THOMSON REUTERS ENDNOTE

[Kumar*, 5(2): February, 2016] ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

PERFORMANCE AND EMISSION CHARACTERISTICS OF EUCALYPTUS OIL AND DIESEL BLEND IN FOUR STROKE SINGLE CYLINDER DIESEL ENGINE

Santosh Kumar*, Rohit Chandel, Rakesh Kumar

Assistant Professor, Department of Mechanical Engineering, Chandigarh Group of Colleges Landran, Mohali, Punjab, India.

Assistant Professor, Department of Mechanical Engineering, Chandigarh Group of Colleges Landran, Mohali, Punjab, India.

Lecturer, Department of Mechanical Engineering, Doaba Polytechnic College, Raipur,Punjab,India.

DOI: 10.5281/zenodo.46497

ABSTRACT

Diesel engines are highly preferred for transportation since they are highly efficient and durable in the long run. However, because of lack of crude oil reserves, fuel cost and emission norms, alternative fuels are of high interest to replace the diesel fuel in diesel engines. Many alternative liquid fuels for diesel engines such as bio-diesel, alcohol have been introduced in the recent past. Today Most of the alternative fuels are biomass derived and easily available. Many alternative fuels blends has been introduce in past and they gave very satisfying results. Therefore, in this work the eucalyptus oil which is high octane biomass derived fuel is blended with diesel in different proportions by volume and used as fuel in four stroke single cylinder diesel engine. The performance and emission characteristics of the engine were studied. The results show the reduction in consumption of fuel as the brake specific fuel consumption was found to decrease. The improvement in brake thermal efficiency is also observed. While the emission parameters were also improved, emissions were significantly reduces as the load was increasing.

KEYWORDS: Brake Thermal Efficiency (BTE), Eucalyptus oil, internal combustion engine.

INTRODUCTION

With the quick development of the global economy, energy requirements have enhancing remarkably, mainly in developing countries like India. [1]. Modification in climate and emissions square measure of the most motivations for analysis of other fuels. Moreover, the atmospheric pollution occurred by the excessive amount of use of gasoline and diesel which leads to explore for environment friendly and renewable fuels. Bio fuels like bio diesel and alcohol are used as alternatives for diesel engines [2]. As another fuel for diesel is biodiesel which may be a carboxylic acid alkyl group organic compound derived from vegetable oils or animal fats. Several researchers have additionally claimed that it will cut back greenhouse gas emissions. Some scientists have pointed that it promotes rural development, and improve financial gain distribution. However the previous researchers have conclude that it is enough to chemical reaction for biodiesel which may lead to insoluble gums and sediments which will impact filter and it will have an effect on sturdiness of engine [3]. A previous review published by Graboski et al. [4] in 1998 was unable to replicate the new analysis achievements this decade, and therefore the latest review completed by Lapuerta et al. [5] in 2008 was lack in data regarding engine sturdiness, and about 20% literatures before 2000 year was cited to clarify the impact of biodiesel on engine characteristics and emissions. An alternative to diesel should be torrential, economically low cost, environmentally acceptable, and simply accessible technically. The current alternative fuel to diesel can be referred to as biodiesel. Bio fuels have another advantage likewise, which can embrace reduction in green house gas emissions, structure and regional development to several countries [6]. A balance between agriculture, economic development, and also the setting can be sought-after by exploitation the biodiesel [7]. It improves the lubrication properties of the mix diesel oil. It additionally reduces long term engine wear in diesel engines for future. Biodiesel additionally has a smart lubricating substance property that is about 66% better than petro diesel [8].

ENERGY SCENARIO OF INDIA

In the 12th plan found out document of the planning Commission it has been indicated that total production of domestic energy by India of 670 million ton of oil equivalent square measure reached by 2017-18 and 845 MTOE by 2022-23. This will cowl around 69 % of expected energy consumption, and balance to be met from imports, expected to be about 268 MTOE by 2017-18 and 376 MTOE by 2022-23. In last decade the cost and amount of import of crude oil has increased gradually. . Fig I show that the demand of crude has reached to 159.3MT during 2009-10 which is about three time more than 57.8MT during 1979-2000.

