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Performance and Emission Characteristics of Eucalyptus and Madhua Oil Diesel Blend in Four Stroke Diesel Engine

M.Rajeshkumar[1], Dr.P.Prabhakaran M.E, Ph.D[2],
M.E Student (Thermal Engineering)[1], Professor[2]
Department of Mechanical Engineering
J.J. College of Engineering and Technology, Trichy, India

Abstract:
Evolutions of vehicles lead to the increase in the usage of fuels. Therefore demand and price of fuel is increasing day by day. This led to find an alternative fuels for internal combustion engines. Biodiesel production is worthy of continued study and optimization of production procedures because of its environmentally beneficial attributes and its renewable nature. Non-edible vegetable oils such as Eucalyptus and Madhuca longifolian oil, produced by seed-bearing shrubs, can provide an alternative and do not have competing food uses. Biodiesel was prepared from the non-edible oil of Eucalyptus and Madhuca longifolian by transesterification of the crude oil with methanol in the presence of NaOH as catalyst. The experimental treatments of a 200ml methanol to oil, addition of 5wt% catalyst, 65-70^{0}C reaction temperature using low quality crude Eucalyptus and Madhuca longifolian oil separately resulted in optimum yield in which the biodiesel content exceeded 95% at 2 hours. The resulting 50% Eucalyptus oil and 50% Madhuca longifolian oil is blended with diesel in different percentage. Performance and emission tests were carried out for 10%, 30%, and 50% Eucalyptus and Madhuca longifolian oil diesel blends. Results confirm that the performance and emission of the engine fuelled Eucalyptus and Madhuca longifolian oil biodiesel and their blend with diesel fuel is by and large comparable with pure diesel.

Keywords: Eucalyptus oil, Madhuca longifolian, Biodiesel, transesterification, Performance and emission tests.

1. INTRODUCTION

Many energy fuels such as eucalyptus oil, hydrogen, CNG, alcohols, Biogas, Producer gas and host of vegetable oils are being investigated as potential substitutes for the current high pollutant diesel fuel derived from diminishing commercial sources. With the fossil fuel depleting, biofuel as a renewable source of energy affords immense potential. In India, our domestic production of fuel is simply not able to keep pace with the ever growing needs, compelling us depend heavily on imports. With about 70% of domestic demand for fuel to be met by imports, there is a huge outflow of valuable foreign exchange. Besides, the increasing use of fossil fuel has also been resulting in such seriously deleterious problems as Green House Effect affecting the entire humanity. It is therefore impending that a safe alternative is explored and exploited. Naturally, biofuel presents a most viable option as it can be obtained from renewable source of energy. The fuels of Bio origin may be alcohols, edible and non edible vegetable oils, biomass, biogas etc. some of these fuels can be used directly while others need to be formulated to bring the relevant properties close to conventional fuels.

1.1 VEGETABLE OILS

In the last few years interest & activity has grown up around the globe to find a substitute of fossil fuel. According to Indian scenario the demand of petroleum product like diesel is increasing day by day hence there is a need to find a solution. The use of edible oil to produce biodiesel in India is not feasible in view of big gap in demand and supply of such oil. Under Indian condition only non-edible oil can be used as biodiesel which are produced in appreciable quantity and can be grown in large scale on non-cropped marginal lands and waste lands. Non-edible oils manila tamarind and custard appleand mahua contain 30% or more oil in their seed, fruit or nut. India has more than 300 species of trees, which produce oil bearing seeds Around 75 plant species which have 30% or more oil in their seeds/kernel, have been identified and listed. Traditionally the collection and selling of tree based oil seeds were generally carried out by poor people for use as fuel for lightning. Biodiesel has become more attractive because of its environmental benefits and fact that it is made up of renewable resources. Although short term test using vegetable oil showed promising results, longer tests led to injector coking, more engine deposits, ring sticking and thickening of the engine lubricant.

1.2 MADHUCA LONGIFOLIA OIL

Mahua longifolia is an Indian tropical tree found largely in the central and north Indian plains and forests. It is commonly known as mahua, mahwa or Iluppai. It is a fast-growing tree that grows to approximately 20 meters in height, possesses evergreen or semi-evergreen foliage, and belongs to the family Sapotaceae.

Figure .1.1 Madhuca Longifolia tree and seed

The two major species of genus madhuca found in India are Madhuca Indica (Longifolia) and Madhuca Indica (Latifolia). The seed potential of this tree in India is 500,000 tons and oil potential is 180,000 tons.Madhuca latifolia can be from medium size to large deciduous tree, distributed in Andhra Pradesh, Gujarat, Madhya Pradesh, Orissa, Bihar and Uttar Pradesh. Madhuca Longifolia, a large ever green tree found in south Indiaand evergreen forest of the western ghats. It attains a height up to 70ft. The tree matures within 8 to 15 years and fruits up to 60 years. The kernels are 70% of seed by weight. Oil content in Latifolia is 46% and 52% in Longifolia. In seed oil content 35% and 16% protein.

