International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

Experimental Investigation on emission Characteristics of 4- stroke Diesel engine fueled with Neem oil

Akshay Kumar Patel[1], V.Abhishek[1,*], Oasis Martha[1], D.Kalyan Kumar[1]
[1]School of Mechanical Engineering, KIIT Univerisity, Bhubaneswar,Odisha,India.

Abstract -*Biodiesel is attracting the world to its side as the alternative fuel due to its good oxidation characteristics and lubricating nature. The present paper gives an idea about the emission characteristics of 4-stroke diesel engine utilizing neem oil methyl ester with diesel blends (B10, B20 and B30). All the emission values were noted and plotted in the graph against loads (Brake Power) varying at 0%,20%,40%,60%,80%,100%. The results depict that which blends shows the less tendency towards emissions like CO, CO_2, HC, NO_x and smoke emission in comparison to other test fuel blends which gives a conclusion for a best alternative fuel capable of replacing current petroleum diesel fuels to reduce the engine emissions. This paper also reports the performance characteristics like Brake specific Fuel Consumption against Brake power with help of a graph.*

Keywords: Neem biodiesel, engine, transesterification, performance, emission

1. INTRODUCTION

Today fuels plays a pivotal role in the economy of every country and majority of the world's energy are fulfilled by the petrochemical resources such as coal and natural gas. Among all the mineral oils present in the earth's surface petroleum plays the most important role in the growth of industries, in transportation sector and meet many fundamental needs of the human beings. According to the International Energy Agency report , the world will need 50% more energy in 2030 than today, of which 45% will be accounted for by India and China. Globally the transportation sector is the second largest consuming sector which is responsible for nearly 60% of oil demand [1]. Since the last 30-40 years, prices of these mineral oils such as petroleum, diesel, kerosene etc. are increasing day by day due to the rapid consumption of these mineral oils. Due to this the fossil reserves are going on depleting day by day. The main reason for the depletion of these resources is due to rapid industrialization and population growth and the sources of fossil fuel generation are non renewable. These mineral oils also pollute the environment and burning of these fuels had lead to emission of many harmful gases like Carbon dioxide, Hydrocarbons and oxides of nitrogen and Sulphur. If this continues it will lead to extinction of many species and it will also pose a great threat to human beings. Therefore the use of alternative source of fossil fuels is becoming increasingly significant due to rapid depletion of petroleum fuels [2]. Plant oils have used for many years since they are renewable and readily available. However these oils cannot be directly used due to a) high viscosity which leads to poor fuel atomization during the injection process, b) low volatility and c) polymerization which results in deposit formation, incomplete combustion and poor emissions. To overcome these advantages oils can be converted to fatty acid methyl esters which are also known as biodiesel. Biodiesel is an alternative fuel that is completely non toxic, biodegradable, renewable and can be adapted easily [3].

Biodiesel is a processed fuel derived from the vegetable oils and animal fats through the esterification and transesterification reactions of free fatty acids and triglycerides, respectively that occur in naturally in renewable biological resources. In other words we can define biodiesel as a mixture of alkyl esters of long chain fatty acids, which are synthesized through esterification and transesterification of free fatty acids and glycerides [4]. In the production of biodiesel we generally use non edible oils because they cannot be consumed by human beings. The extensive use of edible oils might generate a competition for food and feed. It may become an obstacle in meeting the demands of food supply and oils. Therefore, it is more appropriate to use nonedible oils. The major feedstocks from which oil is generated in India are soya bean, neem, palm, rape seed and many more [2,5].

2. METHODS AND MATERIAL

Neem is a tree in the family Meliaceae and its scientific name is "*Azadirachta indicia*". It is an evergreen and deciduous tree with straight trunk and long spreading branches forming a broad round crown and growing to a height of about 12-18m. All the parts of the tree are bitter in taste and posses anti allergic and antimicrobial

