IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Performance and Emission of Turbo Charged 4-Stroke Four Cylinder Diesel Engine using Blends of Diesel and Biodiesel which Produced from a Neem

Prajapti Jaivik J.[*1], R.J.Jani[2]

[*1, 2] Mechanical Department, L.D. College OF Engineering

jaivik_rocks89@yahoo.com

Abstract

This works about the engine performance and emissions characteristics of NOME biodiesel on diesel engine. Overall, the engine performance of the NOME biodiesel and its blends was only poorer performance than diesel at full load condition. From the view of emissions, NOx emissions were slightly higher in NOME than diesel while un-burnt hydrocarbon emissions were higher for NOME than diesel fuel. The aim of the present work is to prepare Neem oil methyl ester as a diesel fuel substitute. High viscosity and poor volatility are the major limitations of Neem oil for utilization as a fuel in diesel engines.

This works discusses the results of investigations carried out on a 4 stroke 4-cylinder, direct injection, diesel engine operated on methyl esters of Neem oil blended with various blend like pure diesel, B05 (Biodiesel 5% and Diesel 95%), B10 (Biodiesel 10% and Diesel 90%), B15 (Biodiesel 15% and Diesel 85%) , B20 (Biodiesel 20% and Diesel 80%) and B100 (100 % Biodiesel).The performance parameters

For different NOME blends were found to be very close to diesel and the emission characteristics of engine improved significantly. At maximum load,

Brake thermal efficiency of blend B5 (5% biodiesel + 95% mineral diesel) found 34.03 % lower than that of diesel. For B5, brake specific fuel consumption 10.98 Kg/hr. observed was higher than that of diesel at higher load. HC emissions were increased from 2 to 19 for B5 blends as compared to diesel. HC emission were increased when the Neem oil methyl ester proportion were increased.CO emission decrease for different blend of methyl ester of Neem oil and diesel. CO2 emission was increased for the blends of Neem oil methyl ester as compared to diesel.

Introduction

The most common process for making biodiesel is known as Transesterification. This process involves combining any natural oil (vegetable or animal) with virtually any alcohol, and a catalyst. There are other thermo chemical processes available for making biodiesel, but Transesterification is the most commonly used one due to the simplicity and high energy efficiency. The chemistry lies in transforming the Fatty acid chains into Alkyl Esters of respective fatty acids present in different feed oils used and isolation of glycerol present in the Triglyceride molecule in the oils and fats. Biodiesel fuel can be made from new, used or non-edible vegetable oils, which are non-toxic, biodegradable, renewable resources. Oils are chemically reacted with methanol to produce chemical compounds known as fatty acid methyl esters. Biodiesel is the name given to these esters when they are intended for use as fuel. Glycerol (used in pharmaceuticals and cosmetics, among other markets) is produced as a co-product.

Neem Oil Biodiesel

Neem oil is a vegetable oil pressed from fruits and seeds of Neem, an evergreen tree which is widespread to the Indian Subcontinent and in many tropical areas. One such factor is Carbon Emission by the vehicles and diesel generators due to the use of petroleum. Use of petrol and diesel is supposed to emit more carbon to the atmosphere than any other aspect. To stop the use of these two non-renewable resources, an alternative fuel called Bio-fuel is discovered.

Neem oil is proved to contain methyl ester which is considered to be the base of a bio diesel. This bio diesel contains alkyl esters of the fatty acids which is the product of the Transesterification process of the Neem oil. Extraction of this diesel is complicated but its results are more efficient like low carbon emission, increases the engine performance, brake specific fuel is saved and reduces the smoke density..

Neem oil is generally red as blood, and has a rather strong odor that is said to combine the odours of peanut and garlic. It is hydrophobic in nature and in order to emulsify it in water for application purposes, it must be formulated with appropriate surfactants.