1.2.1 Use of Madhuca Longifolia Oil

- The oil extracted from the seeds of the Madhuka plant is applied over the area affected with skin diseases and body pain.
- Nasal administration of the fresh juice of the flowers of Madhuka longifolia is done in diseases of vitiated pitta dosha like headache, burning sensation of the eyes etc.
- The dried flowers of madhuka is boiled in milk and administered in a dose of 40-50 ml to treat weakness of the nerves and diseases of the neuro muscular system.
- The decoction prepared from the bark of the tree is given in dose of 30-40 ml to treat Irritable Bowel Syndrome and diarrhea.
- Fresh juice of the flowers is given in a dose of 20- 25 ml to treat hypertension, hiccups and dry cough.
- The flowers of madhuka plant is boiled in milk and added with sugar candy and given in a dose of 40-50 ml to treat less sperm count, premature ejaculation and production of less milk in post- partum period.

1.3 EUCALYPTUS OIL

Eucalypts have special flowers and fruits that no other trees have. When it flowers a bud cap made of petals grows around the flower until it is ready to open. Then the bud cap falls off to reveal a flower with no petals. The woody fruits are called gumnuts. They are roughly cone-shaped and open at one end to release the seeds. Nearly all eucalypts are evergreen but some tropical species lose their leaves at the end of the dry season. The leaves are covered with oil glands. These oils are often used to treat coughs and colds. Many eucalypts also change the shape of their leaves as they get older. Young eucalypts have round leaves. When one to a few years old, the leaves of most kinds become longer and spearhead or sickle shaped. A few kinds keep the round leaf shape all their lives. Most species do not flower until the adult leaves starts to appear.

Figure.1.2 Eucalyptustree and seed

2. PROBLEM DESCRIPTION

Now a day usage of fuel is increasing along with evolution of vehicles. Therefore the fuel demand and price is increasing rapidly. The increased demand of petroleum derived fuel as well as their resulting environmental concerns provides the incentives for the development of alternate fuels from renewable resources. Biodiesel derived from animal fat, vegetable and fruit oils can be used as diesel fuel substitute. The conventional method for the preparation of Biodiesel consists of alkali catalysed transesterification of the low free fatty acid (FFA) oil with methanol. As manila tamarind and custard apple is a Non-edible oil seed grown throughout India is presently being underutilized. For biodiesel, the by-products exhibit interesting biological activity. So vegetable oil is to be extracted from Manila Tamarind seed and Custard Apple seed and will be blended with diesel in various proportions. It is used as a biodiesel and various emission and performance characteristics will be carried out to investigate whether these blends are usable.

3. MATERIALS

3.1 MAHUA (Madhuca Indica)

The two major species of genus madhuca found in India are Madhuca Indica (Longifolia) and Madhuca Indica (Latifolia). The seed potential of this tree in India is 500,000 tons and oil potential is 180,000 tons. Madhuca latifolia can be from medium size to large deciduous tree, distributed in Andhra Pradesh, Gujarat, Madhya Pradesh, Orissa, Bihar and Uttar Pradesh. Madhuca Longifolia, a large ever green tree found in south India and evergreen forest of the western ghats. It attains a height up to 70ft. The tree matures within 8 to 15 years and fruits up to 60 years. The kernels are 70% of seed by weight. Oil content in Latifolia is 46% and 52% in Longifolia. In seed oil content 35% and 16% protein.

3.2 EUCALYPTUS OIL (cineole)

Eucalyptus oil (cineole) is the generic name for distilled oil from the leaf of Eucalyptus, a genus of the plant family Myrtaceae native to Australia and cultivated worldwide. The leaves of selected Eucalyptus species are steam distilled to extract eucalyptus oil. The main chemical components of eucalyptus oil are a-pinene, b-pinene, a-phellandrene, 1,8-cineole, limonene, terpinen-4-ol, aromadendrene, epiglobulol, piperitone and globulol. Eucalyptus is a tall evergreen tree. It attains the height of more than 100 meter. The adult leaves are 15to 30 cm long and 2to5 cm broad. Eucalyptus oil has a history of wide application, as a pharmaceutical, antiseptic, repellent, flouring, fragrance and industrial uses. The cineole (eucalyptol) based oils can also be used as an insect repellent and biopesticide. Eucalyptus oil has been used as an effective way of killing dust mites.

4. EXPERIMENTATION

4.1 EXTRACTION OF OIL

In this experimentation process Eucalyptus and Madhuca longifolian seeds are collected in the plant after 3-4 days dry the seed using sunlight. The seed husk is removed completely and seeds can put into the jaw action bucket crushers. The Eucalyptus and Madhuca longifolian oil is collected in the bucket.

