International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018

Performance and Emission Test on Compression Ignition Engine by using Neem and Eucalyptus Oil as an Alternative Fuel

V.Kumar[*1]
Assistant Professor (Sr.G)
Department of Mechanical Engineering
SRM Institute of Science and Technology
Chennai, India

Paratha S Chakraborty[2],
Associate professor, DACEE,
Jadavpur university, Kolkata

A.Sengolerayan [*1]
Assistant Professor (S.G)
Department of Mechanical Engineering
SRM Institute of Science and Technology
Chennai, India

D.K. Mondal[3],
Associate Professor
Department of Mechanical Engineering,
Jadavpur university, Kolkata

abstract— *Fuels derived from biomass are mostly preferred as alternative fuels for IC engines as it is abundantly available and is renewable in nature. As most of vegetable oils are edible, growing concern for trying non-edible and waste fats for alternative to petro diesel has emerged. In present study diesel fuel is completely replaced by bio-fuels namely methyl ester of Neem oil and eucalyptus oil in various blends.*

Biodiesel is considered a clean burning alternate fuel, produced from renewable resources like virgin or used vegetable oils, both edible and non-edible. It can be used in compression-ignition (diesel) engines with little or no modifications. Biodiesel is simple to use, biodegradable, non toxic, and essentially free from harmful chemical elements like Sulfur and organic compounds like aromatics. It can be stored just like petroleum diesel fuel and hence does not require a separate infrastructure. Its higher Cetane number improves the ignition quality even when blended in petroleum diesel. Nevertheless it is pertinent to note that despite the advantages, there are several implications as far as its applications are concerned specially with the precision Fuel Injection System.

In this proposal work it is planned to study experimentally performance and emission characteristic of a diesel engine using blended fuel (Neem & eucalyptus oils)With diesel. The effects of engine parameter on thermal efficiency, smoke and the specific energy consumption is to be studied.

Index Terms— Neem & eucalyptus oils.

INTRODUCTION

Continuous raise in fuel price, increase in number of road vehicles, depletion of petroleum resources and increase in green house gases are the main reasons for the search of alternative fuels. Up to now many alternative fuels are identified from different resources like waste vegetables, plants, animal fat etc., these are successfully tested over engine with slight modifications in engine or without any modifications. But unfortunately every fuel is experiencing some sort of problem so that these cannot be replaced the existing fuel. Bio fuels can be renewed. These are eco-friendly since these are extracted from plants, animals.

In general oils extracted from plants are classified into two categories. They are triglyceride oils (TG oils) and turpene oils (light oils). In present study triglyceride oils are used. Triglyceride oils are extracted from plant seeds but eucalyptus oil is taken from the leaves and young twigs of plant. Present study involves two trig-

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018

lyceride oils namely methyl ester of Neem oil and eucalyptus oil .Eucalyptus oil is prepared from leaves and young twigs of plant whereas Neem oil is prepared from Neem seed.

The use of edible vegetable oils and animal fats for biodiesel production has recently been of great concern because they compete with food materials. As the demand for vegetable oils for food has increased tremendously in recent years, it is impossible to justify the use of these oils for fuel use purposes such as biodiesel production. Moreover, these oils could be more expensive to use as fuel. Hence, the contribution of non-edible oils such as Neem and eucalyptus will be significant as a non-edible plant oil source for biodiesel production

In India Neem tree is a widely grown up termed as a divine tree due to its wide relevance in many areas of study. Neem is a large tree growing about 25 m in height with semi-straight to straight trunk, 3 m in girth and spreading branches forming a broad crown, starts fruiting after 3-5 years. From the tenth year onwards it can produce up to 50 Kg of fruits annually. The tree has adaptability to a wide range of climatic, topographic factors. It thrives well in dry, stony shallow soils and even on soils having hard calcareous or clay pan, at a shallow depth. Neem tree requires little water and plenty of sunlight and rainfall in the range of 450 to 1200 mm with wide temperature range of 0°C to 49°C. However, it has been introduced successfully even in areas where the rainfall is as low as 150 to 250 mm .It grows on almost all types of soil including clayey, saline and alkaline soil, but does well on black cotton soils and deep well drained soil with good sub-soil water

Eucalyptus oil was selected as the source of biodiesel and the various characteristics were analyzed. The eucalyptus tree is a non-edible species capable of growing in all climatic conditions. Eucalyptus oil was derived mainly from the leaves and barks of the tree and is available throughout the year.