Biodiesel Production and Its Property

Transesterification: - Turning Neem in to Fuel

The most common process used for manufacturing Biodiesel is Transesterification'. Transesterification is the process of using an alcohol (e.g., methanol or ethanol) in the presence of a catalyst, such as sodium hydroxide or potassium hydroxide, to chemically break the molecule of the raw renewable oil into methyl or ethyl esters of the renewable oil with glycerol as a by-product. The methyl ester of vegetable oil, or biodiesel, is very similar to diesel fuel. Its viscosity is only twice that of diesel fuel and its molecular weight is roughly 1/3 of vegetable oil. Most Diesel engines were designed to use highly lubricating, high sulfur content fuel. Recent environmental legislature has forced diesel fuel to contain only a minimum amount of sulfur for lubricating purposes. Thus, the slightly higher viscosity of biodiesel is helpful and lubricating to most Diesel motors.

Process for Making Bio Diesel from Neem Oil

Neem oil was obtained commercially. Chemicals such as Sodium hydroxide, Methanol, Sulphuric acid, Phosphoric acid were purchased from Merck. All the chemicals used were of analytical reagent grade. Biodiesel fuel blend can be conventionally prepared by using alkali or acid as catalyst.100gm of refined Neem oil is mixed with 12gm of alcohol and 1gm of sodium hydroxide (NaOH) which acts as catalyst. The experiments were conducted in a manner similar to Soxhlet extraction apparatus. This mixture is taken in a 500ml round bottomed flask .The amount of catalyst that should be added to the reactor varies from 0.5% to 1% w/w. Using magnetic stirrer and heater equipment the above mixture is thoroughly mixed and maintained at a temperature of 50-55 ^{0}C for two hours. The mixture is now allowed to settle for 24 hours at which two separate layers are obtained. The top layer will be methyl ester of Neem oil (fatty acid methyl ester (FAME) i.e., .biodiesel) and the bottom one glycerin. Using a conical separating funnel the glycerin is separated at the bottom. To separate the FAME (fatty acid methyl ester) from glycerol, catalyst (NaOH) and methanol, washing was carried out with warm water. Further water and methanol will be removed by distillation. Then the NaOH, Glycerol, methanol and water was treated with phosphoric acid for neutralizing the catalyst. Finally glycerin is obtained as a byproduct in case of alkali Transesterification process. Fig.1.1 shows the experimental set up of the process. Acid catalyst production is the second conventional way of making the biodiesel. The most commonly used acid is sulfuric acid. This type of catalyst gives very high yield in esters but the reaction is very slow, requiring almost always more than one day obtaining the final product

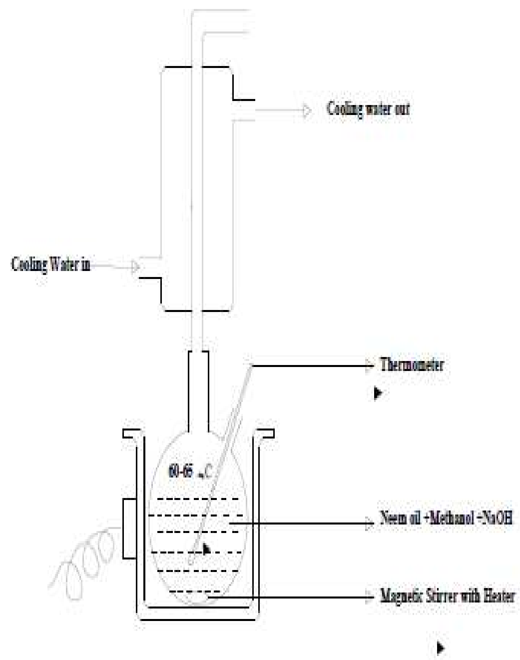


FIG. 2.1 Transterification process

Experimental Setup

Experiment Procedure

A four cylinder, 4-stroke, water-cooled turbo charged diesel engine is considered for the purpose of experimentation. The engine is coupled to an analyzer and thermocouples. The schematic diagram of test setup is shown in fig. 3.1electrical dynamometer through a load cell. It is integrated with a data acquisition system to store the data for the off-line analysis. Engine set up of 4-cylinder turbocharged engine is as shown in fig 3.2

Fig 3.1 4- cylinder turbocharged engine.