Figure.4.1 Eucalyptus and Madhuca longifolian oil Seed crushing machine

4.2 BIODIESEL PREPARATION

4.2.1 Esterification process

Explained the production of biodiesel using Esterification as follows. The methyl ester is produced by chemically reacting Eucalyptus and Madhuca longifolian oil with an alcohol (methyl), in the presence of catalyst. A two stage process is used for the transesterification of Eucalyptus and Madhuca longifolian oil. The first stage (acid catalyzed) of the process is to reduce the free fatty acids (FFA) content in Eucalyptus oil by Esterification with methanol (99% pure) and acid catalyst sulfuric acid (98% pure) in one hour time at 57oC in a closed reactor vessel. The Eucalyptus crude oil is first heated to 50^{o}C and 0.5% (by wt) sulfuric acid is to be added to oil then methyl alcohol about 13% (by wt) added. Methyl alcohol is added in excess amount to speed up the reaction. This reaction is proceeding with stirring at 700 rpm and temperature was controlled at 55-57 ^{o}C for 90 min with regular analysis of FFA every after 25-30 min. When the FFA is reduced up to 1%, the reaction is stopped. Same method used for Madhuca longifolian oil oil. The major obstacle to acid catalyzed Esterification for FFA is the water formation Water can prevent the conversion reaction of FFA to esters from going to completion. After dewatering the esterified oil was fed to the transesterification process.

4.2.2 Transesterification process

Animal and plant fats and oils are composed of triglycerides, which are esters formed by the reactions of three free fatty acids and the trihydric alcohol, glycerol. In the transesterification process, the added alcohol (commonly , methanol or ethanol) is deprotonated with a base to make it a stronger nucleophile. As can be seen, the reaction has no other inputs than the triglyceride and the alcohol. Under normal conditions, this reaction will proceed either exceedingly slowly or not at all, so heat, as well as catalysts (acid and/or base) are used to speed the reaction. It is important to note that the acid or base are not consumed by the transesterification reaction, thus they are not reactants, but catalysts. Common catalysts for transesterification include sodium hydroxide, potassium hydroxide, and sodium methoxide. Almost all biodiesel is produced from virgin vegetable oils using the base-catalyzed technique as it is the most economical process for treating virgin vegetable oils, requiring only low temperatures and pressures and producing over 98% conversion yield (provided the starting oil is low in moisture and free fatty acids). However, biodiesel produced from other sources or by other methods may require acid catalysis, which is much slower. Since it is the predominant method for commercial-scale production, only the base-catalyzed transesterification process will be described below.

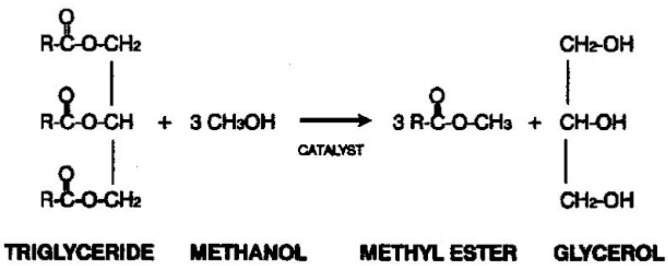


Figure 4.2 Transesterification process

4.2.3 Benefits/Advantages of Biodiesel

- Biodiesel is bio renewable. Feedstock's can be renewed one or more times in a generation.
- Biodiesel is carbon neutral. Plants use the same amount of CO2 to make the oil that is released when the fuel is burned.
- Biodiesel is rapidly biodegradable and completely nontoxic, meaning spillages represent far less risk than petroleum diesel spillages.
- Biodiesel has a higher flash point than petroleum diesel, making it safer in the event of a crash.
- Blends of 20% biodiesel with 80% petroleum diesel can be used in unmodified diesel engines. Biodiesel can be used in its pure form but may require certain engine modifications to avoid maintenance and performance problems.

5. PROPERTIES OF EUCALYPTUS AND MADHUCA LONGIFOLIAN OIL

Table.1.Properties of Eucalyptus And Madhuca Longifolian Oil

S.No	PARAMETERS	RESULT OBTAINED FOR EMME	DIESEL
1.	Flash point by PMCC	82^{o}C	52 ^{o}C
2.	Fire point by PMCC	92^{o}C	56 ^{o}C
3.	Kinematic viscosity @ 40^{o}C	3.50 cst	2.60 cst
4.	Density @15^{o}C	0.8804 gm/ml	0.850 gm/ml
5.	Gross calorific value	9231 Kcal/ kg	4392 Kcal/ kg
6.	Conrad son carbon residue	0.16 %	0.17 %
7.	Ash content	0.07 %	0.01%

6. PERFORMANCE TEST

Engine performance is an indication of the degree of success with which it does its assigned job *i.e.*, conversion of chemical energy contained in the fuel into useful work.In evaluation of engine performance certain basic parameters are chosen and effect of various operating conditions and modifications on these parameters are studied.

