International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 11, November 2015
Available at http://internationaljournalofresearch.org

Experimental Investigation of Emission Characteristics of CI Engine fuelled with Blends of Neem Biodiesel and Diesel

Ajay Gahadwal[1]& Sanjay Yadav[2]

1(Astt. Professor, Dept. of Mech. Engg. IFTM University,Moradabad-244001,UP(India))

2(Astt.Professor, Dept. of Mech. Engg. IFTM University, Moradabad-244001, UP(India))

1. ABSTRACT

For feedstock diversification and utilization of currently available local resources like neem, karanja, mahua, sal etc. should be scientifically investigated for efficient biodiesel production. Keeping this background in consideration, production of neem oil methyl ester (NOME) and its utilization as a potential alternative fuel for CI engine has been investigated. A 3.5 kW, constant speed diesel engine was tested on diesel, NOME-diesel blends in 10:90, 20:80, 30:70, 40:60 and 50:50 ratio. The performance of the engine was found to be satisfactory on the blends. The engine was able to develop power similar to diesel on all the NOME- diesel blends. The Exhaust emission of diesel engine was tested at all the neem biodiesel and diesel blends.CO emissions increases with increase in load. Engine emits more CO using diesel as compared to that of biodiesel blend under all loading conditions. With increasing biodiesel, CO emission decreases.Biodiesel itself has 11% oxygen, which help for complete combustion. Hence CO emissions decreases with increasing biodiesel percentage in fuel. Carbon di oxide emissions increases with increase in load .As load is increasing NOME gives lower carbon di oxide emissions. At all loads, NOME increased with diesel fuels and levels of oxygen for blends slightly increased as blend ratio increased, may be because fuels were oxygenated. Higher oxygen levels in fuel blends are always preferred. Variation of unburnt hydrocarbon with respect to load indicates that NOME is not shows decreasing trend at all loads.

Key words - Neem Oil Methyl ester (NOME); B10; B20; B30; B40; B50; Diesel; Exhaust emissions

[1] Email – ajaygahadwal@gmail.com,MOB.NO.-9997324408

2. INTRODUCTION

Energy consumption plays very important role in the economy of any country. Oil is the major source of the energy for the entire world as it convenient to store and handle. During the 21st century, an alarming scarcity is supposed to come in the production of crude petroleum oil and they will be costly to produce and at the same time there will likely be an increase in the number of automobile and other internal combustion engine. Although, the fuel economy of engine has been greatly improved through continued researches across the world and will probably continue to be improved but there will be a great demand for fuel in coming decades due to the rapid pace of industrialization world over. At present, India is the sixth biggest country in the world in terms of energy demands which is 3.5 percent of world commercial energy demand and is expected to grow at the rate of 4.8 percent per annum of its present demand **(Kumar, 2003)**. The petroleum import bill is currently about 30 percent of total import bill and yearly consumption of diesel oil in India is about 40 million tones forming about 40 percent of the total petroleum product consumption.

The ongoing economic expansion, robust GDP growth, urbanization, agriculture mechanization and increase in vehicular population would increase the demand for transportation fuel in short and medium term at high rates. The crude oil import bill has gone to Rs. 450,000 crore in the year 2011 and this has already depleted foreign exchange reserves and made dent in Indian economy. Thus, alternate fuel technology availability and use will become more common for both automobile application and for stationary motive power in coming decades. Another reason motivating the development of alternative fuels for internal combustion engine is concern over the emission problems of gasoline and diesel engines.

3. LITERATURE REVIEW

This chapter reviews the feasibility of this fuel source and some of the results obtained from investigation on the use of vegetable oils and their esters as fuel in CI engine.

3.1 Use of edible vegetable oil as engine fuel

He Yong (1998) conducted an experimental research on a S195 type diesel engine using cottonseed oil as an alternative fuel for a single cylinder diesel engine. The fuel used was a blend of 30 percent cottonseed oil and 70 percent diesel oil. The working of the engine on the blend and diesel fuel was compared by studying the effect of intake valve closing angle, exhaust valve opening angle, fuel delivery angle, injection pressure and specific fuel consumption on engine performance. It was concluded that cottonseed oil could be a promising alternative fuel source for diesel engine as its use does not require any structural change in the engine.

However, in order to get the highest power and thermal efficiency, the relevant working parameters of the engine should be readjusted.

It was suggested that the fuel delivery angle be advanced for improving combustion performance when using cotton seed oil as fuel.

