel. The palm oil based WCO-biodiesel and esters of fresh palm oil are transformed into respective biodiesel, by transesterification process. They conclude finally Performance of the pure WCO-biodiesel was only marginally poorer at part loads compared to the base line diesel performance. At higher loads engine suffers from nearly 1 to 1.5 % brake thermal efficiency loss, Thermal performances of WCO biodiesel closely bear a resemblance to the performance of fresh oil biodiesel. From emission standpoint the NO_x, CO and CO_2 emissions were approximately same as that of base line diesel emissions and interestingly hydrocarbon emissions of WCO biodiesel fuel were lower than base line diesel operation.A.Veereshbabu [2] He was studied Biodiesel was prepared from the non-edible oil of Pongamia pinnata L. By transesterification of the crude-oil with methanol in the presence of NAOH as catalyst. Crude pongamia oil was transesterified using NAOH as cat a list and methanol to form biodiesel. The con version was 94% at 60 °C with 1:10 molar ratio (oil, methanol) for NAOH (1 wt. %) catalyzed transesterification. The fuel proper ties especially

viscosity (4.71 Cost at 40 °C) and flash point (170 °C) of the transesterified product (biodiesel) com pare well with accepted biodiesel standards I.e. ASTM and Ger man biodiesel standards. B. Rajendra Prasad [3] in his work, a comprehensive model has been developed for diesel engines and LHR engines and applied for the cases of using two different fuels, viz. diesel and biodiesel. In an experimental investigation that was conducted on a DI diesel engine, located at the authors' laboratory. It is revealed that the developed model predicts adequately well both engine performance and emissions for the two fuels examined. The main results obtained from this model are given briefly. The presented model can predict the combustion characteristics such as cylinder pressure and heat release in good agreement with the theoretical results. Also, the engine performance parameters such as work done as a direct outcome of brake thermal efficiency obtained from the presented model have reasonably agreed with the experimental results. The model can be used to predict NO emissions; it has the reasonable agreement with theoretical results. The presented model can be used easily and the run time is sufficiently low for the full cycle simulation. The developed model can be adapted for alternative diesel engine fuel studies. C This model has been also adapted for determining the effects of biodiesel blends. G Lakshmi NarayanaRao [4] He is study in this, used cooking oil was dehydrated and then transesterified using an alkaline catalyst. The combustion, performance and emission characteristics of Used Cooking oil Methyl Ester (UCME) and its blends with diesel oil are analyzed in a direct injection C.I. engine. The fuel properties and the combustion characteristics of UCME are found to be similar to those of diesel. A minor decrease in thermal efficiency with significant improvement in reduction of particulates, carbon monoxide and unburnt hydrocarbons is observed compared to diesel. The use of transesterified used cooking oil and its blends as fuel for diesel engines will reduce dependence on fossil fuels and also decrease considerably the environmental pollution S.Murugan [5] His tests have been carried out to evaluate the performance and emission characteristics of a single cylinder direct injection diesel engine fuelled by 10, 30 and 50 percent blends of Tyre pyrolysis oil (TPO) with diesel fuel (DF). The combustion parameters such as heat release rate, cylinder peak pressure and maximum rate of pressure rise were also analyzed. For this work, TPO was derived from waste automobile tires through vacuum paralysis in one kg batch paralysis unit. The following conclusions are drawn from the experimental results: Brake thermal efficiency of the engine increased with increase in TPO blend concentration than DF. Thermal efficiency for DF operation at full load is 29.3 %, In case of TPO 10 it is 29.6 %. The efficiency for TPO 30 and TPO 50 at high load is 29.77 % and 29.87 % respectively. No engine seizing, injector blocking was found during the entire operation of the engine running with different percentage of TPO-DF from 10% to 50%. Hydrocarbon emission is higher for TPO-DF blends than DF at peak load. TPO 10 exhibited approximately 3 % increase in HC at peak load. In case of TPO 30 and TPO 50 operation the rise in HC at peak load is 15 % and 21 % respectively. This is due to the PAH present in the TPO. Carbon monoxide emission is also higher for TPO-DF blends than DF, but the values are less than 0.1 %. NOx emission was higher for TPO-DF blends with increase in blend concentration than DF. TPO 10 exhibited approximately 0.5 % increase in NOx at full load. In case of TPO 30 and TPO 50 operation the rise in NOx at full load is 4.5 % and 10 % respectively. Smoke is about 7 % higher for TPO 50 operation at full load compared to DF. Ignition delay is longer for TPO-DF than DF. Peak pressure and rate of pressure rise for TPO-DF blends are higher compared to DF. It is concluded that reducing the aromatic content and viscosity would help in using TPO as a fuel in diesel engine. HarySulistyo [6] He can study the Transesterification of candlenut