6.1 Basic performance parameters

1. Power and mechanical efficiency
2. Mean effective pressure
3. Volumetric efficiency
4. Thermal efficiency
5. Specific fuel consumption

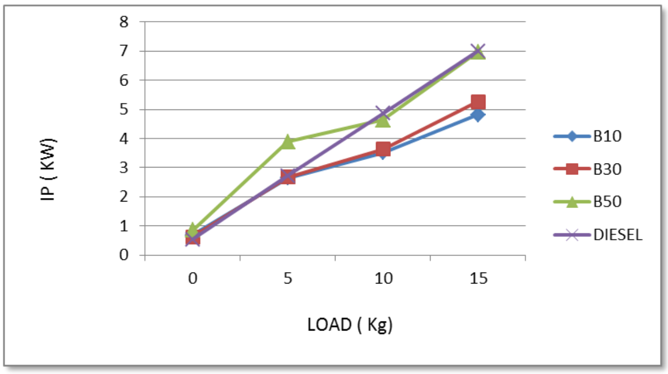
Figure6.1 Specification of VCR research engine

6.2 Data collection

There are four test fuels were used during performance test includes 100 % diesel, 10 % EMME blend with diesel, 30% EMME blend with diesel, 50 % EMME blend with diesel. The following tables shows the obtained data's from performance tests for various EMME Diesel blends such as Brake power, Indicated power, brake mean effective pressure, indicated mean effective pressure, brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, volumetric efficiency, specific fuel consumption, air flow, fuel flow and air fuel ratio

Table 6.1 Indicated power for various EMME Diesel blend

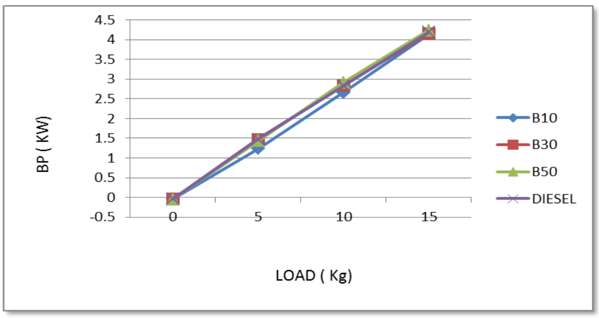
LOAD (kg)	INDICATED POWER (kW)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	0.69	0.62	0.85	0.54
5	2.65	2.67	3.89	2.72
10	3.51	3.64	4.64	4.86
15	4.81	5.27	6.97	7.00



This graph shows how the indicated power is varies for 10 %, 20 %, 30% Eucalyptus and Madhuca longifolian methyl ester diesel blends and pure diesel. Indicated power for diesel at 15kg is 7 kW. Indicated power for 10 %, 20 %, and 30 % of Eucalyptus and Madhuca longifolian methyl ester diesel blend is 4.81, 5.27, and 6.97 kW respectively. It clear that indicated power is decreases if the EMME percentage in fuel is increased.

Table 6.2 Brake power for various EMME Diesel blend

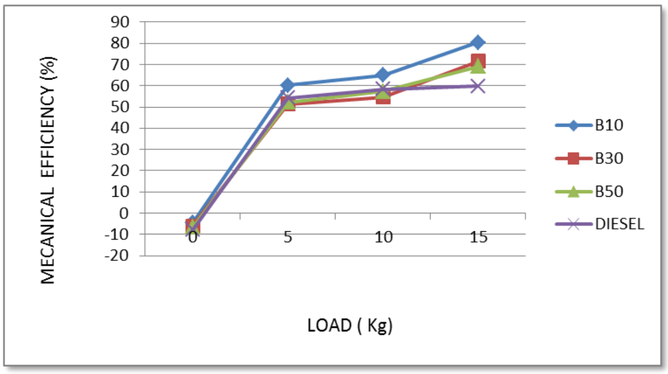
LOAD (kg)	BRAKE POWER (kW)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	-0.04	-0.04	-0.05	-0.04
5	1.23	1.48	1.43	1.48
10	2.65	2.84	2.91	2.83
15	4.13	4.15	4.23	4.19



This shows how the brake power is varies for 10 %, 20 %, 30% Eucalyptus and Madhuca longifolian methyl ester diesel blends and pure diesel. Brake power for diesel at 15kg is 4.19 kW. Indicated power for 10 %, 20 %, and 30 % of Eucalyptus and Madhuca longifolian methyl ester diesel blend is 4.12, 4.11, and 4.23 kW respectively. It is observed that brake power for different blends is higher as compared to pure diesel.