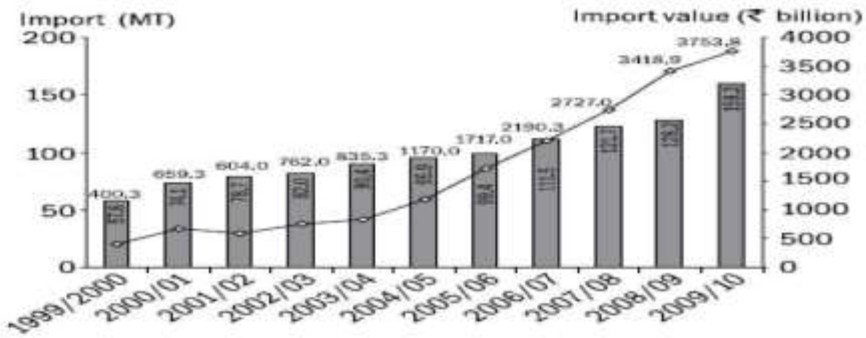


Figure 1: Annual imports and cost of crude oil imports [10]

GLOBAL OIL SCENARIO:

Usage of oil in whole planet is predicted to increase from about 79 million barrels per day (mbpd) in 2003 to 98 mbpd in 2015 and 119 mbpd in 2030 as per Energy information Administration (EIA), International Energy Outlook (IEO) 2006. The costs of oil rise from $31 per barrel in 2003 to $56 per barrel in 2030, and share of oil of world’s total energy use can falls from 39% to 33%.

Figure 2: Oil share to the total energy production

The main objective of this work is to study the emission parameters mainly exhaust parameters like hydrocarbon emissions, oxides of carbon (CO & CO2) and oxides of nitrogen (NOx) and to analyse performance parameters like BTE and BSFC at various loads. Hence an attempt has been made to replace the Diesel in single multi cylinder diesel engine with some percentage of Eucalyptus oil.

LITERATURE REVIEW

Magı´n Lapuerta [5] applied review study on effect of biodiesel fuels on internal-combustion (diesel engine) emissions. A rise in BSFC has been found once exploitation biodiesel in most of the reviewed studies. . **Santacesaria et al. [13]** carried out review study on main technologies in biodiesel production. It was estimated that the price of biodiesel is especially altered with the price of the feedstock .However additionally an improvement of the adopted technology will contribute in reducing the prices. **Tamilvendhan.D et al. [14]** carried out the experimental study on the performance, emission characteristics of a alkyl group organic compound sun flower volatile oil – eucalyptus oil on one cylinder air cooled and direct injection internal-combustion engine as an alternate fuel and also the results that were obtained by the above test were compared with the results whereas running with standard fuel. **Basheer Hasan**

Diya'uddeen [15] carried out review study Performance analysis of biodiesel used domestic waste oils. **Gaurav Dwivedi[16]** carried out experimental study on Impact of Biodiesel and its mixture with Diesel and Methanol on Engine Performance. From the results it's observed that brake specific fuel consumption (BSFC) for B100 was 14.9% more than diesel. **Siddharth Jain [17]** dispensed review study on survey of biodiesel from Jatropha in Asian Nation. **Gaurav Dwivedi et al.[18]** complete experimental study on Performance analysis of diesel motor using Biodiesel from genus Pongamia Oil. It had been found that BSFC for B100 just in case of genus Pongamia biodiesel was 30 % more as compared to diesel. **K. Anandavelu[19]** carried out Experimental Investigation of victimization volatile oil and diesel oil Blends in Kirloskar TV1 Direct Injection diesel motor. It was concluded that brake thermal efficiency enlarged about 6% for 60:40 DF/EOF mix (blend has 60 % of diesel and 40 % of eucalyptus oil) as compared to plain diesel oil (DF) operations.