Singh (2003) carried out the feasibility of supplementing rice bran oil in a CI engine. A 3.73 kW Kirloskar make, single cylinder water cooled compression ignition engine having a displacement volume 552.92 cc and compression ratio 16.5:1 was tested. The fuel types used were blends of diesel-rice bran oil in 90:1, 80:20, and 70:30 and diesel methyl ester of rice bran oil blended in 90:10, 80:20, 70:30, 60:40, 50:50 ratio.

The characteristic fuel properties of all the above fuel blends were reported to be comparable with diesel fuel. It was observed that there was an increase in the ash and carbon residue content in the blend with increase in concentration of rice bran oil in the fuel blend.

International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 11, November 2015
Available at http://internationaljournalofresearch.org

All fuel types found to be stable and homogeneous at normal room temperature. All the fuel types showed similar power producing capabilities at rated load. The fuel consumption of the engine was found to be lower on all the fuel blends compared to diesel at rated load. The brake thermal efficiency of the engine on diesel-methyl ester rice bran oil was comparable with diesel. The emission of CO, HC and NOx from the engine on above fuel blends was within the limits. However, the exhaust gas temperature of the engine on blends of rice bran oil and diesel and methyl ester of rice bran oil and diesel was reported to be lower than that observed on diesel at rated load condition.

3.2 Use of Neem oil as CI Engine Fuel

Ragit *et al.* (2011) conducted experiments on standardization of transesterification process parameters for the production of methyl ester of filtered neem oil and fuel characterization for engine performance. The effect of process parameters such as molar ratio, preheating temperature, catalyst concentration and reaction time was studied to standardize the transesterification process for estimating the highest recovery of ester with lowest possible viscosity.

It was observed that filtered neem oil at 6:1 M ratio (methanol to oil) preheated at 55ºC temperature and maintaining 60ºC reaction temperature for 60 min in the presence of 2 percent KOH and then allowed to settle for 24 h in order to get lowest kinematic viscosity (2.7 cS) with ester recovery (83.36%). Different fuel properties of the neem methyl ester and neem oil were also measured.

Viscous oil when injected to the cylinder do not atomize properly and may results in incomplete combustion of fuel, build- up of carbon deposits on injectors, cylinder head and piston. Some this unburnt fuel blow by the piston rings into crankcase causing dilution of lubricating oil to solidify due to oxidation and polymerization of vegetable oils which may result in complete failure of the lubricating oil and may ruin the engine.

However, the above problems can be overcome with the use of esterified oils and their blends with diesel. Since the ester are less viscous than neat vegetable oils and, therefore, improved engine performance through better atomization and combustion in the cylinder was observed when either neat esterified oils or their blends with diesel were used. The esterification reduces the viscosity and removes glycerol from the oil. Hence the problem of cold start, plugging of filters, fuel lines, injectors carbon deposition, oxidation and polymerization of lubricating oil are least associated particularly when blends of esterified fuel were used as engine fuel. In view of above, use of either esterified vegetable oil alone or their blends with diesel appear to be promising alternative fuels of the future.

4.MATERIALS AND METHODS

This chapter briefly describes the methodology used for the experimental procedure adopted to evaluate performance of a **VCR diesel engine** on the blends.

4.1 Selection of Fuel Constituents

The experiments were carried out using diesel as reference fuel and neem oil methyl ester (NOME) and their blends with diesel in various proportions as engine fuel.

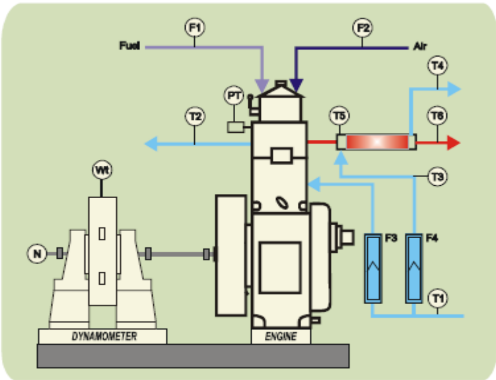
4.2 Preparation of Fuel Blends

High viscosity of neem oil makes it unsuitable as complete replacement of diesel for the CI engine. The neem oil methyl ester (NOME)-

diesel blends were prepared by blending neem oil methyl ester (NOME) with diesel.

4.3 Test Engine

The setup consists of single cylinder, four stroke, VCR (Variable Compression Ratio)Diesel engine connected to eddy current type dynamometer for loading.
softLV" is provided for on line performance evaluation.