(aleuritesmoluccana) oil with methanol using potassium hydroxide as catalyst The following conclusion can be drawn from this study Candlenut oil has suitable to produce methyl ester with similar properties to biodiesel. The cultivation of candlenut plant can be considered as potential alternative for renewable energy sources. The ethanol to oil molar ratio is one variable that has most influence on the process. The best result was obtained for a 6/1 molar ratio. Potassium hydroxide can be used as catalyst on methanolysis of candlenut oil. There was an optimal concentration of 1% referred to the initial oil. The effect of temperature was less pronounced. The biodiesel formed was increased with increasing temperature. Nevertheless the transesterification can be undertaken at room temperature. Of the variables studied, the triglyceride conversion is almost reached in 15 min and the curves have an asymptotic tendency with the time.From the above literature survey it is concluded that alternate fuels can be used as substitute for diesel by evaluating the properties and blends them with diesel in small proportions can improve performance parameters and reduce emissions without any modifications in already existing diesel engine.

3. Material and Method:

Chemical: Sodium Hydroxide, Methanol, Methyl Orange Indicator, Isopropyl alcohol, Neem Oil all chemical used was from sigma chemicals.

4. Sample Preparation

4.1: Removed the Moisture Content

To remove the moisture content before to use for transesterification heated the oil for five minute at the temperature of 100^0C.

4.2: Catalyst Quantity

1 ml of Oil+10 ml isopropyl alcohol is titrated against 1% of NaOH where Methyl orange is used as a indicator. Color changed to pink and immediately noted reading and repeated this process three times. Finally got average reading and added 3.55 gm NAOH as per standard criteria. We found 6.8 gm NAOH per kg of oil and as per standard procedure of Bio-Diesel preparation mixed 20ml carbinol per 100 ml of oil.

4.2 Production method

Purchase the Neem oil from the Vellore market oil as a raw product. Heat the oil for removing moisture content for five minute at the temperature 100 degree Celsius. Catalyst is dissolved in the alcohol using a standard mixer. The catalyst/alcohol mix is then changed into a closed vessel and the neem oil is added. The system from here on is totally closed to the atmosphere to prevent the loss of alcohol. Add 20 ml Methanol for 100 ml of oil and stirred for 45 minute and maintained temperature between 45-60 degree. The cooled oil then kept in separating funnel and after 24 hr, thick layer of glycerin was found. Glycerin removed by gravity settling by using

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separating funnel. Once separated from glycerin, the biodiesel is then purified by washing gently with warm water to remove residual catalyst. Oil collected and stored.

4.3 Distillation of Biodiesel

The biodiesel was composed of FAME (fatty acid methyl ester) and methanol. FAME was purified by distillation; for distillation purpose heated the oil at the 125^0C.

5. Analysis of Different –Different Oil Properties.

5.1 pH: Added few drops of HCL to make oil neutral.

5.2 Flash Point-To checks the flash point used Penesky Martin apparatus. For to measure flash point took a sample of oil and placed it in apparatus which was surrounded by heating coil and also put a thermometer to check the temperature .we observed that with increasing the time temperature grown up and after attaining the temp of oil 160^oC brought a burning wood in contact of oil. So that observed a blue flame which indentified as flash point of oil.