Eucalyptus oil alone cannot replace diesel in diesel engine since the Cetane number of eucalyptus oil is insufficient. But the blended form of eucalyptus and methyl ester of Neem oil can replace diesel to a maximum extent since the properties of blends are nearer to the properties of diesel fuel. These blends can be used over diesel engine without any further modifications. In the present work performance, emission and combustion characteristics of these bio fuel blends are examined over a 4 stroke, Single cylinder vertical air cooled Diesel Engine.

POTENTIAL CHARACTERIZATION OF NEEM OIL

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. Neem oil is Light to Dark Brown in color, Bitter in taste and has a strong odor. It comprises of Triglyceride and Triterpenoid compounds. Neem Oil is Hydrophobic in nature and in order to emulsify it in water for application purpose. Neem Oil contains steroids (Campesterol, beta-sitosterol, stigmasterol) and a plethora of Triterpenoid.

NEEM / MARGOSA TREE (Azadirachta indica)Family- Meliaceae English-Neem Tree, Margosa Tree, Indian Lilac A Neem is one of the most widely cultivated and naturally occurring species in South india. It is a sacred tree, known to Indians since ages, seen near temples and in villages. Chemical content of Oil: Limonoid, Mahmoodin, Protolimonoid,Naheedin,Tetranortriterpenoids, Azadirone, Epoxyazadirone, Nimbin, Gedunin, Azadiradione, Deacetylnimbin, 17-hydroxy azadiradione, Nimbocinol, 17-Epinimbocinol.

POTENTIAL CHARACTERIZATION OF EUCALYPTUS

A few eucalyptus species mainly melees produce leaf oil. The botanical name is eucalyptus globules. These oils are composed of mixture of volatile organic compounds including hydrocarbons, alcohols, aldehydes, keytones, acids, ethers and esters. 1-8 cineole or simply cineole is active component of eucalyptus oil.

Cineole is as cyclic ether with empirical formula C10H18O and systematic name 1, 3, 3- trimethy, 1-2-oxabicyclo octane (Ramesh B et al (1994)). It is sometimes traded commercially as eucalyptol. It is a colourless liquid over the temperature range 0c to 177c with a vapour pressure of 69 mm of Hg at 20c and a strong characteristics odour.

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018

I. METHOD OF NEEM OIL EXTRACTION

Extraction with ram press and expeller are referred to as cold pressing extraction .Expellers are the most popular oil extraction Engines. They are designed into devices that can cater for small scale extraction. Oil seed ram press is simply a piston inside a cage. With the seeds placed inside the cage, the piston can compress the seeds and force out the oil. Sometimes the operating force of the ram can be from a manual pump lift.

FUEL PROPERTIES

Properties of Neem oil

Property	**Petro-diesel**	**Neem biodiesel**
Calorific Value	43.2 MJ/Kg	39.87MJ/Kg
Density (15º C)	0.845	0.88
Viscosity (40º C) cSt	1.57	6.17
Flash point (0C)	56	120
Fire point (0C)	65	130
Cetane Index	50	54.2

Properties of Eucalyptus oil

Property	**Petro-diesel**	**Eucalyptus biodiesel**
Calorific Value	43.2 MJ/Kg	42.5 MJ/Kg
Density (15º C)	0.845	0.908
Viscosity (40ºC) cSt	1.57	1.85
Flash point (0C)	56	32
Fire point (0C)	65	42
Cetane Index	50	48

Blend Ratio Details

S.NO	**Name of the blend**	**Neem Biodiesel [%]**	**Eucalyptus Biodiesel [%]**	**Diesel [%]**
1	B100	100	-	-
2	B20	20	5	75
3	B40	40	5	55
4	B60	60	5	35
5	B80	80	5	15
6	D100	-	-	100