Schematic arrangement

F1	Fuel consumption	kg/hr
F2	Air consumption	kg/hr
F4	Calorimeter water flow	kg/hr
T3	Calorimeter water inlet temperature	^0K
T4	Calorimeter water outlet temperature	^0K
T5	Exhaust gas to calorimeter inlet temp.	^0K
T6	Exhaust gas from calorimeter outlet temp.	^0K

Figure – 3.10 A VCR Engine connected with computer system

Table 3.1 Neem Oil Methyl Ester – Diesel Blends selected for Experiments

S. No.	Fuel Types	Nomenclature
1.	Diesel	-
2.	Raw Neem oil	-
3.	10% Neem Oil Methyl Ester + 90% Diesel	B10
4.	20% Neem Oil Methyl Ester + 80% Diesel	B20
5.	30% Neem Oil Methyl Ester + 70% Diesel	B30
6.	40% Neem Oil Methyl Ester + 60% Diesel	B40
7.	50% Neem Oil Methyl Ester + 50% Diesel	B50

4.4 Engine Performance Test

The performance of the engine was evaluated by conducting fuel consumption and rating tests as per **IS: 10000 [P: 8]:1980.**

5.RESULT AND DISCUSSION

The fuel consumption test and rating test of 3.5 kW, constant speed CI engine was also conducted to evaluate the performance of the engine on diesel as well as different blends of NOME with diesel.

International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 11, November 2015
Available at http://internationaljournalofresearch.org

5.1 Exhaust Emissions of the Engine

Engine exhaust emissions of selected fuels are shown in figures 4.9 to 4.12.

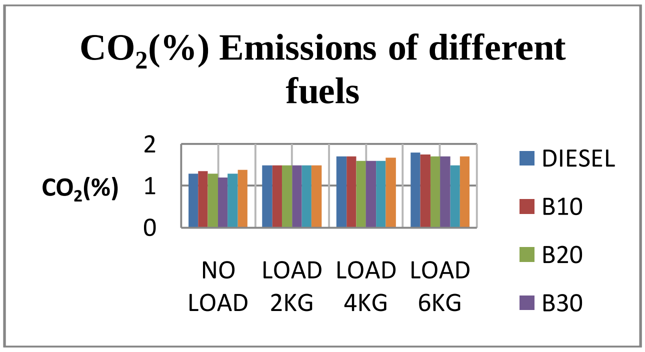


Fig -4.9 Exhaust Emissions of Carbon dioxide for different fuels

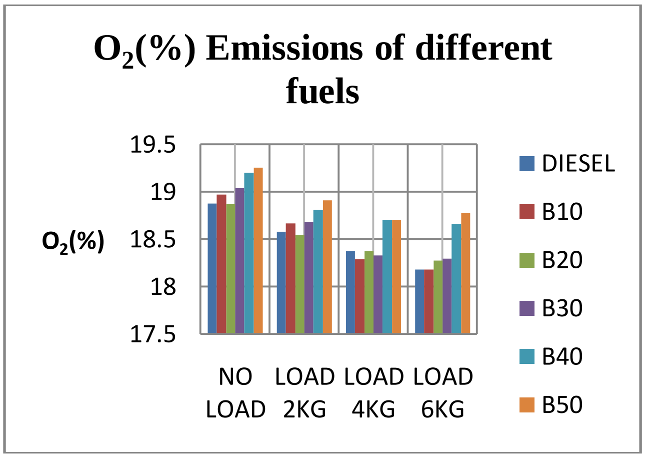


Fig –4.10 Oxygen Emissions of different fuels

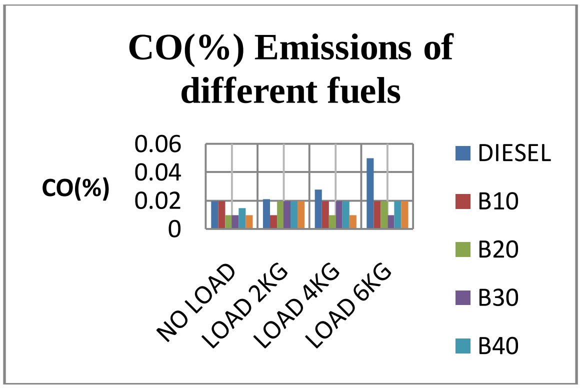


Fig – 4.11 Carbon mono oxide Emissions of different fuels

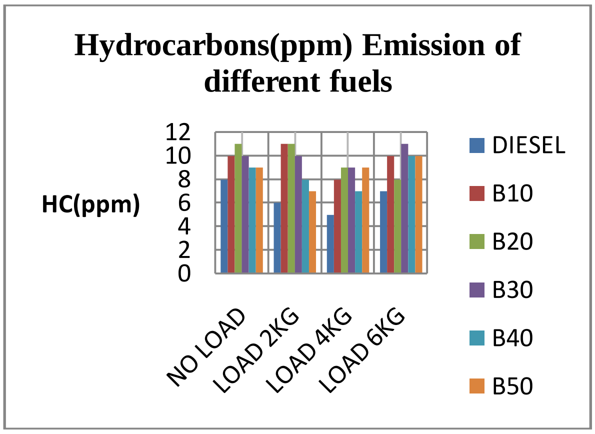


Fig – 4.12 Hydrocarbon Emissions of different fuels

From the figure - 4.10 of CO_2 it is observed that Carbon Dioxide emissions increases with increase in load. As load is increasing NOME gives lower CO_2 emissions.