MATERIALS AND METHODS

Biodiesel are often made either from edible or from non-edible. Most of the edible oils square measure made from the crop land. Eucalyptus may be a tall evergreen tree.. Eucalyptus has regarding 625 species and sub-species with many varieties and hybrids.

Table 1: Physical and chemical properties of eucalyptus oil [21]

Properties	Gasoline	Diesel	Eucalyptus oil
Formula	C4 to C12	C8 to C25	C10H18 O
Molecular Weight	100-140	200-240	154.25
Composition (% Weight)	C88 H15	C87 H16	-
Density (kg/m^3)	780	830	913
Specific Gravity	0.78	0.83	0.913
Boiling Point (°C)	30-220	180-340	175
Viscosity (cSt)	0.4	3-4	2.0
Latent Heat of Vaporization (kJ/kg)	350	230	305
Lower Heating Value (kJ/kg)	43,890	42,700	43,270
Flash Point (˚C)	- 43	74	53
Auto Ignition Temperature (°C)	300-450	250	300-330
Flammability limit(%Volume)	1.4	1.0	0.8
Cetane Number		40-55	

In present analysis, two samples of Eucalyptus oil were used to prepare biodiesel.

[5]Eucalyptus Oil – Central Drug House Ltd. (Sample A)

Minimum Assay (as cineole content) > 60.0%

Wt. per ml at 20 °C = 0.897 - 0.924 g

Refractive Index(n) = 1.457-1.469

[6]Eucalyptus Oil – SDFCL Ltd. (Sample B)

Wt. per ml at 25 °C = 0.905 – 0.925

Refractive Index(n) = 1.458-1.47

PROCEDURE FOR PREPARATION OF BIOFUEL

Transesterification

Transesterification is the process of reacting a triglyceride like oil with an alcohol in the presence of alkaline catalyst to produce fatty-acid esters and glycerine. We adopted Transesterification technique for preparation of biodiesel. Transesterification is that the foremost typical methodology of fixing oil into biodiesel which will be used directly or as blends with diesel in ICE. A transesterification reaction is represented in Fig.3

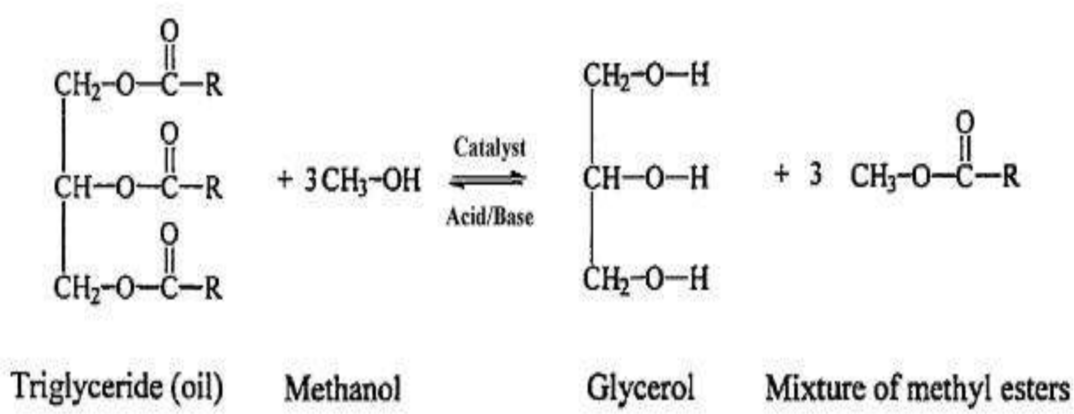


Figure 3: Transesterification Reaction

3.2 EXPERIMENTAL ORIGINATED FOR TRANSESTERIFICATION:

The reactor used for experiments shown in Figure 4 can be a 1000 ml three-necked spherical bottom flask.

3.3 PREPARATION OF POTASSIUM METH OXIDE

The methanol is mixed into a solution with the KOH, making potassium methoxide in an exothermic reaction.