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018

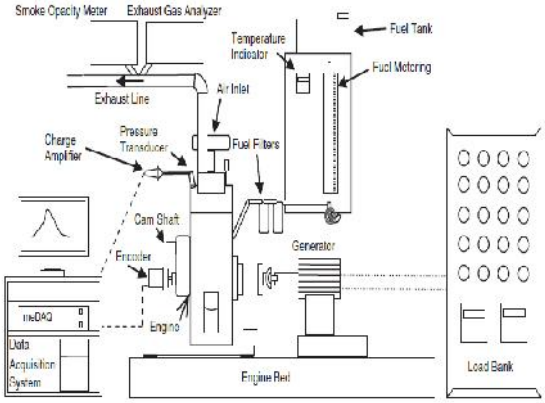
VI.STIRRER PROCESS EQUIPMENTS

S.NO	SPECIFICATION	MS 500
1	Max.speed	100 rpm
2	Stirring capacity	1.0 litre
3	Width mm	90
4	Depth mm	125
5	Height mm	100
6	Phase	single

220 / 230 volts 50 -60 HZ single phase

STIRRER PROCESS EQUIPMENT

VII.EXPERIMENTAL SETUP SCHEMATIC DIAGRAM



A four-stroke, single cylinder, constant-speed, water-cooled, direct injection diesel engines (Make: Kirloskar Oil Engines Ltd. India; Model: DM-10) was used to experimentally investigate different neem oil biodiesel blends for engine performance, emissions and combustion. The detailed specifications of the engine used are given.

The engine is operated at a constant speed of 1500 rpm.The fuel injection pressure is in the range of 200–205 bars. crank angle with a resolution of 0.5° crank angle. A TDC marker was used to locate the top dead center position of the piston in every cycle of the engine. The signals from the charge amplifier, TDC marker and shaft encoder were acquired using a high-speed data acquisition system.

(Make: Hi-Techniques, USA; Model: meDAQ). Engine tests are carried out at 1500±3 rpm, at 200 bar fuel injector pressure for diesel Pressure data.

All tests were carried out after thermal stabilization of the engine. Exhaust gas opacity was measured using smoke opacimeter (Make: AVL Austria; Model: 437). The exhaust gas composition was measured using exhaust gas analyzer (Make: AVL India, Model: DIGAS 444). It measures CO2, CO, HC, NO and O2 concentrations in the exhaust gas.

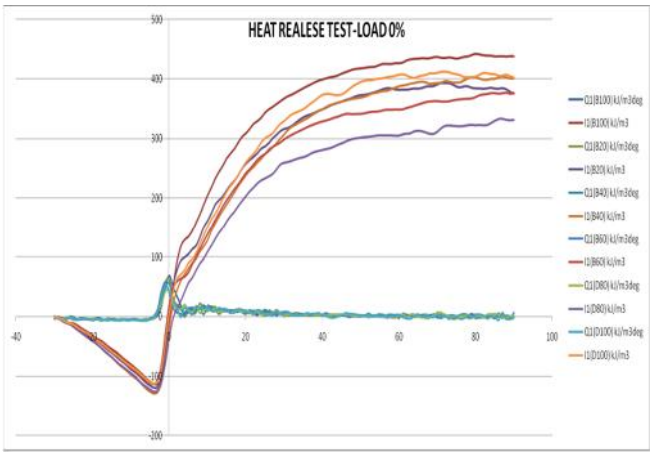
VIII. COMBUSTION ANALYSIS

The significant features related to combustion aspects are summarized. The peak pressure achieved using diesel, Neem, and Eucalyptus biodiesel and their blends at full load condition .The heat release rate at selected operating points of different diesel–biodiesel blend fuels and neat diesel operation are also shown in Fig. 3. The peak pressure, heat release rate at 0% load 25%, 50%, 75% and 100% load are also analyzed, which gives very significant information on the ignition delay in case of biodiesel, diesel and their blends.