5.3 Fire Point-For to check fire point again Used the Penesky Martin apparatus after attaining flash point temperature, with increase of time temperature of oil grown up and when reached at 180^oC again we brought a burning wood in contact of oil so that we observed a yellow flame which identified as fire point of oil.

5.4 Density-To calculate the density first I took empty weight of graduate cylinder (m_1) and later took weight of graduate cylinder after filling the water (m_2).
M_1=50 gm
$M_{2=}$154 gm
By using Verniar caliper measured the dimensions of graduate cylinder and found
Diameter=48 mm
Height=70 mm
Volume=$\pi/4\ D^2\ h=0.1396\times10^{-3}\ m^3$
Density=Mass/Volume=M_2-M_1/V= (153-49.5)gm/$0.1196\times10^{-3}\ m^3$=858 kg/m^3

5.5 Viscosity: To measure the Viscosity used redwood viscometer. First took the sample of oil and placed at the centre of apparatus after reaching the temperature 40^0C lift the stopper and calculated time to fill the graduate cylinder up to the 50 ml and repeated the procedure till the

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four interval of reading and note down the time to fill the oil up to the 50 ml and got a graph as shown below.

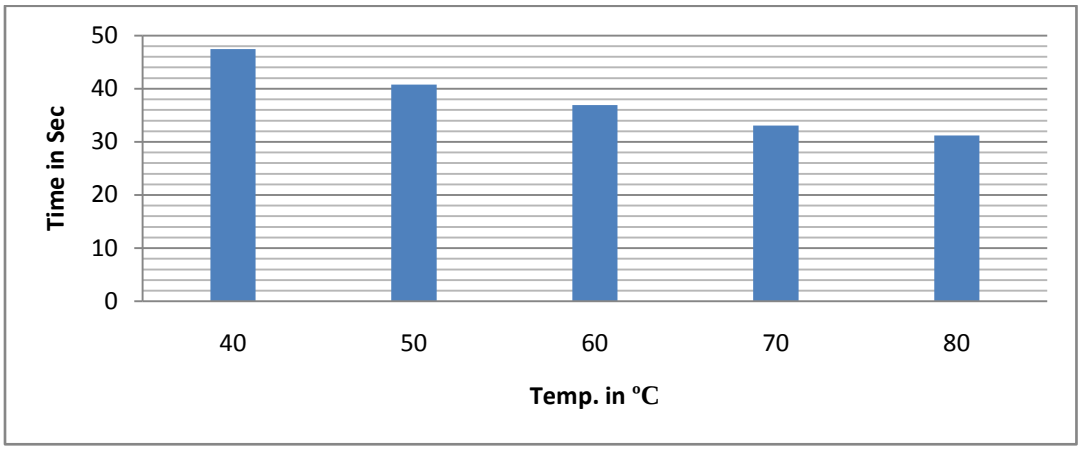

Figure 1: Shows Temp Verses Time

From this graph T_{avg}=37.9 Sec

By applying formula

Kinematic Viscosity=At-B/t × 10^{-6} m^2/sec Where A=0.25 B=168

=0.24×37.9-172/37.9 ×10^{-6} m^2/sec=4.657 × mm^2/Sec

6: Properties of oil

P_H	7.1
Flash Point (in deg)	160.5
Fire Point (in deg)	180.5
Kinematic Viscosity (mm^2/sec)	4.87
Density (Kg/m^3)	858

Engine specification

HONDA Engine

Single Cylinder, Two Strokes

Rated Speed: 1600 rpm

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B.P:4.6 Kw

6. Performance and Emission Characteristic.

6.1 Carbon monoxide emission

The carbon monoxide emissions of the pure diesel and other blends of biodiesel were found, the result shows (Fig.1.1) carbon monoxide emissions are found at the same load for B20 it is least and for B10 it is little more than B20 and for diesel CO emission is highest .