3.4 INTERMIXING AND HEATING

In a typical experiment a famed quantity of oil was charged to a throated spherical bottom flask (figure 5).

3.5 SETTING AND SEPARATION

Allow the solution to settle and cool for last 24 hours, perfectly longer. The methyl group esters (biodiesel) are going to be floating on high whereas the denser glycerol can have jellied on the bottom of the instrumentation.

3.6 PURIFICATION (ORGANIC PHASE) BIODIESEL

The methyl group organic compound part was washed with water 5 times that removes the catalyst along with the residual methanol.

3.7 MAGNETIC STIRRING

Finally, product obtained after washing is stirred in magnetic stirrer with the assistance of magnetic beads. Process is carried out till biodiesel becomes clear as shown in fig.8

Figure 4: Experimental set up for the preparation of methyl esters from vegetable oil

Figure 5: Separating Funnels for separation of Methyl Ester from Glycerol

Fig 6: Water Washing to Separate Soap

Figure 7: Water and Methyl Ester layers during separation

Figure 8: Magnetic Stirrer for Heating

[Kumar*, 5(2): February, 2016]
ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

EXPERIMENTAL SETUP

A schematic of experimental setup shown in Fig.9 consist of following parts

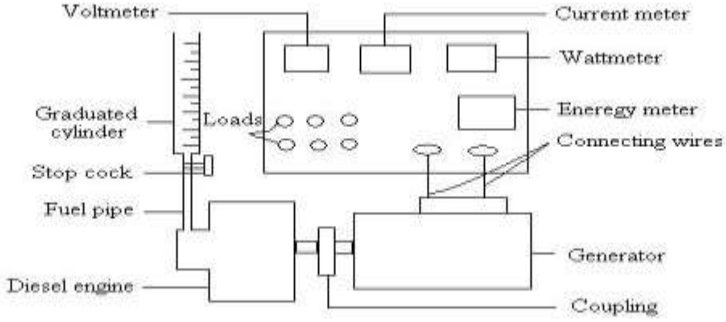


Figure 9: Schematic of experimental setup

A Field Marshal make, single cylinder, water cooled, direct injection, Model No. BF2 diesel engine was selected for the produced research work, which is primarily used for agriculture activities and household electricity generation. The detail specification of the selected engine has been given below:

Table 4: Engine Specifications:

Parameter	Value
Engine No.	HX 28036
Model No	BF2
Type	DI
Output	4.8/6.5 KW/bhp
Speed	1500 r.p.m
SFC	240g/kwh
Bore of Engine (D)	85 mm
Stroke Length of Engine (L)	110 mm
Outer diameter	20 mm
Cross Section Area of Orifice	0.0031416 (M)
Coefficient of Discharge	0.62

Figure 10: Experimental Setup

The objective is to maximise the substitution of fuel with biofuels while not considerably touching the engine performance and resultant reduction of exhaust emission. In this set up the engine was directly coupled to generator and loaded by impedance. The separate fuel measuring unit was connected with engine. A resistive load panel was attached with the output of the generator. Following methodology was adopted.
First we checked the performance on pure diesel of diesel testing engine at 20 ml diesel, noted the readings that is Voltage,

Current, Time for consumption of fuel. Then make the blend of bio fuel and diesel at B10 and follow the same procedure. Then do the same for blends B30, B50 and B100 and note down the readings. In the last step Brake Thermal Efficiency (BTE), Brake Specific Fuel Consumption (BSFC) was calculated.