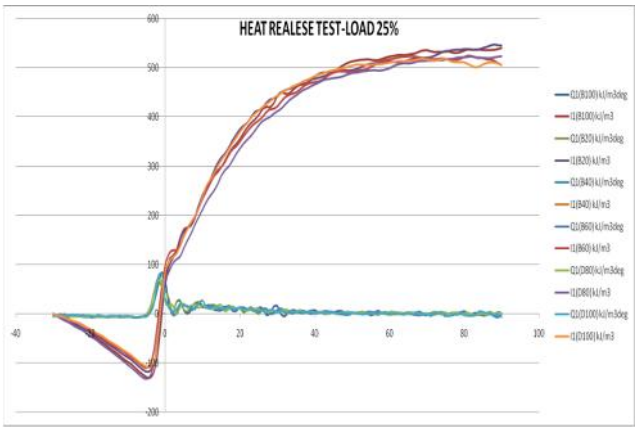
International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018

IX. EFFECT OF BLENDS ON HEAT RELEASE RATE

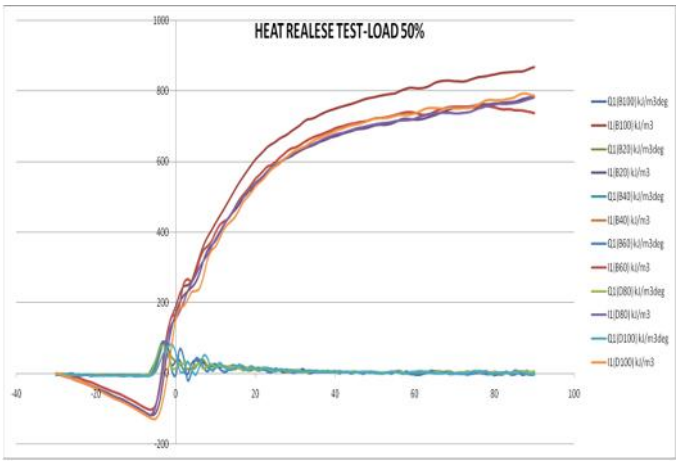
The effects of blends on heat release compared with various loads and various blends shows that comparatively same results while compare with petro diesel. The graph results are mentioned below as follows.