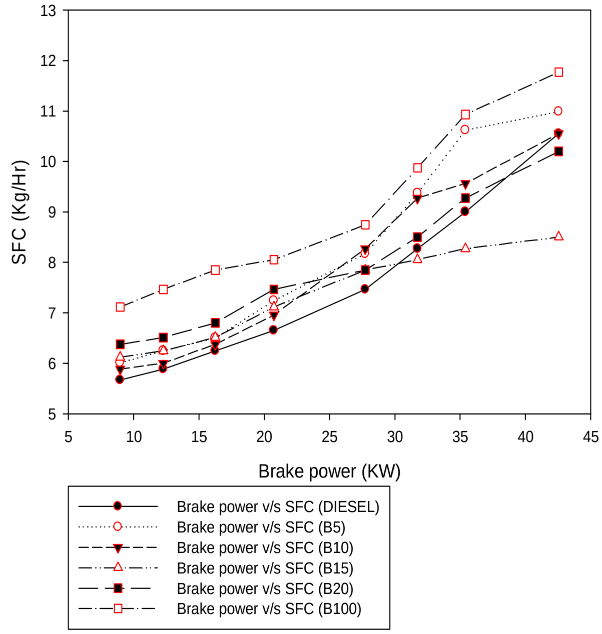
Result AND Discussion

Observation Table 4.1 (Diesel)

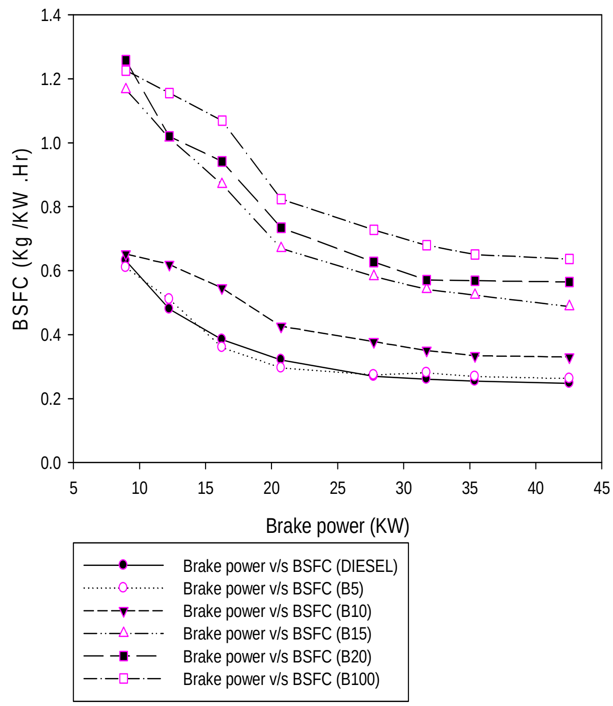
Volt (v)	Ampere (I)	BP (KW)	Time in sec (100 cc)	SFC Kg/Hr.)	BSFC (Kg/KW.Hr)	BTE (%)
256	19	8.97	54	5.6	0.6	13.64
289	23	12.2	52	5.8	0.4	17.95
308	28.6	16.2	49	6.2	0.3	22.42
321	35	20.7	46	6.6	0.3	26.84
344	43.7	27.7	41	7.4	0.2	32.01
351	49	31.7	37	8.2	0.2	33.05
374	51.3	35.4	34	9	0.2	33.88
399	57.8	42.5	29	10	0.2	34.74

Observation Table 4.2 Exhaust Emission (Diesel)

CO (ppm)	*HC* (ppm)	CO_2 (%)	O_2 (%)	NO_x (ppm)
0.016	8	3.08	16.06	283
0.02	7	3.59	15.25	363
0.022	6	4.13	14.43	592
0.024	5	5.14	13.09	606
0.028	4	5.98	11.93	764
0.03	4	7.8	9.35	999
0.033	3	10.4	6	1037
0.037	2	10.62	5.68	1095