RESULTS AND DISCUSSION

Table 5: Results of Diesel

Diesel					
S. No.	**Load (W)**	**m_F (Kg/hr)**	**Brake Horse Power (B.H.P.) (KW)**	**Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)**	**Brake Thermal Efficiency (B.T.E) (%)**
1	20	0.5966	1.3643	0.4372	19.28
2	40	0.7323	2.02	0.3638	23.164
3	60	0.9182	2.94	0.3123	26.995
4	80	1.0945	3.659	0.2991	28.185
5	100	1.268	4.59	0.2762	29.92

Table 6: Results of Eu10A Blend

Eu10A					
S. No.	**Load (W)**	**m_F (Kg/hr)**	**Brake Horse Power (B.H.P.) (KW)**	**Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)**	**Brake Thermal Efficiency (B.T.E) (%)**
1	20	0.8949	1.3068	0.6848	12.14
2	40	1.04675	2.0468	0.5114	16.26
3	60	1.2048	2.9	0.4154	20.02
4	80	1.3553	3.3795	0.3784	21.97
5	100	1.4828	4.625	0.3206	25.95

Table 7: Results of Eu30A Blend

Eu30A					
S. No.	**Load (W)**	**m_F (Kg/hr)**	**Brake Horse Power (B.H.P.) (KW)**	**Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)**	**Brake Thermal Efficiency (B.T.E) (%)**
1	20	0.8649	1.542	0.5608	14.83
2	40	0.9667	2.0209	0.4783	17.39
3	60	1.1141	2.825	0.3943	21.11
4	80	1.4290	3.7336	0.3827	21.74
5	100	1.7436	4.75	0.3670	22.66

Table 8: Results of Eu50A Blend

Eu50A

S. No.	Load (W)	m_F (Kg/hr)	Brake Horse Power (B.H.P.) (KW)	Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)	Brake Thermal Efficiency (B.T.E) (%)
1	20	0.5777	1.3068	0.442	18.82
2	40	0.872	2.0209	0.417	19.94
3	60	1.072	2.8	0.3828	21.72
4	80	1.3477	3.5929	0.3751	22.18
5	100	1.5306	4.456	0.3434	24.22

Table 9: Results of Eu100A Blend

Eu100A					
S. No.	Load (W)	m_F (Kg/hr)	Brake Horse Power (B.H.P.) (KW)	Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)	Brake Thermal Efficiency (B.T.E) (%)
1	20	0.3938	1.175	0.3351	24.82
2	40	0.6215	2	0.31075	26.77
3	60	0.8301	2.787	0.2978	27.93
4	80	0.9521	3.5822	0.2657	31.30
5	100	1.048	4.1318	0.2536	32.80

Table 10: Results of Eu10B Blend

Eu10B					
S. No.	Load (W)	m_F (Kg/hr)	Brake Horse Power (B.H.P.) (KW)	Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)	Brake Thermal Efficiency (B.T.E) (%)
1	20	0.6320	1.3068	0.4836	17.20
2	40	0.8217	1.8295	0.449	18.52
3	60	1.1532	2.875	0.4011	20.74
4	80	1.3695	3.7	0.3464	22.47
5	100	1.5651	4.642	0.3371	24.67

Table 11: Results of Eu30B Blend

Eu30B					
S. No.	Load (W)	m_F (Kg/hr)	Brake Horse Power (B.H.P.) (KW)	Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)	Brake Thermal Efficiency (B.T.E) (%)
1	20	0.6444	1.3068	0.4931	16.87
2	40	0.8016	2.0454	0.3919	21.22
3	60	1.0956	2.8254	0.3817	21.45
4	80	1.2889	3.65	0.3531	23.56
5	100	1.494	4.5772	0.3264	25.48

Table 12: Results of Eu50B Blend

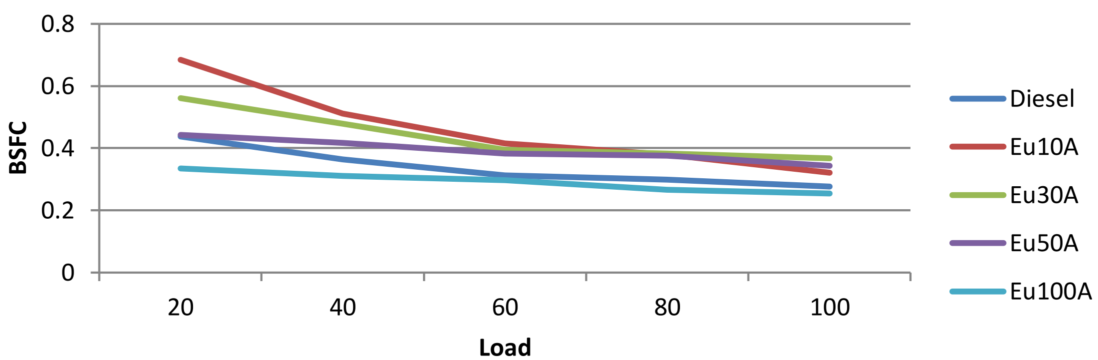
Eu50B					
S. No.	Load (W)	m_F (Kg/hr)	Brake Horse Power (B.H.P.) (KW)	Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)	Brake Thermal Efficiency (B.T.E) (%)