Comparison Graph load 0%

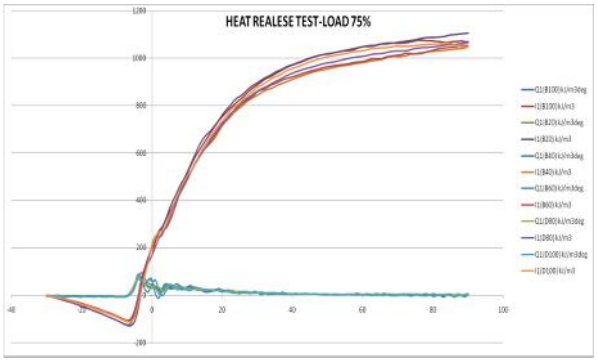


Comparison Graph load 25%

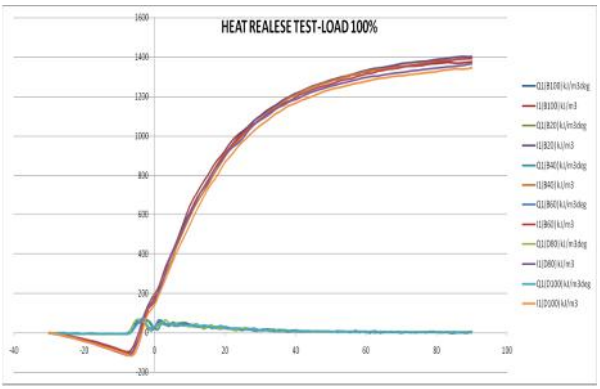


Comparison Graph load 50%

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018



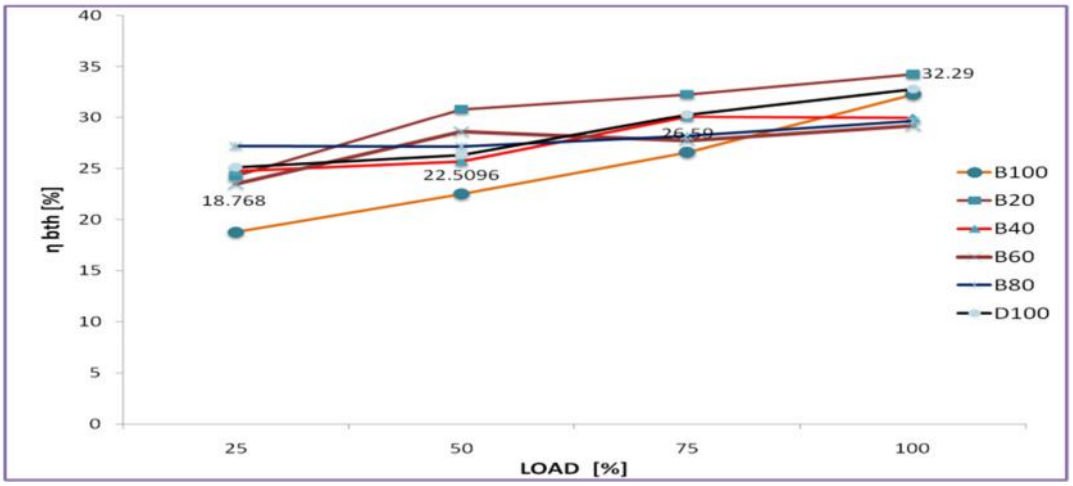
Comparison Graph load 75%



Comparison Graph load 100%

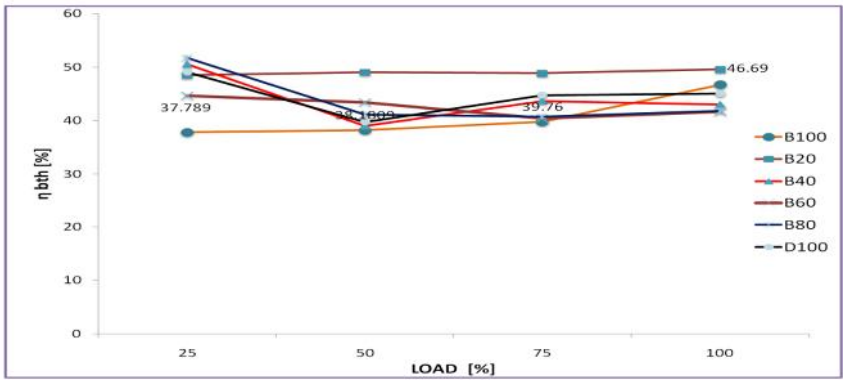
X. PERFORMANCE ANALYSIS

The obtained results are compared with the results obtained when operated with diesel, Neem biodiesel and diesel, Neem+ eucalyptus oil + diesel mixture at various Blend ratios. The below indicated graphs are used to study various characteristics of engine like brake thermal efficiency, mechanical efficiency, engine outlet temperature.