Table 6.3 Mechanical efficiency for various EMME Diesel blends

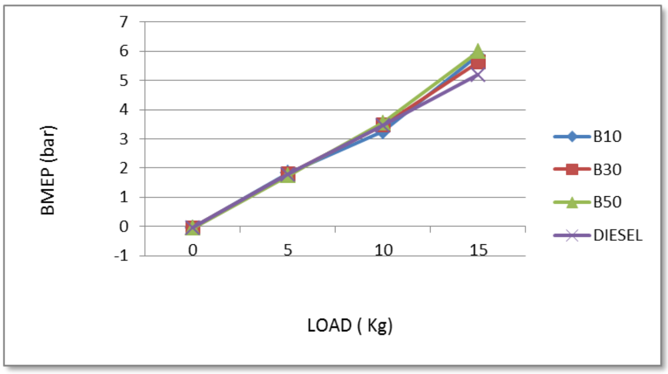
LOAD (kg)	MECHANICAL EFFICIENCY (%)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	-4.62	-6.12	-6.78	-7.86
5	60.13	51.44	52.13	54.32
10	65.02	54.56	57.31	58.29
15	80.42	71.51	68.98	59.77



The comparisons of EMME diesel blends with pure diesel are shown in figure. Mechanical efficiency for pure diesel at 15kg load is 59.77 %. The same for 10 %, 20 %, and 30 % EMME diesel blends are 80.42 %, 71.51%, and 68.98% respectively. It is observed that for all EMME diesel blends mechanical efficiency is higher when compared to pure diesel. It is also observed that the mechanical efficiency is decreased from 80.42 to 71.51 % for 20 % EMME diesel blend from 10 % EMME diesel blend and again it is increased to 68.98 % for 30 % EMME diesel blend.

Table 6.4 Brake mean effective pressure for various EMME Diesel blends

LOAD (kg)	BRAKE MEAN EFFECTIVE PRESSURE (%)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	-0.05	-0.05	-0.06	-0.05
5	1.83	1.79	1.73	1.78
10	3.25	3.47	3.54	3.46
15	5.85	5.62	5.98	5.19



The variation of brake mean effective pressure for various EMME diesel blend and pure diesel is shown in figure. Mean effective pressure for pure diesel at 15kg load is 5.19 bar. The same for 10 %, 20 %, and 30 % EMME diesel blends are 5.85, 5.62, and 5.98 bar respectively. It is observed that for 30 %EMME brake mean effective pressure is higher as compared to diesel after that it is decreases for 10 % and 20 % EMME gradually.

Table 6.5 Indicated mean effective pressure for various EMME Diesel blends

LOAD (kg)	INDICATED MEAN EFFECTIVE PRESSURE (kW)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	1.27	1.16	1.03	0.64
5	2.39	3.54	5.25	3.27
10	5.48	5.62	6.17	5.94
15	7.54	8.12	8.69	8.68

The variation of indicated mean effective pressure for various EMME diesel blend and pure diesel is shown in figure7.5. Indicated mean effective pressure for pure diesel at 15kg load is 8.68 bar. The same for 10 %, 20 %, and 30 % EMME diesel blends are 7.54, 8.12, and 8.69 bar respectively. It is observed that indicated mean effective pressure is decreases if EMME diesel blend is increases.

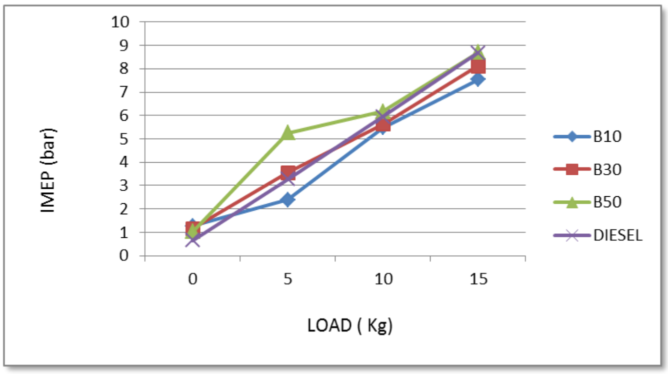
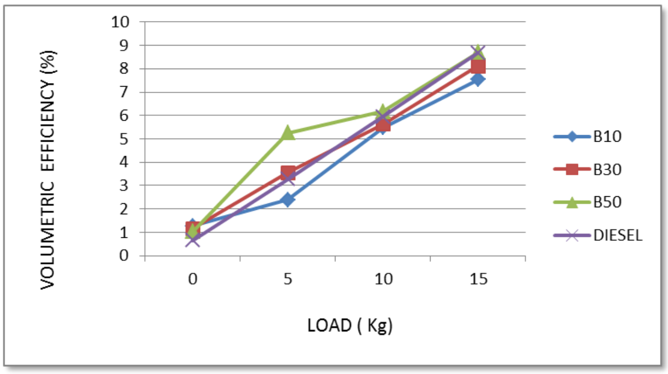