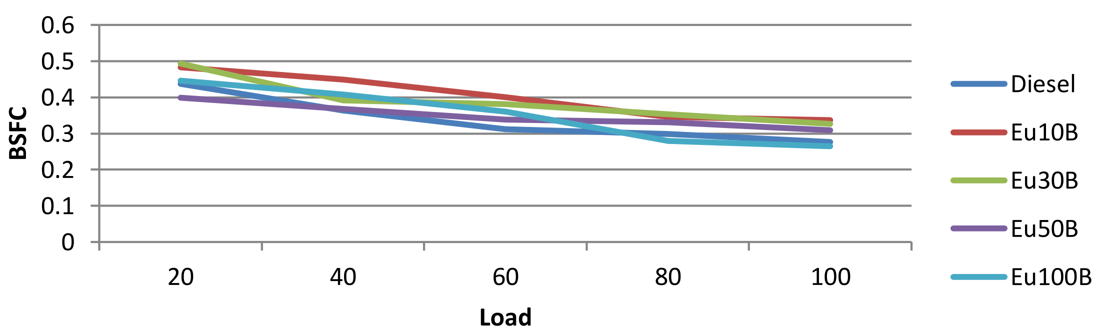
1	20	0.4803	1.202	0.3995	20.82
2	40	0..6679	1.8136	0.3682	22.59
3	60	0.9308	2.75	0.3383	24.58
4	80	1.206	3.6403	0.3317	25.11
5	100	1.3997	4.534	0.3087	26.95

Table 13: Results of Eu100B Blend

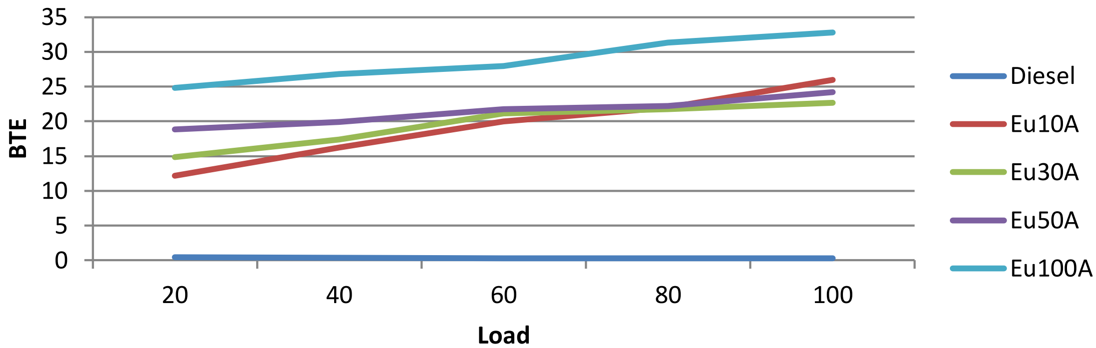
Eu100B					
S. No.	**Load (W)**	**m_F (Kg/hr)**	**Brake Horse Power (B.H.P.) (KW)**	**Brake Specific Fuel Consumption (B.S.F.C.) (Kg/KW-hr)**	**Brake Thermal Efficiency (B.T.E) (%)**
1	20	0.5573	1.25	0.44585	18.66
2	40	0.8111	1.9909	0.4074	20.42
3	60	0.9814	2.725	0.3601	23.10
4	80	0.9944	3.555	0.2797	29.74
5	100	1.1277	4.2545	0.2650	31.38