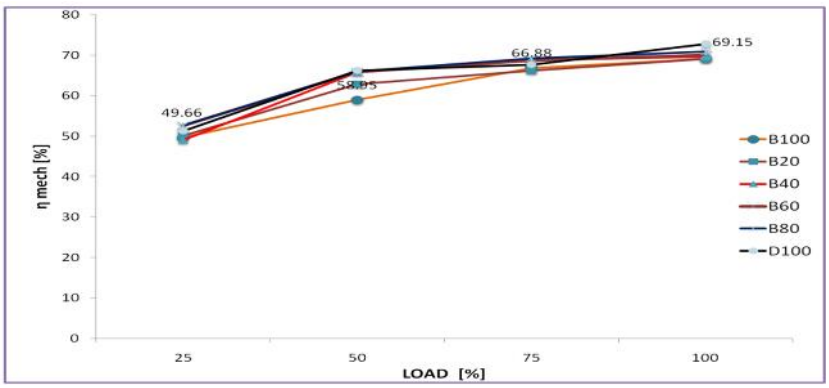


Comparison Graph Brake thermal efficiency) % Vs Load

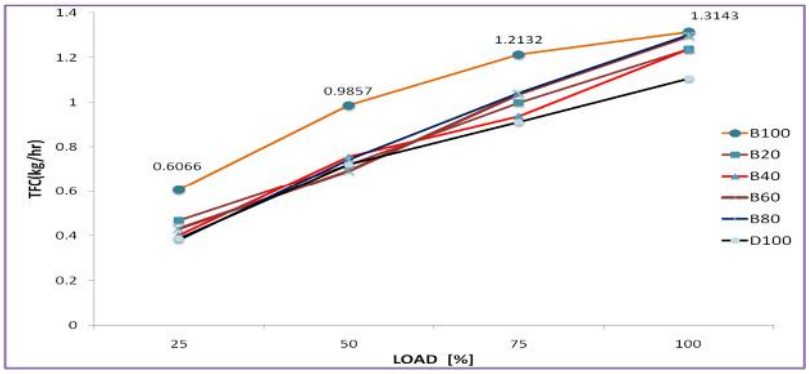
International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018



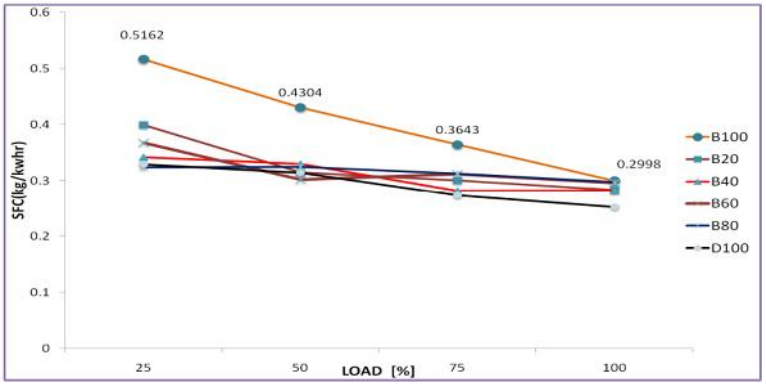
Comparison Graph indicated thermal efficiency%Vs Load