Table 6.6 Volumetric efficiency for various EMME Diesel blends

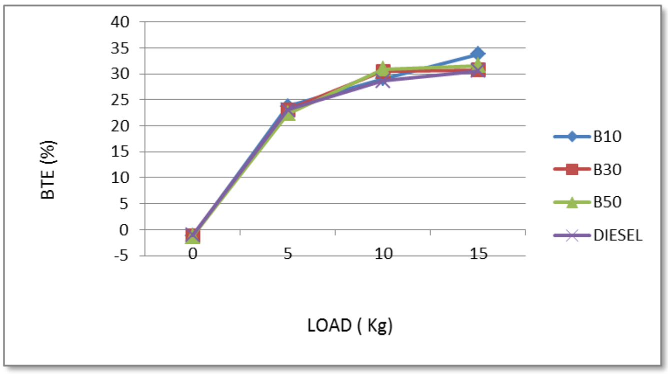
LOAD (kg)	VOLUMETRIC EFFICIENCY (%)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	78.54	78.84	78.76	79.03
5	78.51	78.27	78.12	78.13
10	77.17	77.20	77.55	77.14
15	76.37	76.30	76.01	75.89



The variation of volumetric efficiency with load is shown in Figure. It can be observed from the figure that the volumetric efficiency is 75.89 % at 15kg for diesel. However when the engine is fuelled with EMME-diesel blends such as 10% EMME, 20% EMME, and 30% EMME, It gives the volumetric efficiency of 76.37%, 76.30% and 76.01%, respectively at full load. It is observed that the volumetric efficiency of the Eucalyptus and Madhuca longifolian methyl ester blend is closer or slightly higher to diesel except 10 % EMME diesel blend.

Table 6.7 Brake thermal efficiency for various EMME Diesel blends

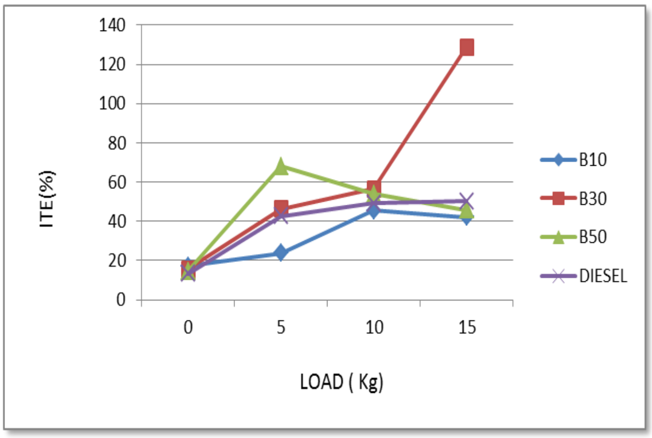
LOAD (kg)	BRAKE THERMAL EFFICIENCY (%)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	-1.20	-1.23	-1.33	-1.04
5	23.78	23.08	22.30	23.11
10	29.04	30.51	30.93	28.68
15	33.77	30.76	31.63	30.56



The variation of brake thermal efficiency with load is shown in Figure. It can be observed from the figure that the thermal efficiency is 30.56% at 15kg load for diesel. However when the engine is fuelled with EMME-diesel blends such as 10% EMME, 20% EMME, 30% EMME, it gives the thermal efficiency of 33.77%, 30.76%, 31.63%, respectively at 15kg load. It is also observed that brake thermal efficiency is higher for 10% and 30% EMME Diesel blends and it is slightly lower for 20 % EMME Diesel blend when compared to pure diesel.

Table 6.8 Indicated thermal efficiency for various EMME Diesel blends

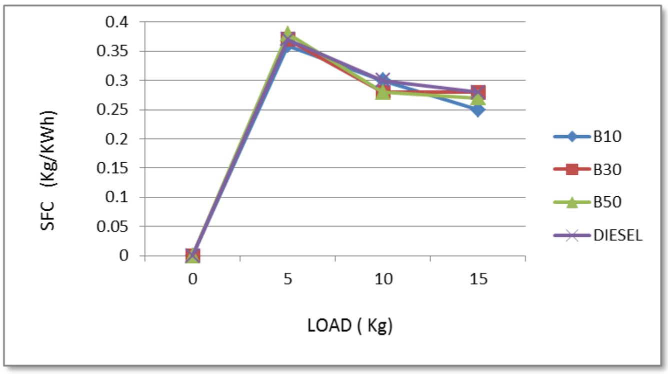
LOAD (kg)	INDICATED THERMAL EFFICIENCY (%)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	17.23	15.75	14.62	13.17
5	23.76	46.14	67.93	42.53
10	45.54	56.60	53.96	49.21
15	41.99	128.78	45.86	50.2



The variation of indicated thermal efficiency with load is shown in Figure. It can be observed from the figure that the indicated thermal efficiency is 50.2 % at 15kg load for diesel. When the engine is fueled with EMME diesel blends such as 10% EMME, 20% EMME, and 30% EMME, it gives the thermal efficiency of 41.99%, 128.78%, and 45.86% respectively at 15 kg load. It is also observed that indicated thermal efficiency is also higher for 20% and 30% blends and it is slightly lower for 10% EMME Diesel blend when compared to pure diesel.