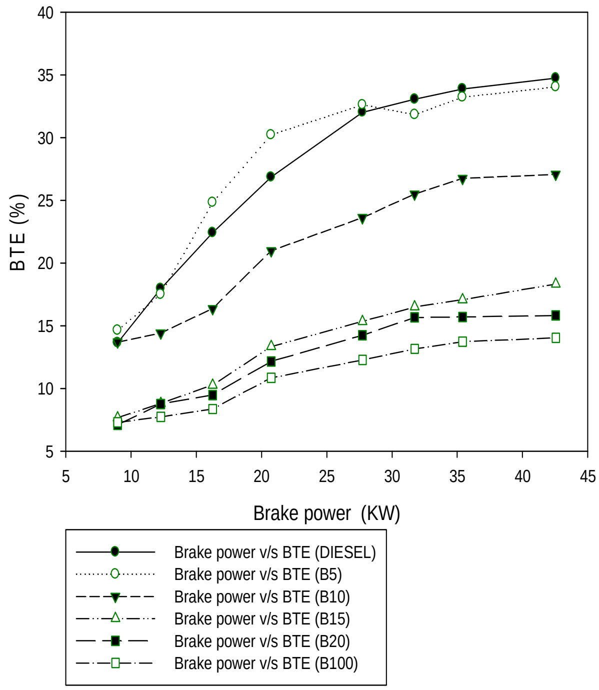


Graph 4.1 variation of SFC with brake power

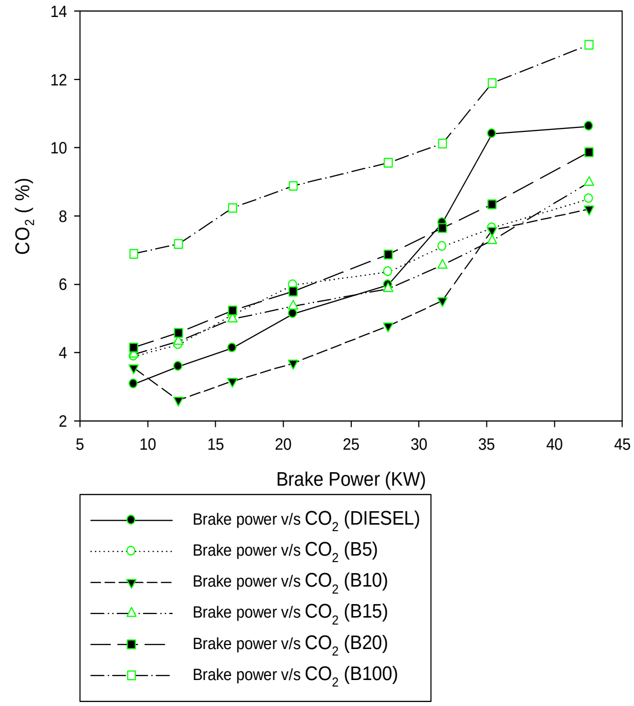


Graph 4.2 variation of BSFC with brake power

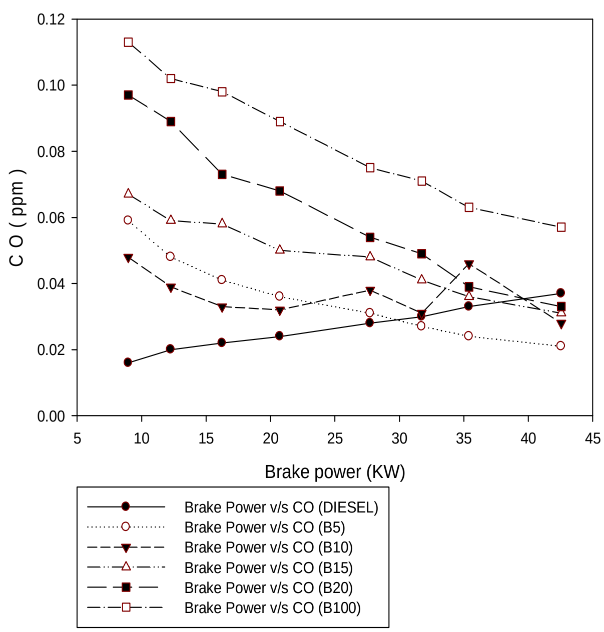
 ISSN: 2277-9655