properties [6]. The neem cakes and neem powder are used as biopestcides. This plant also holds a very religious importance. It is generally found across the whole of South Asia. In India it is mostly found in the regions of Uttar Pradesh, Tamil Nadu, Madhya Pradesh, Maharashtra, Andhra Pradesh and Gujarat. Neem is one of the most important trees available in India [4]. The tree is valuable because of its medicinal properties. This plant is also recommended for afforestation of dry areas, soil conservation and reclamation of alkaline soils. The neem plant is generally grown by two methods that is by seed method and vegetative methods. At the commencement of rains the seedlings are planted in the field. It generally grows in full sun and comparatively less maintenance is required. It is resistant to high winds and drought. The rate of growth of Neem plant is found to be rapid up to 5 years and after that it slows down. It is one of the most promising tree species suitable for providing oil for biodiesel production which conforms to international standards. Oil percentage in neem kernel varies from 18-25%. In addition the oil seed cake is also found to have 7-12% residual oil which can be extracted through solvent extraction. The plants bear plenty of fruits and seeds. The seeds of these plants are not edible because they are bitter in taste. So, the oil extracted from these seeds may be better exploited for biodiesel production [7].

Table-1 Physical and chemical properties of neem oil [2,8]

PROPERTY	NEEM OIL	PROPERTY	NEEM OIL
COLOUR	GREENISH BROWN	BOILING POINT	154^0C
MOLECULAR WEIGHT	720	POUR POINT	8^0C
CETANE NO.	47	MELTING POINT	13^0C
SPECIFIC GRAVITY	0.916	FLASH POINT	180^0C
VISCOSITY	30	FIRE POINT	210^0C

3. PERFROMANCE AND EMISSION CHARACTERISTICS

3.1 Carbon mono oxide Vs Brake Power for diesel and NOME blends

Carbon monoxide is one of the intermediate products formed during the combustion of hydrocarbons in the cylinder [8]. It was noted that amount of CO produced decreased with increase in load on the engine for pure diesel and various blends of NOME, but at higher loads there is a steep increase in CO emission as observed.

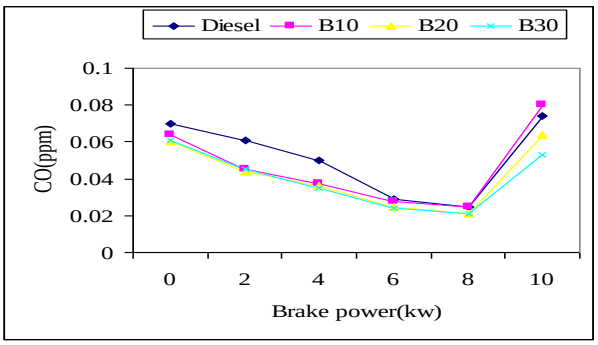

Fig.1 CO Vs Brake Power for diesel and NOME blends

3.2. Hydrocarbon Emission Vs Brake Power for diesel and NOME blends

As the Brake power increases the Hydrocarbon Percentage gradually increases and it is highest for diesel and low for B30. Hydrocarbons damage the ozone layer to a maximum extent so using B30 it can be reduced [9].

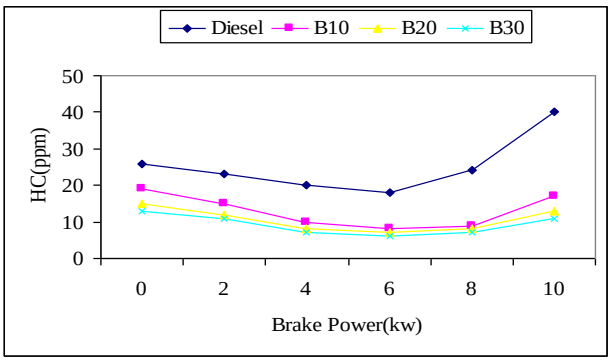

Fig.2 HC Vs Brake Power for diesel and NOME blends

3.3. Nitrogen Oxide Emission Vs Brake Power for diesel and NOME blends

The production of oxides of nitrogen in the cylinder is affected mainly due to two factors that is the oxygen content and combustion temperature. Nitrogen oxide emission increases with the increase in load on the engine. It was also noted that NO formation from the blends of biodiesel was slightly higher than that of neat diesel. Due to the presence of oxygen in biodiesel it leads to better combustion and higher temperature leading to higher emission [10].