Table 6.9 Specific fuel consumption for various EMME Diesel blends

LOAD (kg)	SPECIFIC FUEL CONSUMPTION (kg/kWh)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	0.00	0.00	0.00	0.00
5	0.36	0.37	0.38	0.37
10	0.30	0.28	0.28	0.30
15	0.25	0.28	0.27	0.28



The variation of specific fuel consumption with load is shown in Figure. It can be observed from the figure that the specific fuel consumption is 0.28kg/kWh at 15kg load for diesel. When the engine is fueled with EMME diesel blends such as 10% EMME, 20% EMME and 30% EMME, its specific fuel consumption is 0.25 and 0.28 kg/kWh, and 0.27 kg/kWh respectively at 15kg load. It is also noted that the specific fuel consumption is decreased for 10 % and 20% EMME Diesel blends and it is equal for 30 % EMME Diesel blend when compared to diesel.

7. EMISSION TEST

7.1 Types of Emission

1. Carbon monoxide (CO)
2. Hydrocarbons (HC)
3. Carbon dioxide (CO_2)
4. Oxygen (O_2)
5. Nitrogen oxide (NO_X)

Table 7.1 carbon monoxide (CO) for various EMME Diesel blends

LOAD (kg)	CARBON MONOXIDE (CO)(% BY VOLUME)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	0.08	0.07	0.06	0.09
5	0.08	0.08	0.06	0.09
10	0.09	0.09	0.08	0.10
15	0.10	0.10	0.12	0.12

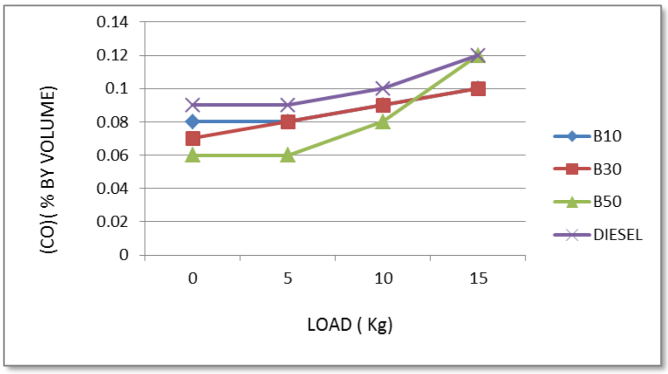


Table 7.2 hydrocarbons (HC) for various EMME Diesel blends

LOAD (kg)	HYDRO CARBONS (HC) (ppm)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	50	52	54	57
5	50	54	59	70
10	55	60	61	83
15	57	62	63	100

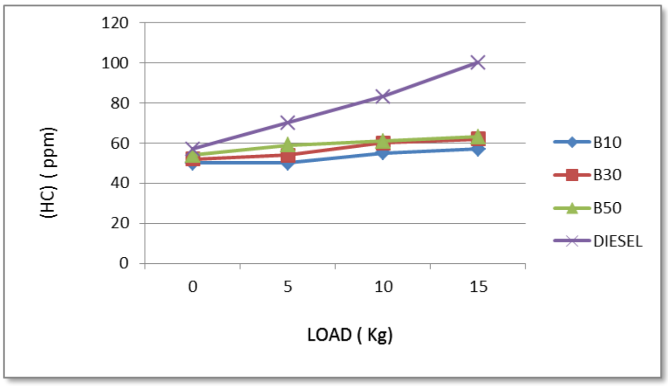


Table 7.3 Carbon dioxide (co_2) for various EMME Diesel blends

LOAD (kg)	CARBON DIOXIDE (CO_2) (% BY VOLUME)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	2.56	2.52	2.36	2.41
5	3.16	3.54	3.37	3.29
10	3.33	5.02	4.10	3.98
15	5.05	6.26	5.07	6.50