Comparison Graph Mechanical efficiencyVs Load

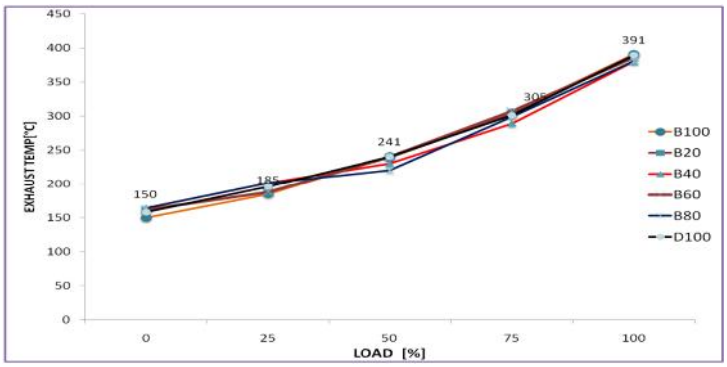


TFC comparison graph with various Load conditions

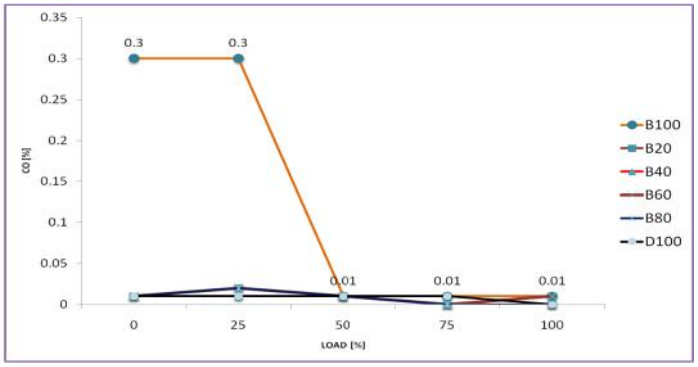


SFC comparison graph with various Load conditions

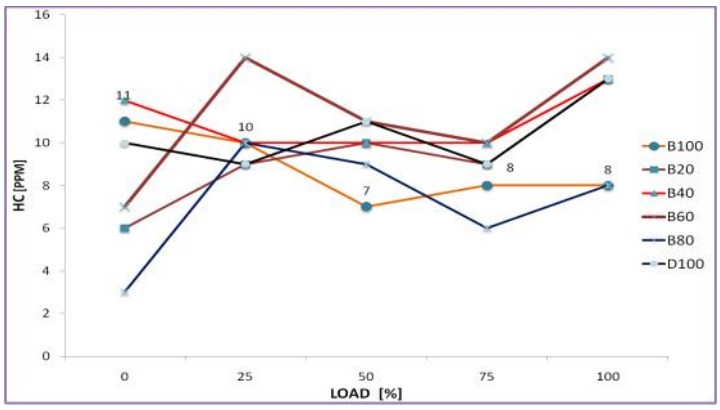
International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018