From the figure – 4.11 of O_2 it is observed that At all loads, Oxygen level increased with diesel fuels and levels of oxygen for blends slightly increased as blend ratio increased, may be because fuels were oxygenated. Higher oxygen levels in fuel blends are always preferred.

From the figure – 4.12 Carbon Mono Oxide Emissions it is observed that CO emissions increase with increase in load. Engine emits more CO using diesel as compared to that of biodiesel blend under all loading conditions.With increasing biodiesel , CO emission decreases.Biodiesel itself has 11% oxygen,which help for complete combustion.Hence CO emissions decreases with increasing biodiesel percentage in fuel.

From the figure – 4.13 Hydrocarbon emissions it is observed that Variation of unburnt hydrocarbon with respect to load indicates that NOME is not shows decreasing trend at all loads.

6.Summary and Conclusion

A 3.5 kW, constant speed diesel engine was tested on diesel, NOME-diesel blends in 10:90, 20:80, 30:70, 40:60 and 50:50 ratio. The performance of the engine was found to be satisfactory on the blends. On the basis of the results obtained from the whole experiment the following conclusion can be drawn:

1. CO emissions increase with increase in load. Engine emits more CO using diesel as compared to that of biodiesel blend under all loading conditions. With increasing biodiesel, CO emission decreases.

The above discussion indicate that neem oil methyl ester (NOME) may be recommended as CI engine fuel. However for the better performance of the engine B20 may also be recommended for low emission.

7. REFERENCES

[1] Worgetter M. Result of long term enfine tests based on rape seed oil fuel. Beyond the energy crisis—opportunity and challenge volume III. In: Fazzolre RA, Smith CR, editors, Third international conference on energy use management, Berlin (West). Oxford: Pergamon Press; 1981. p. 1955–66.

[2] B. Freedman, R.O. Btterfield and E.H. Pryde. 1986. Transesterification kinetics of soybean oil. Journal of the American Oil Chemists' Society. 63(10).

[3] Rao PS, Gopalakrishnan KV. Vegetable oils and their methylesters as fuels for diesel engines. Indian J Technol 1991;29(6):292–7.

[4] Ali Y, Hanna MA, Cuppett SL. Fuel properties of tallow and soybean oil esters. J Am Oil Chem Soc 1995;72(12):1557–64.

[5] F. Ma and M.A. Hanna. 1999. Biodiesel production: a review. Bioresource Technology. 70:1-15.

[6] Kumar, M.S., Ramesh, A. and Nagalingam, B.: "An experiment comparison of methanol and jatropha oil in a CI engine", Biomass and Bioenergy, Volume 25,2002, Pages: 239-248.

[7] Rehman, H. and Phadatare, A.G.: "Diesel engine emissions performance from blends of karanja methyl ester and diesel", Biomass and Bioenergy, Volume 27,2004, Pages: 393-397.

[8] Tiwari AK, Kumar A, Raheman H. Biodiesel production from jatropha oil (Jatropha curcas) with high free fatty acids: An optimized process, *Biomass and Bioenerg*., 2007, 31, 569-575

[9] Agarwal A K. Biofuels (alcohols and biodiesel) applications as fuels for internal combustion engines,*Progress in Energy and Combustion Science*, 33 (2007), pp.233–271.

[10] Scott P, Pregelj L, Chen N, Hadler J S, Djordjevic M A, Gresshoff P M, (2008), Pongamia pinnata: an untapped resource for the biofuels industry of the future. Bioenergy Research; 1:2–11.

[11] Singh, R.K., and Padhi, S.K., Characterization of jatropa oil for the preparation of biodiesel, *Natural Product Radiance*, 2009; 8(2) 127-132.

[12] S S Ragit,S K Mohapatra, K Kundu,Performance and emission evaluation of diesel engine fuelled with methyl ester of Neem oil and filtered Neem oil,*Journal of Scientific and Industrial Research*,2010,69,62-66