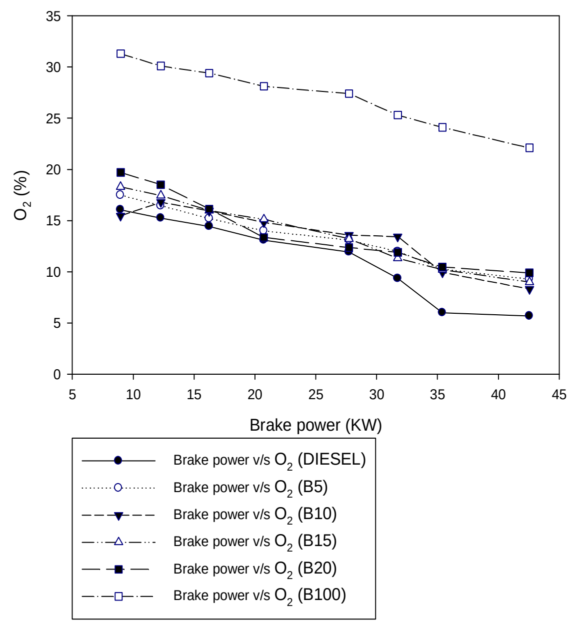
Graph 4.3 Variation of BTE with brake power



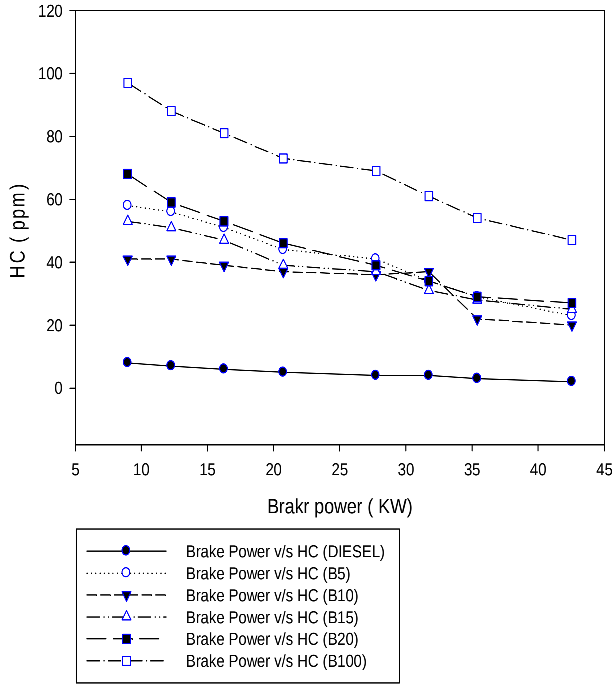
Graph 4.5 Variation of CO_2 with Brake power



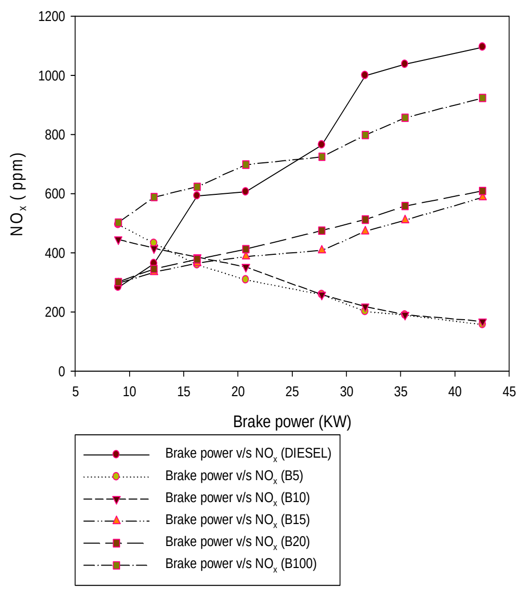
Graph 4.4 variation of CO with Brake power