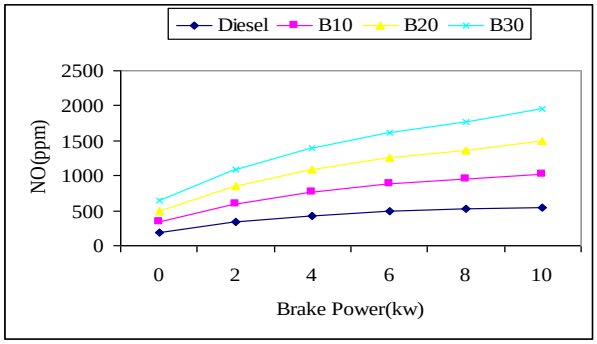

Fig.3 NO Vs Brake Power for diesel and NOME blends

3.4 Carbon dioxide Emission Vs Brake Power for diesel and NOME blends

It was observed that Carbon Dioxide emission increases with the increase in load on engine. The emission rate was found to be higher from the blends of biodiesel as compared to that of neat diesel. The variation of carbon dioxide emission with brake power is given in the figure below [11].

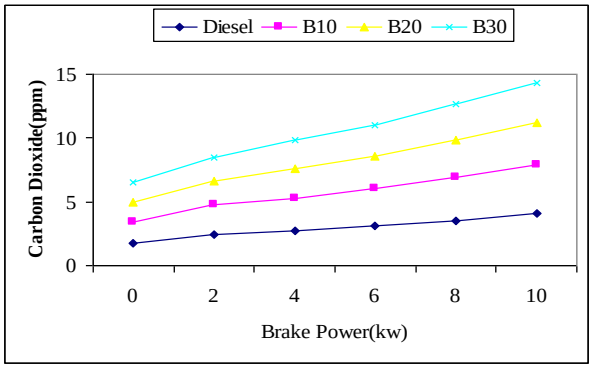

Fig.4 Carbon dioxide Vs Brake Power for diesel and NOME blends

3.5. Opacity Vs Brake Power for diesel and NOME blends

It was observed that opacity increased with the increase in load on the engine. It was also noted that opacity was higher for neat diesel as compared to those of the biodiesel blends. When the load is maximum, opacity is maximum for pure diesel and minimum value of opacity is observed for B30 NOME blend. The possibility behind this is that biodiesel if free from Sulphur [12]. Sulphur dioxide is the major source of smoke formation.

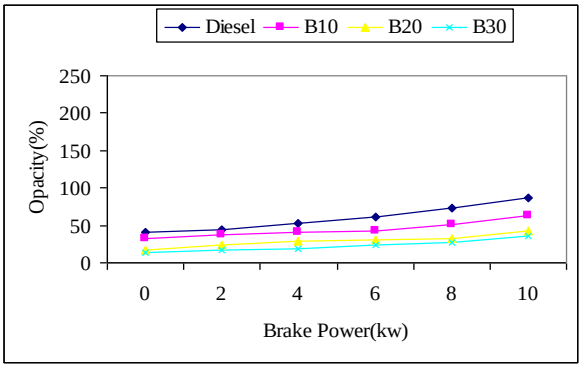

Fig.5 Opacity Vs Brake Power for diesel and NOME blends

3.6 Brake Specific Fuel Consumption Vs Brake Power for diesel and NOME blends

It was seen that brake specific fuel consumption decreases with increase in load on the engine for neat diesel and NOME blended fuel. As the total fuel consumption increases with increase in biodiesel percentage in the blend because more fuel has to be inducted due to lower calorific value of biodiesel as compared to that of biodiesel [13,14]. Thus BSFC increase with increase in biodiesel percentage in the fuel.

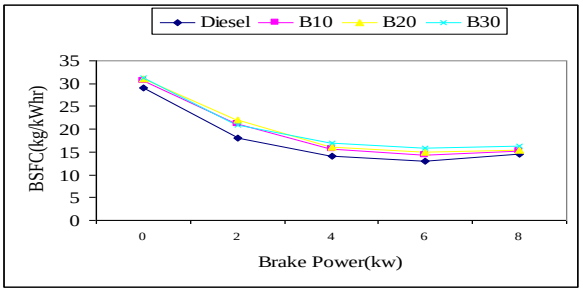

Fig.6 BSFC Vs Brake Power for diesel and NOME blends

4. RESULTS AND CONCLUSION

The brake power, break thermal efficiency & mechanical efficiency increases with increase in additive percentage in biodiesel & it is lower in case of pure biodiesel.