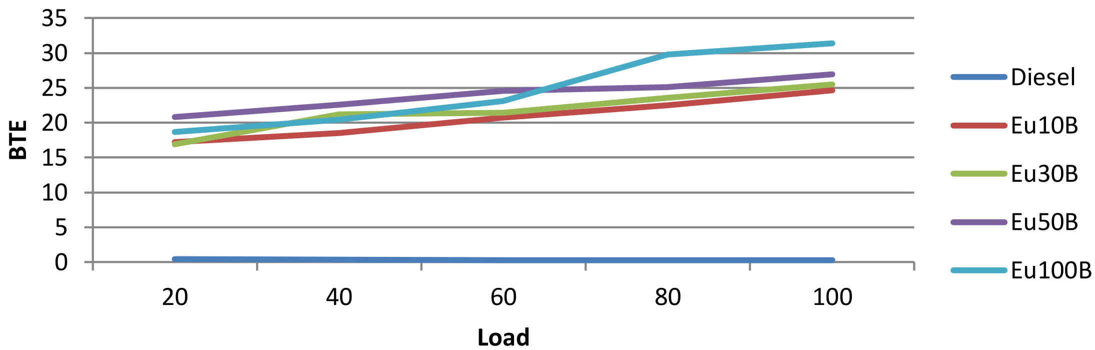
Result Analysis



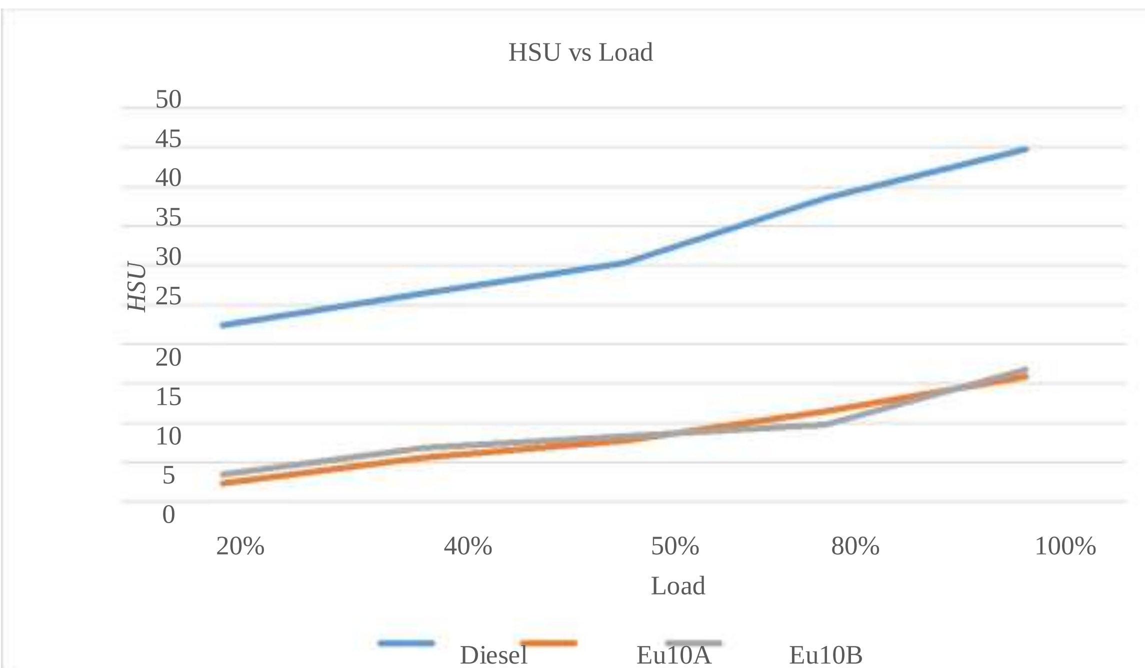


 ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785





Emission Analysis in terms of HSU:



CONCLUSION AND FUTURE SCOPE

Eucalyptus oil is mixed with diesel and tested on four stroke single cylinder internal-combustion engine. Performance and emission characters were known and all over as follow:

1. The fuel properties like density flash purpose, consistence and hot price of B10, B20 square measure terribly the

same as diesel and so biodiesel can be very easily a substitute for diesel in coming years.
2. It has also been investigated that BSFC for Eu100A and Eu100B just in case of Eucalyptus biodiesel was 8.18% and 4.05% below the given fuel for maximum load, which shows that lesser quantity of B100 manufacture power the same as diesel.
3.The performance analysis of BTE for Eu100A and Eu100B just in case of Eucalyptus biodiesel was 9.62% and 4.87% over the given fuel for maximum load, which shows that lesser quantity of Eu100A can producer power the same as diesel
4. Performance analysis of E10A and E10B shows that BSFC and BTE square measure below pure diesel however exhaust emission square measure thanks to lower that's 64.5% and 62.5% severally in terms of HSU.
The Study provides biodiesel has been focussed as an area replacement element of fossil fuel diesel. the explanations for this goal square measure certain because almost all countries of the world square measure exploring substitutes for the energy sources, that square measure setting friendly and square measure from non-conventional sources. Biofuels scores alright as a substitute fuel because it helps in less dependency on fossils and conjointly because no sulphur is contained in it. The present study can be further advanced to calculate the BSFC and BTE of Biodiesel on engine with turbocharger.

REFRENCES

[1] Vine E. ‘Brakeing down the silos: the integration of energy efficiency, renewable energy, demand response and climate change’. Energy Efficiency 2008;1:49–63.
[2] Agarwal AK. Biofuels (alcohols and biodiesel) applications as fuels for internal combustion engines. Prog Energy Combust Sci 2007;33:233–71.
[3] Gaurav Dwivedi, Siddharth Jain, M.P. Sharma, ‘Impact of Biodiesel and its Blends with Diesel and Methanol on Engine Performance’ - International Journal of Energy Science Vol.1 No.2 2011 PP.105-109.
[4] Graboski, M. S., McCormick, R. L”.Combustion of fat and vegetable oil derived fuels in diesel engines.” Prog Energ Combust 1998, 24:125–64.
[5] Lapuerta, M., Armas, O. and Rodriguez-Fernandez, J. “Effect of biodiesel fuels on diesel engine emissions.”Prog Energ Combust 2008, 34:198–223.
[6] Demirbas A. Importance of biodiesel as transportation fuel. Energy Policy 2007;35:4661–70.
[7] Demirbas A. New liquid biofuels from vegetable oils via catalytic pyrolysis. Energy Educ Sci Technol 2008;21:1–59.
[8] Dunn RO. Alternative jet fuels from vegetable-oils. Trans ASAE 2001;44:1151–757.
[9] Monyem A., Gerpen J.H.V., *Biomass and Bioenergy*, 20 (2001) 317–325.
[10] D7: EU27 Report 2009.
[11] Energy Statistics, 2013, Twentieth Issue, Central Statistics Office Ministry of Statistics and Programme Implementation, Government of India.
[12] http://www.re-focus.net.
[13] E. Santacesaria, G.Martinez Vicente, M. Di Serio, R. Tesser Main technologies in biodiesel production: State of the art and future challenges”, Catalysis Today 195 (2012) 2– 13.
[14] Tamilvendhan. D, Ilangovan.V, “Performance. Emission and combustion characteristics of a methyl ester sunflower oil- eucalyptus oil in a single cylinder air cooled and direct injection diesel engine”, ISSN: 0975-5462, Vol. 3 No. 3 March 2011.
[15] Basheer Hasan Diya’uddeen, A.R. Abdul Aziz, W.M.A.W. Daud, M.H. Chakrabarti, “Performance evaluation of biodiesel from used domestic waste oils: A review”,Process Safety and Environmental Protection 90 (2012) 164-179.