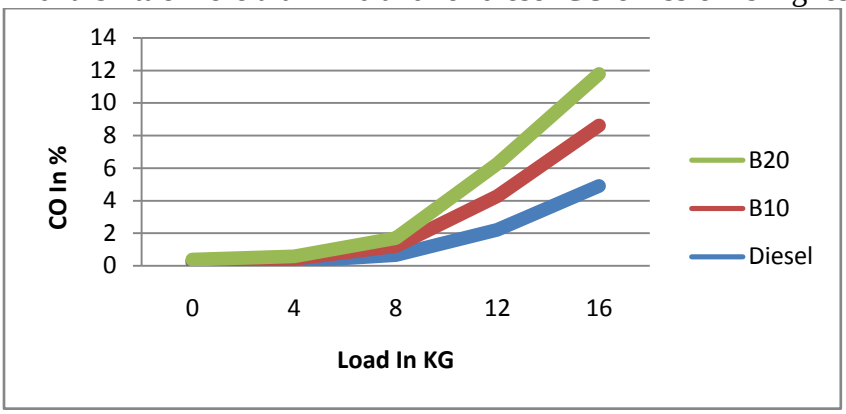

Fig 1.1Carbon monoxide emission

With increasing biodiesel percentage CO emission level decreases up to 16%blend the presence of oxygen which helps for the complete combustion. Some reports show that the carbon monoxide emissions emerging from the biodiesel will lower the overall load and speed ranges up to 51.6% [10].

6.2 NO_X emission

The NOX emission characteristics with respect to various blends of Neem oil were found. The result shows (Fig.2) the diesel fuel is having lower NOX emission and blended Neem oil is having higher NOX emission. Compared to conventional fuel the NOX emission is increased by 7% with the blend of Neem oil.

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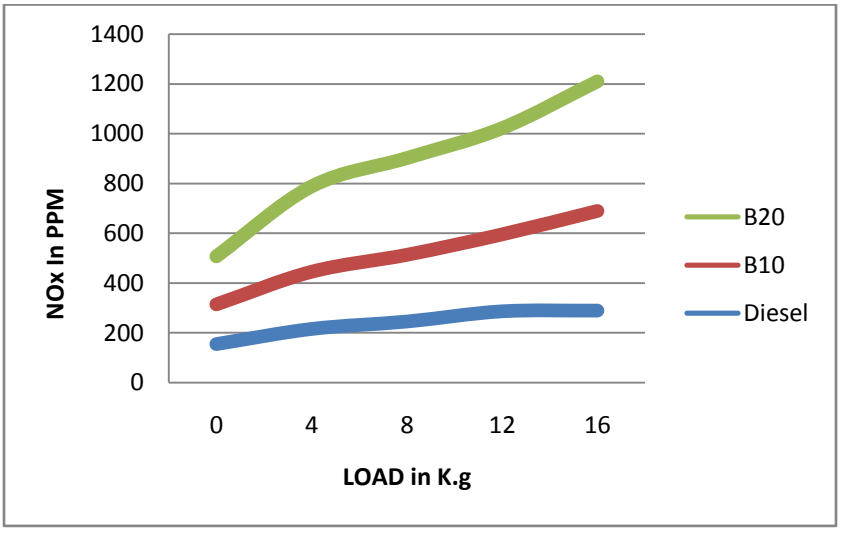

Fig 1.2 NO_X *emission*

The presence of oxygen in biodiesel helps to produce more amount of NO_X. The impact of fuel injection also play a role in the higher NO_X emissions. The NO_X. Variations were less than 8%, which is consistent with most published results [11].