Break specific fuel consumption is highest for pure biodiesel & decrease with increase in additive percentage in biodiesel.

Exhaust gas temp. is found highest for pure biodiesel & tends to decrease with increase in additive percentage in biodiesel.

CO & HC emissions are found highest for diesel & decrease with increase in additive percentage in biodiesel.

Smoke & Nox emissions are found highest for pure biodiesel & decrease with increase in additive percentage in biodiesel.

Hence it may be concluded that with increase in additive percentage in NEEM BIODIESEL engine performance gets better with lower emission.

5. REFERENCES

[1] G. Hemanth, B. Prashanth, Nayan Benerjee, Tuhin Choudhuri, Mrityunjay, Dual Fuel Mode Operation and its Emission Characteristics in Diesel Engine with Producer Gas as Primary Fuel and Jatropha Biodiesel as Pilot Fuel. International Journal of Mechanical Engineering and Technology, 8(4), 2017, pp. 138–147.

[2]Prashanth.B. ,Saiteja.R., SunilKumar.B., Swarup Kumar Nayak.2016.Performance Characteristics of a four Stroke Single Cylinder Diesel Engine Fuelled with Waste Cooking oil and Diesel Blends.Proceedings of International Conference on Emerging Trends in Mechanical Engineering(ICETIME-2016).747-751.

[3] Bobade S.N and Khyade V.B, Detail study on the Properties of Pongamia Pinnata (Karanja) for the Production of Biofuel, Research Journal of Chemical Sciences, 2012, 2(7), 16-20.

[4] Mishra Sruti Ranjan, Mohanty Mahendra Kumar, Pattanaik Ajay Kumar, Preparation Of Biodiesel from Crude oil of Simarouba glauca using CaO as a Solid Base Catalyst, Research Journal of Recent Sciences, 1, 2012, 49-53.

[5] Agarwal AK. Biofuels (alcohols and biodiesel) applications as fuels in internal combustion engines. Progr Energy Combust Sci 2007, 32,233–71.

[6] Nayak,S.K.,Mishra,P.C. Emission from utilization of producer gas and mixes of jatropha biodiesel Volume 38,Issue 14,17 July 2016,Pages 1993-2000.

[7] Demirbas A. Biodiesel production from vegetable oils via catalytic and non-catalytic supercritical methanol transesterification methods. Progr Energy Combust Sci 2005, 31,466–87.

[8]Nayak,S.K.,Behera,G.R.,Mishra,P.C. Physio-chemical characteristics of punnang oil and rice husk-generated producer gas,Volume 39,Issue 3,! February 2017,Pages 291-298.

[9] Graboski MS, McCormick RL. Combustion of fat and vegetable oil derived fuels in diesel engines. Progr Energy Combust Sci 1998, 24,125–64.

[10] Komninos NP, Rakopoulos CD. Modeling HCCI combustion of biofuels: A review. Renew Sustain Energy Rev 2012,16,1588–610.

[11] Dorado, M. P., Ballesteros, E., Arnal, J.M.; Gomez, J., Lopez, F.J. Exhaust emissions from a Diesel engine fueled with transesterified waste olive oil. Fuel 2003, 82, 1311–1315.

[12] Utlu, Z., Kocak, M.S. The effect of biodiesel fuel obtained from waste frying oil on direct injection diesel engine performance and exhaust emissions. Renew. Energy 2008, 33, 1936–1941.

[13] Nayak, C., Pattanaik,B.P.,Nayak, S.K. Effect of preheated Jatropha oil and Jatropha Oil methyl ester with producer gas on diesel engine performance, Volume 9,Issue 1,2014,pages 1709-1722.

[14]Nayak,S.K.,Mishra,P.C.,Kumar,A.,Behera,G.R.,Nayak,B. Experimental investigation on property analysis of karanja oil methyl ester for vehicular usage.Volume 39,Issue 3,1 February 2017,Pages 306-312.