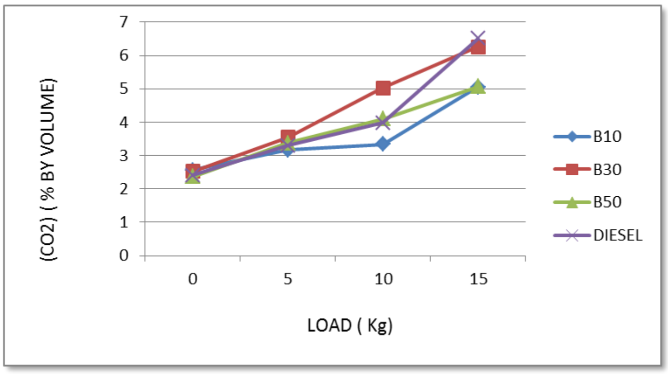


Table 7.4 Oxygen (O_2) for various EMME Diesel blends

LOAD (kg)	OXYGEN (O_2) (% BY VOLUME)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	50	52	54	57
5	50	54	59	70
10	55	60	61	83
15	57	62	63	100

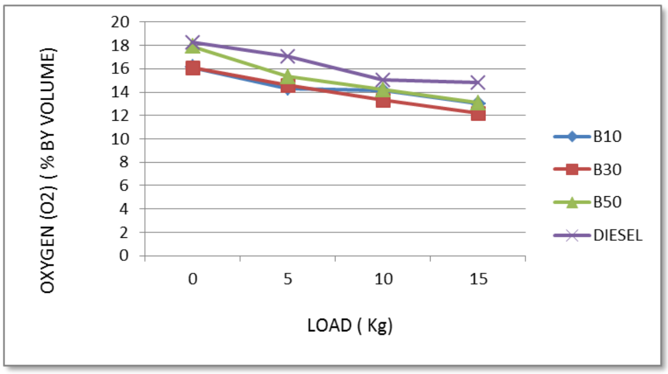
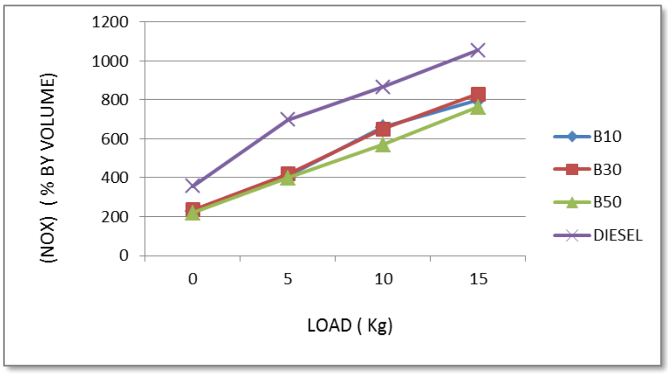


Table 7.5 Nitrogen oxide (NO_X) for various EMME Diesel blends

LOAD (kg)	NITROGEN OXIDE (NO_X) (% BY VOLUME)			
	10 %EMME Diesel blend	30 %EMME Diesel blend	50 %EMME Diesel blend	Diesel
0	222	256	263	356
5	415	456	399	697
10	651	650	570	866
15	756	831	763	1054



8. CONCLUSION

In our work the Biodiesel was prepared from the non-edible oil of Eucalyptus and Madhuca longifolian by transesterification of the oil with methanol in the presence of NaOH as catalyst. A maximum conversion of 92% (oil to ester) was achieved at 65˚C. the received Eucalyptus and Madhuca longifolian is blended in different propotion 10%, 30%, and 50%.the blends are subjected to performance and emission test rig engine the calculation are arrived

- Engine was able to run with 50% waste Eucalyptus and Madhuca longifolian oil -diesel blend.
- Engine fuelled with 50 % waste Eucalyptus and Madhuca longifolian oil-diesel blend exhibits higher brake power (4.23 kW) when compared to pure diesel (4.19 kW).
- Mechanical efficiency (80.42 %) is higher for 10 % waste Eucalyptus and Madhuca longifolian oil-diesel blend when compared to pure diesel (59.77%).
- The volumetric efficiency of the waste Eucalyptus and Madhuca longifolian oil-diesel blend is closer or slightly higher when compared to diesel except 10 % EMME diesel blend.
- Indicated power for all EMME diesel blend is lesser when compared to pure diesel

- Brake mean effective pressure is higher for 50 % EMME -diesel blend and also 10 % and 30 % EMME -diesel blends when compared to pure diesel.
- Emission for carbon monoxide (CO) 10 % and 30% is lesser when compared to 50% and pure diesel.
- Emission for Hydrocarbons (HC) and Carbon dioxide (CO_2) 10% is lesser then 30%, 50%, and pure diesel.
- Emission for all EMME diesel blend is lesser when compared to pure diesel.
- Hence a blend of 10% biodiesel and 30% diesel (B30) is recommended. There was no significant change in efficiency.
- The results are in line with that reported in literature by different researchers using various biodiesel fuels and their blends and
- Economic analysis shows that Eucalyptus and Madhuca longifolian oil biodiesel can be used in an existing diesel engine without any engine modifications which will lead to employment generation and saving in vital foreign exchange.

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