6.3 Hydro carbon emission

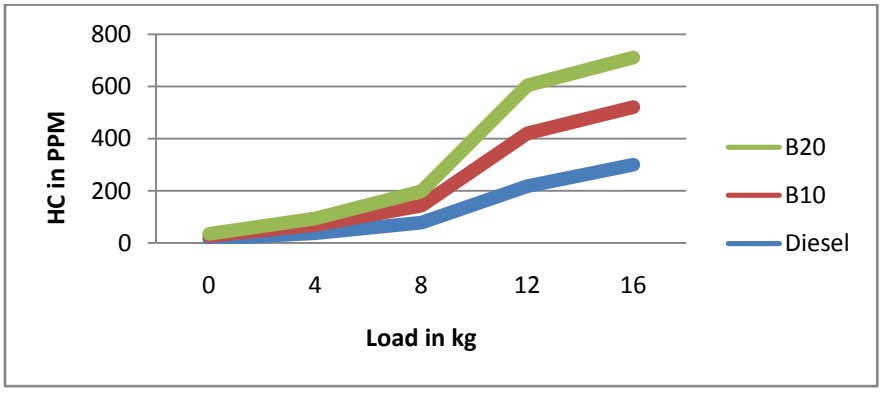

Fig-1.3 HC Emission

As Graph clearly states that at the same load for B20 we got least HC and for B10 little more that B10 but in case of diesel we are getting maximum HC emission and same thing found at different –different load.

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6.4 Load Vs BSFC

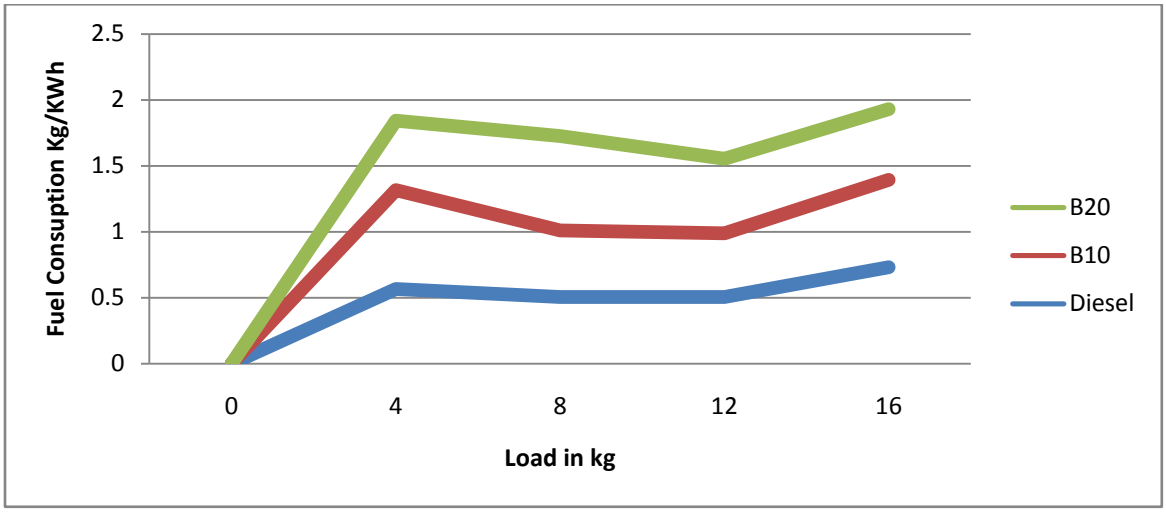

Fig.1.4 Load Vs Break thermal efficiency

Calculated load versus Break thermal efficiency of engine and as graph indicating for different-different oil composition. For B10 it is increasing and decreasing at some point I found constant and then It is further increasing For B20 It is increasing and further It is decreasing and in case of diesel first it is increasing and for sometime it is constant and further increment we found

Conclusion

Study has been made by using Bio-Diesel a novel feedstock of obtaining Bio-Diesel which is renewable in nature. After Preparation of Bio-Diesel we checked the oil properties and all properties stated above now one of the Major Part of analysis is Performance characteristic in case of HC and at the same load for Diesel, B10, and B20 we found in decreasing state but in case of NO_X found increasing for the same load. This is major drawback of using Bio-Diesel. During the experiment we found rate of fuel consumption lower for B20, B10 .Overall to make environment greener we can use Bio-Diesel.

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