Graph 4.6 Variation of O_2 with Brake power



Graph 4.7 Variation of HC with Brake power



Graph 4.8 Variation of NO_x with Brake power

Conclusion and Future Scope

Conclusion

1. The brake thermal efficiency decreased with increase of NOME in the blend. B100 gave the lowest brake thermal efficiency of 14.02 % at output of 18.50 kW.
2. The specific fuel consumption increased with increase of NOME in the blend. B100 gave specific fuel consumption of 11.76 Kg/hr. As against 10.55 Kg/Hr. of diesel at highest load.
3. The Basic specific fuel consumption increased with increase of NOME in the blend. B100 gave Basic specific fuel consumption of 0.6361 Kg/KW.Hr. As against 0.2479 Kg/KW Hr. of diesel at highest load.
4. The HC emission is going to increase with increased the proportion of NOME in the blend. Emission of HC for diesel is very lower as compared to NOME. B100 gave 47 ppm where diesel gave 2 ppm at full load but B5 gives the better performance with compare to the other blend which is decreased with increased the load.
5. The CO emission is going to increase with increased the proportion of NOME in the blend. Emission of CO for diesel is lower as compared to NOME. B100 gave 0.037ppm where diesel gave 0.057 ppm at maximum load.
6. The CO_2 emission is going to increased with increased the proportion of NOME in the blend. Emission of CO_2 for diesel is lower as compared to NOME. B100 gave 3.08% ppm where diesel gave 6.89% at normal load.
7. The O_2 emission is going to decreased with increased the proportion of NOME in the blend. But increase with compare to the diesel. Emission of O_2 for diesel is lower as compared to NOME. B100 gave 16.06% where diesel gave 31.3 % at normal load.
8. The NOx emission is going to increased with increased the proportion of NOME in the blend. But decrease with compare to the diesel. Emission of NOx for diesel is lower as compared to NOME. B100 gave 923 ppm where diesel gave 1095 ppm at normal load.

Future Scope

1. At higher load B100 produced 0.057 ppm CO. So by using the appropriate Emission Reduction method or Device will try to minimum CO and content of Emission level of CO to atmosphere.
2. NO_x emission is decrease at full load as compare to the diesel so it is good for atmosphere condition
3. Using the EGR system for minimizing the CO and CO2 for Multi Cylinder Diesel Engine.

References

[1] Raheman H, Ghadge SV. Performance of compression ignition engine with Mahua (Madhuca indica)biodiesel. Fuel 2007;86:2568–73.

[2] Hazar H. Cotton methyl ester usage in a diesel engine equipped with insulated combustion chamber. Appl Energy 2010;87:134–40.

[3] Taymaz I. An experimental study of energy balance in low heat rejection diesel engine. Energy 2006;31:364–71.

[4] M.A. Kalam, M. Husnawan, H.H. Masjuki, "Exhaust emission and combustion evaluation of coconut oil-powered indirect injection diesel engine". Renewable Energy, Vol. 28, No. 15, 2003, 2405-2415.

[5] D. Haupt, K. Nord, K. Egeback, P. Ahlvic, "Hydrocarbons and aldehydes from a diesel

[6] Engine running on ethanol and equipped with EGR, catalyst and DPF". Society of Automotive Engineering (SAE) Technical Paper Series No. 2004-01-1882, 2004.

[7] J. Senda, N. Okui, T. Tsukamoto, H. Fujimoto, "On board measurement of engine performance and emissions in diesel vehicle operated with biodiesel fuel". Society of Auto motiveEngineering (SAE) Technical Paper Series No. 2004-01-0083, 2004.

[8] Ibrahim, A.M., Nassib A.M., Abdel-Hafz O.M., Bady M.F. *A study of the performance and exhaust emissions of spark ignition engine fuelled by ethanol-gasoline blends*, Proceedings 3rd International Conference on Heat Powered Cycles, Cyprus, October 2004.

[9] Umar Garba M., Al Hassan M., Kovo, A.S. *A review of advances and quality assessment of biofuels*, Leonardo Journal of Sciences, 9: 167-178, 2006.

[10] Agrawal AK, Das LM. Biodiesel development and characterization for use as a fuel in compression ignition engines. Trans ASME 2001;123:440–7.

[11] Fangrui Ma, Milford A. Bio-diesel production—review. Bioresour Technol 1999.

[12] Canakci M, Van GJ. Biodiesel production from oils and fats with high free fatty acids. Trans ASAE 2001; Peterson C.L., Reece D.L., Hammond B.C., Thompson J.C., Beck, S., P*roduction and testing of ethyl and methyl esters*, A Report of Department of Agricultural Engineering,University of Idaho, 1995.