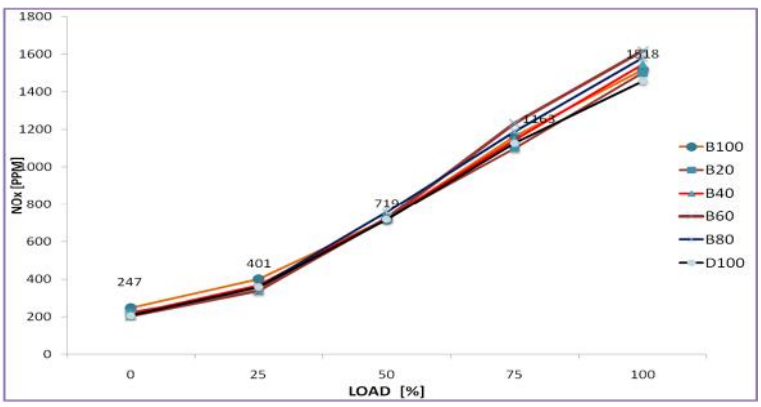
Exhaust gas temp Vs Load



Carbon monoxide (CO) emission Vs Load

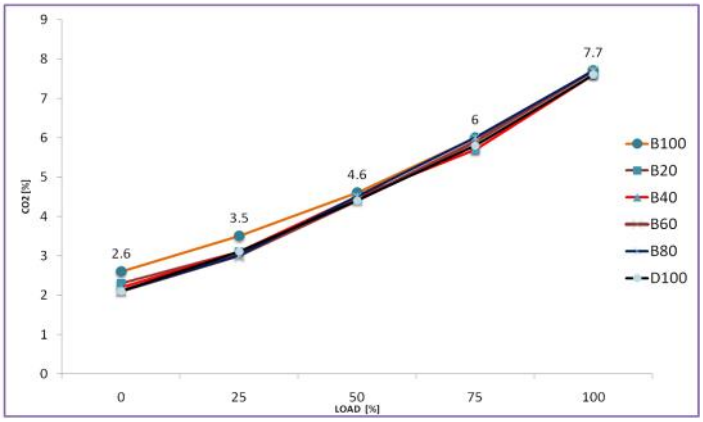


Hydrocarbons (HC) emission Vs Load

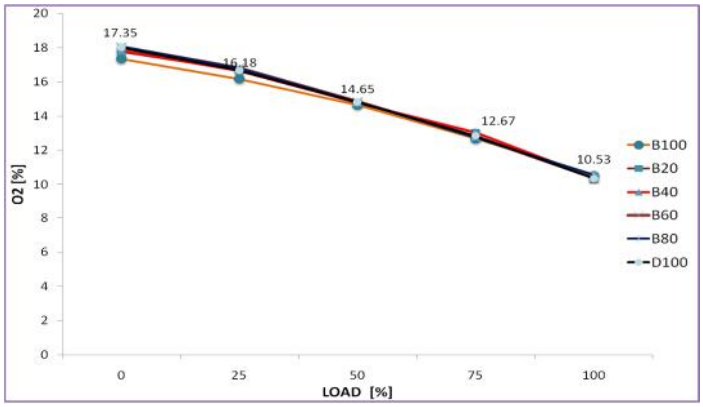


NOx emission Vs Load

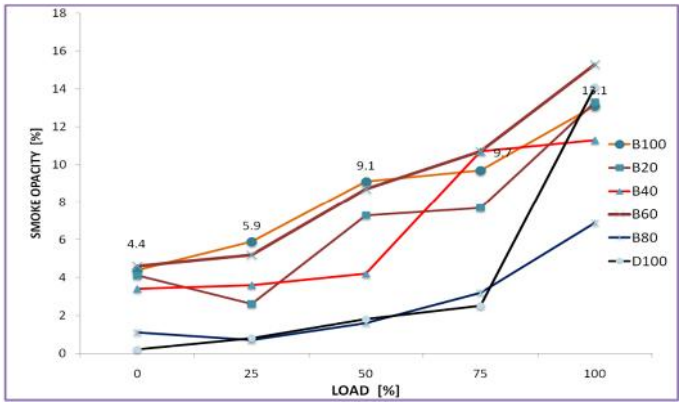
International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 2
February 2018



CO2 emission Vs Load



Comparison Graph for Oxygen (O2) emission Vs Load



Comparison Graph for Smoke Opacity Vs Load

XI. RESULTS AND DISCUSSIONS

The properties of biodiesel and their blends are compared with those of ASTM biodiesel standards. Most of the fuel properties of Neem, Eucalyptus and their blends are comparable to those of diesel. The present results obtained show that the transesterification process improved the fuel properties of the oil with respect to density (kg/m3), calorific value (kJ/kg), viscosity (cSt), flash point (C), cloud point (C) and pour point (C). The comparison of these properties with diesel shows that the methyl esters of Neem and Eucalyptus oil have relatively closer fuel property values to that of diesel (HSD). Hence, no hardware modifications are required for handling these fuels (biodiesel and their blends) in the existing engine. The calorific values of all the biodiesel

and their blends are lower than that of diesel because of their oxygen content. The presence of oxygen in the biodiesel helps for complete combustion of fuel in the engine. The flash point of all the biodiesel and their blends is lowered by transesterification, but it is still higher than that of diesel. Addition of a small quantity of biodiesel with diesel increases the flash point of diesel. Hence, it is safer to store biodiesel–diesel blends as compared to diesel alone. It is observed that the typical combustion characteristics of Neem and Eucalyptus biodiesel are in the close range of the requirement of the engine.

REFERENCES

[1] Krieger R B, and Borman G L., "The computation of Apparent Heat release for Internal combustion Engines" ASME paper 66-WA/DGP-4, 1956.
[2] A Ramesh , B Nagalingam and K V Gopla Krishnan " A simple method to obtain the heat release rates Of a diesel engine using a single analyzer". National conference on IC engines and combustion, Dec17- 19, 1987, PA-55.
[3] Ulf Schuchardta, Ricardo Serchelia, and Rogerio atheus Vargas*b. "Transesterif-ication of Vegetable Oils": A Review", 1997.
[4] A.S.Ramadhas, S.Jayaraj, C.Muralidheeren, "Use of vegetable oil as I.C.engine fuels: A review", Renewable Energy, Vol. 29, 2003, 727-742.
[5] International Journal & Magazine of Engineering, Technology, Management and Research- ISSN No: 2348-4845
[6] Dr. D. K. Tuli-Indian Oil Corporation Ltd, R &DCentre.
[7] Ambarish Datta and Bijan Kumar Mandal, Impact of alcohol addition to diesel on the performance combustion and emissions of a compression ignition engine, *Applied Thermal Engineering*, 2016, Vol. 98, pp.670-682.
[8].Ambarish Datta and Bijan Kumar Mandal, A comprehensive review of biodiesel as an alternative fuel for compression ignition engine, *Renewable and Sustainable Energy Reviews*, 2016, Vol. 57, pp.799-821.
[9].Ambarish Datta and Bijan Kumar Mandal, A numerical study on the performance, combustion and emission parameters of a compression ignition engine fuelled with diesel - palm stearin biodiesel and alcohol blends, *Clean Technologies and Environmental Policy*, 2017, Vol. 19: pp.157-173
[10]. Ambarish Datta and Bijan Kumar Mandal, Engine performance, combustion and emission characteristics of a compression ignition engine operating on different biodiesel-alcohol blends, *Energy*, 2017, Vol. 125, pp. 470-483.